

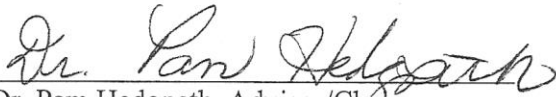
COMPARING ADMINISTRATOR AND TEACHER PERCEPTIONS
OF TECHNOLOGY INTEGRATION USING THE TECHNOLOGICAL
PEDAGOGICAL CONTENT KNOWLEDGE FRAMEWORK
AND 2017 ISTE STANDARDS FOR EDUCATORS

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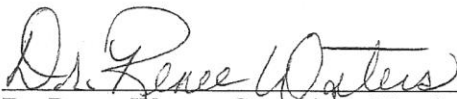
The undersigned, approved by the Department Chair of Graduate Studies in Education, have examined a dissertation entitled:

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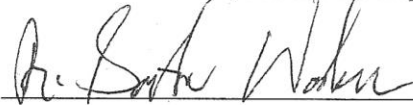
Presented by Scott Shellhorn, a candidate for the degree of Doctor of Education, and hereby certify that in their opinion it is worthy of acceptance.



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A Dissertation
Presented to
The Faculty of the Graduate Education Department
Southwest Baptist University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

By

Scott Shellhorn, B.S., M.S.

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April 2019

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ABSTRACT

The purpose of this quantitative study was to identify perceptions, determine differences in perceptions, and identify how effective the implementation of a framework such as TPACK connected to classroom technology integration of design and facilitation as defined by selected 2017 International Society for Technology in Education (ISTE) Standards for Educators. Prior research on teacher use of technology indicated teachers are not confident in incorporating technology into the classroom for student-centered learning (Sutton, 2011) and teachers and building administrators need to have a thorough understanding of the relationship of content, pedagogy, and technology. The researcher administered a survey instrument to identify content, pedagogical, and technological domains utilized by teachers and the Designer and Facilitator 2017 ISTE Standards for Educators. Descriptive and inferential statistics were used to analyze the survey items. The findings from the research revealed a gap between building administrator and teacher perceptions of technological knowledge (TK); a statistically significant difference in building administrator and teacher perceptions of the Designer and Facilitator 2017 ISTE Standards for Educators; access and utilization of technology in Missouri public schools was prevalently available; ISTE Standards were being used for curriculum or professional development expectations; and finally the data suggested there was ample opportunity to the accessibility of technology, however, the adoption and implementation of standards, a technological framework, and aligned professional learning may be lagging behind based upon the responses of building administrators and teachers in this study.

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CHAPTER ONE

INTRODUCTION

Technology outpaced the education system in the early 21st century. The U.S. Department of Education, Office of Educational Technology's (2010) National Education Technology Plan (NETP) called for "revolutionary transformation rather than evolutionary tinkering" (p. ix). The plan further recognized that:

Technology is at the core of virtually every aspect of our daily lives and work, and we must leverage it to provide engaging and powerful learning experiences and content, as well as resources and assessments that measure student achievement in more complete, authentic, and meaningful ways. (U.S.

Department of Education, Office of Educational Technology, 2010, p. ix.)

The 2016 revisions to the NETP focused on using technology to transform learning and increase equity. The plan recognized that in order for educators to be transformative with technology they need to have the knowledge and skills necessary to leverage technology-rich learning environments. During the time in between the writing of the 2010 and 2016 NETP, the 2016 revision identified (a) the conversation had shifted from whether technology should be used in learning, to how it can improve learning to ensure that all students have access to high-quality education experiences; (b) increasingly, technology was being used to personalize learning and give students more choice over what and how they learn and at what pace, preparing them to organize and direct their own learning for the rest of their lives; (c) a digital use divide continued to exist between learners who were using technology in active, creative ways to support their learning and those who predominantly used technology for passive content

consumption; and (d) teacher preparation and professional development programs failed to prepare teachers to use technology in effective ways. Recommendations identified in the plan included providing professional learning experiences powered by technology to increase digital literacy and build capacity in online and blended instruction in teachers (U.S. Department of Education, Office of Educational Technology, 2016).

The pressures of being an educator are ever increasing and public demand for success and accountability are not going away anytime soon. As far back as 1986, Cuban identified that many classrooms experienced conflict due to challenges presented by the content, pedagogy, and available time teachers had to educate students. Cuban summarized that these competing forces made teachers operate from a “practical pedagogy” (p. 2) where teacher solutions focused on transferring knowledge and skills via direct instruction. Cuban believed this pedagogy was previously successful, however, the ever-changing expectations of what constitutes “success” in schools leaves teachers prone to criticism. With multiple competing forces and lack of time, Cuban observed that teachers were trying to figure out how to efficiently teach content with technology as a means to increase the engagement, productivity, and speed of learning with less effort given by the teacher.

Cuban (1986) also stated that educators were enticed with technology in hopes that it would increase learning and efficiency, individualize instruction, and take content beyond the walls of the classroom. Ironically, once teachers had a piece of technology in their classroom, they responded in surveys with their infrequent use of the tool, which lead to criticism from administrators and the blame game of teachers not using technology began (Cuban, 1986). The intent of this research was to identify the

perceptions of teachers and building administrators regarding the effect of a technological pedagogical and content knowledge (TPACK) framework on effective technology integration at the classroom level as defined by selected 2017 International Society for Technology in Education (ISTE) Standards for Educators. The study also looked for differences in the two groups' perceptions about how these practices impact the standards.

Theoretical Framework

Teachers face complex and competing problems when it comes to teaching with technology (Bull et al., 2007; Masten, 2016; Mishra & Koehler, 2007) as the challenge is to find the appropriate combination of professional learning, outcomes, teaching approaches, and aligned technology. Masten (2016) referred to professional development as a “wicked” (para. 1) problem and emphasized wicked problems do not imply “evil” problems; rather, they are complicated to solve due to many involved factors and have incomplete, conflicting, and dynamic requirements. Mishra and Koehler (2007) proposed to approach teaching with technology as a wicked problem as teaching is an extremely complex form of problem-seeking and problem-solving. Working with wicked problems, such as technology integration, requires creative solutions that recognize the intricacy of the challenges and contexts presented to each classroom.

As schools modernize curriculum, allocate resources, and set the expectation of technology integration inside and outside of classrooms, teachers are left to figure out how to effectively integrate technology while teaching. Teachers look towards technology to increase engagement, motivation, and the incorporation of 21st-century skills. The Partnership for 21st Century Learning (n.d.-a) frequently asked questions

website defined 21st-century skills as “what students need to succeed in today’s globally and digitally interconnected world” (para. 7). P21 advocated that students need 21st-century skills to bridge the gap between what is learned in school and what is needed in the workplace. Twenty-first-century skills include problem-solving, communication, collaboration, information and media literacy, critical thinking, and creativity (Lambert & Gong, 2010). As technology shows promise of increasing learning in students, teachers experience barriers to successful integration such as inadequate access, time, resources, training, budget, support, and beliefs, in addition to fear of using technology to successful integration (Cuban, 1986; Daniel, 2012; Ertmer, 1999; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Hechter & Vermette, 2013; Hew & Brush, 2007; Hsu, 2016; Kalota & Hung, 2012; Lewis & Sanchez, 2012; Ramorola, 2014; Staples, Pugach, & Himes, 2005; Tsai & Chai, 2012; Zhao, Frank, & Ellefson, 2006).

The researcher selected a teacher knowledge framework for examining effective technology integration, known as TPACK, as the theoretical underpinning for this study. TPACK addresses the interconnectedness of content, pedagogy, and technology, and expands upon the work of Shulman’s (1987) pedagogical content knowledge (PCK). Shulman recognized traditional teaching focused more on classroom management and found that teachers were not asking students questions about the content of the taught lessons and proposed a new way to define knowledge for effective teaching. Shulman also identified that teaching knowledge with pedagogy was not a common practice and this blind spot led to the development of PCK. PCK sought a working relationship between content knowledge and pedagogical knowledge where the intersection of content

knowledge and pedagogical knowledge is leveraged for effective teaching and student learning (Hofer & Grandgenett, 2012; Shulman, 1987).

An understanding of the TPACK framework can help teachers as they design and implement curriculum. TPACK is the foundation of effectively teaching with technology and requires knowing “what” and “how” to teach while using appropriate technologies to activate and deepen learning. TPACK is using technology for student learning as opposed to a teacher’s personal use and ensures technology is integrated in a meaningful way (Benton-Borghini, 2013; Young, Young, & Hamilton, 2013). Research has suggested that teacher beliefs and knowledge base affect a teacher’s pedagogical decisions and practices (Hechter & Vermette, 2013). TPACK was introduced to the educational field as a framework for integrating technology in addition to content and pedagogy (Koehler, Mishra, & Cain, 2013) and recognizes the three bodies of teachers’ knowledge and the interactions among them described as content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK; Koehler et al., 2013).

CK is the teacher’s expert knowledge in the given subject area or may be referred to as the “what” teachers teach including the facts, concepts, and theories of a given discipline. CK implies that the teacher knows “what” and “when” to teach and is likely comfortable with content knowledge as this TPACK body of knowledge assumes this is why the teacher chose this profession (Common Sense Education, 2016; Crompton, 2016; Koehler et al., 2013).

PK is “how” teachers teach while using their expert knowledge of the art and science of teaching. Teachers who are proficient in this body of knowledge know how to transfer knowledge using different assessments, instructional strategies, and learning

theories. Being successful with the components of PK allows the teacher to create meaningful and relevant learning experiences for their students (Koehler et al., 2013; Common Sense Education, 2016; Crompton, 2016).

TK is the understanding of available technologies in teaching and learning, and represents teacher knowledge about the tools including how to select, use, and integrate technology into the curriculum (Crompton, 2016). Koehler et al. (2013) stated that TK is more difficult to define as compared to CK and PK because technology is ever changing and penning a definition of technology would be obsolete by the time the definition was published. In summary, TPACK added a third domain, technology, to Shulman's (1987) pedagogical knowledge and content knowledge domains. Mishra and Koehler (2006) realized that the effective use of technology required its own domain and an understanding of the relationship of the technology to the intersections of the PK and CK domains.

The researcher selected the Designer and Facilitator standards from the 2017 ISTE Standards for Educators to additionally guide the research as the standards incorporates the use and management of technology when designing and facilitating learning with technology. The ISTE standards provide a framework for modern learning and teaching. The 2017 ISTE Standards for Educators (n.d.-a) consist of seven standards and their respective indicators: (a) Learner, (b) Leader, (c) Citizen, (d) Collaborator, (e) Designer, (f) Facilitator, and (g) Analyst. Previous iterations of the ISTE Standards for Educators focused on teacher use of digital tools, which made the tool the priority. It became evident that teachers knew how to use the tool but lacked training on how to use the tool for learning and incorporation into lesson and unit design. As teachers

transitioned from a focus on the tool to a focus on how to use the tool for learning, another change in practice occurred that ultimately led to using technology for substitution instead of innovation. The 2017 set of ISTE Standards for Educators challenged educators to effectively use digital tools in the best possible way for learning (Crompton, 2017).

The 2017 version of the ISTE Standards for Educators reflected how the evolution of learning takes place inside and outside of the classroom as the classroom is increasingly blending with life experiences. Students now have the capability to learn from nearly any place, while at their pace, gaining new knowledge and skills as they become authors and assessors of their own learning. Educators are recognizing that they are no longer the single source of knowledge in the classroom and are transitioning to the role of facilitator as they teach students to find and understand information for themselves (Crompton, 2017).

The 2017 ISTE Standards for Educators provide direction when making decisions pertaining to curriculum, instruction, professional learning and the use of technology in the classroom and are not solely standards for technology. The research in this study used the TPACK framework and the Designer and Facilitator 2017 ISTE Standards for Educators as benchmarks to compare differences and relationships in perceptions of technology integration. The study sought relationships between TPACK and the Designer and Facilitator ISTE Standards and identified how teacher and administrator perceptions of TPACK and ISTE impact learning in the classroom.

Problem Statement

There has been a lack of research regarding teacher and building administrator perceptions of the effective implementation of the TPACK framework's relationship to classroom design and facilitation processes. There was also a lack of research regarding the 2017 ISTE Standards for Educators in Missouri classrooms in improving student achievement. Effective technology integration is essential in classrooms if improved student achievement is to be the end result. TPACK development in teachers and administrators may be key to successful technology integration in the classroom.

The expected outcomes of 21st-century standards such as the 2017 ISTE Standards for Educators as supported by the P21 framework for 21st-century learning depend on the depth and breadth of content, effective implementation of pedagogy, and deep technological knowledge of the classroom teacher. Prior research has indicated teachers lack the confidence to use technology in the classroom (Fleming, Motamedi, & May, 2007); use technology in the classroom in a limited way (Lewis & Sanchez, 2012); face barriers such as inadequate access, time, resources, training, budget, and support (Hechter & Vermette, 2013); and demonstrate various beliefs regarding effective technology integration in the classroom (Ertmer, 2005).

Teachers need to understand the content, including standards such as ISTE, and competencies such as P21, and then transfer the content through proper pedagogical and technological applications. As TPACK asserted what effective technology integrators "know," the ISTE Standards claimed what effective technology integrators "do" (DeSantis, 2016). The purpose of this survey research, quantitative study was to identify perceptions, determine differences in perceptions, and identify how effective the

implementation of a framework such as TPACK connects to classroom technology integration of design and facilitation as defined by selected 2017 ISTE Standards for Educators.

Rationale for the Study

Sutton (2011) stated that previous studies suggest teachers still do not believe they are prepared to incorporate technology into the classroom for student-centered learning. Educational Technology (EdTech) is an ever-increasing presence both inside and outside of the classroom. As of 2017, The EdTech industry had an estimated worth of \$8,000,000,000 and was forecasted to reach \$252,000,000,000 by the year 2020 (Maniar, 2017). Teachers believe that technology in the classroom is important or essential, increases student engagement, improves student outcomes, and would like to use even more tech in the classroom than they currently do (Bates, 2016). With a desire to do more with technology in the classroom and a significant financial investment from school districts, it is imperative that teachers integrate technology appropriately and effectively.

As schools continue to advance with the use of technology in the classroom it is also important that teacher and administrators have a thorough understanding of the relationship of content, pedagogy, and technology. Teachers know the what, or subject matter, to teach and can leverage technology for how to teach. Teachers need to discern how applied technology can change the subject matter being taught and the TPACK framework best identifies these relationships of bodies of knowledge (Hofer & Grandgenett, 2012).

This study was designed to assess the differences in the perceptions of teachers and building administrators as to the development of technology practices among the

TPACK domains. Second, this study proposed to address Missouri school districts' implementation of the Designer and Facilitator 2017 ISTE Standards for Educators. Finally, the study proposed to investigate the relationship between teachers' and building administrators' perceptions of TPACK and the relationship to the ISTE Designer and Facilitator standards.

Research Questions

The study compared perceptions of technology and the practices of teachers nominated (by their building administrator) as leaders in the area of effectively using technology. The researcher examined data yielded from surveyed building administrators and nominated teachers on TPACK domains and self-assessment of selected 2017 ISTE Standards for Educators.

This study was designed to investigate the following research questions:

1. What is the difference in perceptions of the implementation of the TPACK framework between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?
2. What is the difference in perceptions of the implementation of the 2017 ISTE Designer and Facilitator Standards between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?

This study was designed to investigate the following hypotheses:

H₀1. There is no statistically significant difference in building administrators' and teachers' perceptions of TPACK.

H₀2. There is no statistically significant difference in building administrators' and teachers' perceptions of the selected ISTE Standards.

To address these research questions, the author will present a relevant and comprehensive literature review in Chapter Two, as well as present quantitative findings from building administrator and teacher surveys in Chapter Four.

Limitations/Delimitations/Assumptions

Limitations. The following limitations were present for this study:

1. Teacher and/or building administrator proficiency and comfort level in the use of technology were uncontrollable factors in this study.
2. Teachers who were selected by building administrators may not have been experienced with successful technology integration in the classroom.
3. The 2017 ISTE Standards for Educators were relatively new and may not have been formally adopted or implemented in the districts surveyed.
4. Survey fatigue and/or time of year of the survey for teachers and administrators may lead to a low response rate.
5. An incentive was not provided to participants for this research.

Delimitations. The following delimitations were present for this study:

1. The researcher included data only from building administrators and their nominated teachers from public PK-12 school districts located in the state of Missouri.
2. The surveys used were self-assessments for the teacher and an appraisal about the teacher's facilitation of TPACK and ISTE implementation from the building principal.

Assumptions. The following assumptions were present for this study:

1. It was assumed participants were honest with their responses.
2. The researcher assumed the nominated teachers met the selection criteria as defined by the researcher to the participants.

Design Controls

This descriptive, survey research study used a survey to collect data regarding building administrator and teacher perceptions of TPACK facilitation and implementation of the Designer and Facilitator 2017 ISTE Standards for Educators. The researcher selected survey research as “it determines and reports the way things are” and is also used to “assess the preferences, attitudes, practices, concerns, or interests of a group of people” (Gay, Mills, & Airasian, 2009, p. 9). The researcher invited and delivered an electronic survey to building administrators and their nominated teachers in all public school districts across the state of Missouri as a method to obtain a large population. The population included multiple school districts of varying sizes of enrollment, teachers, and building administrators. Basic demographic information was asked to identify access and utilization of educational technology tools, school district student enrollment, and teacher characteristics. No identifiable responses were included.

Building administrators and teachers were presented with a description of the survey and were provided an opportunity to decline participating, as well as an option to opt out of the research at any time. Participation was voluntary, and participants consented to the study by completing the survey instrument (See appendix A). All responses were collected and hosted through QuestionPro. Data gathered from the study were purged and deleted from the QuestionPro server upon completion of the research.

There was little to no risk to participants in the research. Information regarding the purpose of the study, voluntary participation, anonymity, and confidentiality was provided in the e-mail invitation to participate.

Definition of Key Terms

For the purposes of this study the following terms and definitions were used by the researcher:

Building Administrator. An educator who holds at minimum an initial administrator certificate granted by the Missouri Department of Elementary and Secondary Education (DESE, n.d.-a).

Educational Technology. “The use of technology tools in the classroom to improve learning” (Magana & Marzano, 2014, p. 8).

International Society for Technology in Education (ISTE). “The ISTE Standards are a framework for students, educators, administrators, coaches and computer science educators to rethink education and create innovative learning environments” (ISTE, n.d.-b).

Teacher. An educator who holds at minimum an initial teaching certificate granted by the Missouri Department of Elementary and Secondary Education (DESE, n.d.-b).

Technology. “Electronic, digital, or multimedia tools used to achieve a goal more efficiently or effectively” (Magana & Marzano, 2014, p. 8).

Technological Pedagogical and Content Knowledge (TPACK). A framework for integrating technology in addition to content and pedagogy (Koehler et al., 2013) that recognizes the three bodies of teachers’ knowledge and the interactions among them

described as content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK; Koehler et al., 2013).

21st-Century Pedagogy. Strategies and tools used to help transfer knowledge and skills through the use of higher order thinking skills, peer collaboration, media, information and technological fluency, project-based learning, problem-solving, assessment, self and peer reflection, and using digital tools in a collaborative manner (TeachThought.com, n.d.).

21st-Century Skills. Twenty-first-century skills “include among other things, problem-solving, communication, collaboration, information and media literacy, critical thinking, and creativity” (Lambert & Gong, 2010, p. 55).

Summary

This study was designed to compare differences in the perceptions of building administrators and teachers regarding the TPACK framework and selected 2017 ISTE Standards for Educators. The study attempted to identify differences between building administrator and teacher perceptions of TPACK and facilitation of selected 2017 ISTE Standards for Educators. Additionally, the study determined differences in practice and pedagogy of teachers using the Designer and Facilitator ISTE standards. The next generation of teacher leaders have many tasks, challenges, and initiatives ahead of them. This research was about identifying technological perceptions and seeking the successful pedagogical practices that will support and enhance the effective use of technology in classrooms for current and future generations of teachers. This chapter explored the foundational challenges and problems of effectively integrating technology with pedagogy and content. The chapter also questioned the quantity of successful technology

integration in classrooms of teachers and presented the theoretical underpinning to the effective use of technology inside the classroom.

Chapter Two will summarize history of technology and education; identify the impact of technology on the economy, classroom, and workforce; summarize 21st-century learning; introduce the ISTE Standards for Educators and the Technological Pedagogical Content Knowledge (TPACK) framework; outline effective classroom technology integration; and identify barriers to successful technology integration.

Chapter Three will outline the selection process used to identify the teachers in Missouri and present the data for the areas of concern in this study. Chapter Four will present the findings of the study. Chapter Five will summarize the findings of the research and present the implications of the study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Introduction

The knowledge and skills needed to be successful and competitive in the job market and economy of today are vastly different from the knowledge and skills called for in an industrial revolution school system. Technology has created a sense of urgency for a change in pedagogy and has served as a catalyst for preparing students for their future (Jackson, Helms, Jackson, & Gum, 2011; Langub & Lokey-Vega, 2017; Partnership for 21st Century Learning, 2014). The study focused on administrators' and teachers' perceptions of technology integration by analyzing the application of the TPACK framework and its impact on the implementation of select 2017 ISTE Standards for Educators. Analysis of technological perceptions provided insight related to successful pedagogical practices that supported and enhanced the effective use of technology in classrooms.

Chapter Two provides an overview of research related to instructional technology. The research is categorized into the following headings: history of technology and education; impact of technology on the economy, classroom, and workforce; overview of 21st-century learning skills, explanation of ISTE Standards for Educators; the Technological Pedagogical Content Knowledge (TPACK) framework; overview of effective classroom technology integration; and identified barriers to successful technology integration.

History of Technology and Education

Examples of technology throughout the history of education include wooden paddles with printed lessons during the Colonial years; the Magic Lantern, an archaic form of a slide projector; and the chalkboard (which arrived around 1890), followed by the pencil (in 1900). Audio in the form of radio started in the 1920s; the overhead projector was introduced in 1930, the ballpoint pen in 1940, and headphones in 1950. Videotapes were first used during the early 1950s, and Skinner's all-inclusive teaching machine came thereafter. The late 1950s and early 1970s produced the photocopier and handheld calculator, and Sokolski's Scantron system began scoring assessments in 1972. Everyday use computers arrived in the 1980s, the Internet was born in the early 1990s, and Apple released the first personal digital assistants (PDAs) in 1993.

By this time, classrooms had at least one computer in the room and 93% of those computers had access to the Internet (Purdue University, n.d.). Fast forward to 2013 where 71% of the population of the United States ages 3 and over were using the Internet. Elementary- and secondary-age school children ages 5 to 19 also have a high percentage of Internet use from their home. As much as 52.5% of 5-to 9-year-olds, 71.4% of 10-to 15-year-olds, and 84.6% of 16-to 19-year-olds use the Internet from their home (National Center for Education Statistics [NCES], 2017).

Traditionally, access to computers has required a trip to the library or other dedicated computer lab for students. Gray, Thomas, and Lewis (2010) reported on the number of computers in teacher classrooms, availability and frequency of device use during instructional time, and students' use of educational technology during class time. The report found 97% of teachers had at least one computer in the classroom and 54%

had access to computers that could be brought into the classroom. At the time of the study the ratio of students to computers in the classroom was 5.3 to 1. Teachers responded that they or their students used computers during instructional time “often” 40% and “sometimes” 29%.

Technology in the classroom at the time of the report included liquid crystal display (LCD) screens, projectors, interactive whiteboards, and digital cameras (NCES, 2010). A catalyst to the increased use of technology was the 1:1 initiative as over 50% of teachers responded they had a 1:1 student-to-device ratio. As accessibility continues to rise inside and outside of the classroom, the role and impact of technology in the economy is certain to increase as well. A 2018 Consortium for School Networking (CoSN) K-12 IT Leadership Survey report found that 1:1 goals and implementations are increasing across the country. The 1:1 implementation rate at middle schools was recorded at 53% with an additional 30% of respondents planning to progress towards a 1:1 environment in their middle school. High school responses were similar to their middle school peers: 47% responded a 1:1 implementation was in place and 32% of high schools were pursuing 1:1 in the future. Elementary buildings showed the least interest in moving towards a 1:1 environment as 33% responded 1:1 was not a building goal and 64% responded that 1:1 was a goal or already had been implemented in their building.

A 2017 survey (Sharp, 2016) of over 2,500 teachers and administrators illustrated the use of technology in schools across the United States. Three out of five teachers stated they would increase their technology use during 2016-2017 school year; 80% of teachers felt accessibility to technology in their school was already good or great; and 75% of teachers responded to using technology daily with their students.

In a word, technology has incrementally crept into classrooms over the years as a means to have a positive impact on student achievement and relieve teachers of repetitious work (Cuban, 1986; Martin, 2016). As technology has advanced and been adopted in the workplace, more and more educators are seeing the impact of technology both inside and outside of the classroom. Schools are aligning the experiences of students to the workforce with outcomes that will prepare students to succeed in an economy where technology has increasingly expanded its role and impact in the workplace (Martin, 2016).

Impact of Technology on the Economy, Classroom, and Workforce

Today's economy has changed the landscape and reshaped the expected outcomes of the successful graduate, in large part due to technology (Martin, 2016). Preparing students for the 21st-century economy requires successful integration of 21st-century skills, an increase in cognitive consumption, and simultaneous implementation of digital tools. Knowledge and skills needed for mass production and industrialization of the 20th century were aligned to an economy dependent upon assembly-line workers. The education system delivered employees who would show up on time and repeat the same task multiple times throughout the day without complex or independent thinking. The tasks for the "job" did not call for high cognitive skills, merely simple "rote" memorization. Schools of the early 20th century mirrored the workforce and the educational outcomes created a worker who may have only had a sixth-grade education with foundational cognitive skills in math, reading, and writing (Martin, 2016; McGivney & Winthrop, 2016).

Gentry, Baker, Thomas, Whitfield, and Garcia (2014) recognized that the globalization of the economy coupled with always available technology has created a demand on teachers to move past simple integration of technology, and progress towards using technology in a transformative manner to support 21st-century teaching and learning. The economy has shifted from an industrial-based economy primarily driven by manufacturing, to a service-based economy where knowledge, skills, and innovation are driven by substantial and ever-growing amounts of information.

Research from the UCLA Anderson School of Management found that the information services economy grew from 36% to 56% from 1967 to 1997 (Apte, Karmarkar, & Nath, 2008). The U.S. Bureau of Labor Statistics further (2015) underscored the rise of the service sector. Between 1995 and 2005, 3,000,000 manufacturing jobs were lost while 17,000,000 service-sector jobs were created. Industry employment and output projections to the year 2024 according to the Bureau of Labor Statistics predicted that consistent with its decline over the past 10-year period, manufacturing employment would continue to fall while the service-providing sectors would account for the majority of the projected job growth.

The education system worked for the early 20th-century economy in large part because manufacturing was the economy (Martin, 2016). The knowledge, skills, and expectations were aligned to the roles of the assembly-line worker. Applying this educational model to a modern and adaptive 21st-century economy would be a mistake that ultimately would leave students unprepared for a modern and sophisticated workforce where technology is ever present (McGivney & Winthrop, 2016). Today's student needs a skillset far more innovative and complex than that of his or her industrial

age ancestors. Routine tasks were substituted by computers as they were repetitive and predictable, and ultimately lead to an automated task (Autor, Levy, & Murnane, 2001; Autor & Price, 2013). As technology continues to transform the workplace we need to ensure students are complemented by technology instead of being replaced by it (Brynjolfsson & McAfee, 2014). Teachers must instill the digital literacy knowledge, skills, and outcomes needed to leverage the available technologies for student and future employee success (Martin, 2016).

Research completed at Bentley University found that 71% of in-demand skills are required across two or more job categories and those who have the needed cross-category skills will be best prepared for the “hybrid job” of tomorrow. Hybrid jobs add new skills to traditional job descriptions that also pay more. Bentley University President Gloria Larson summarized that the success of the future employee depends on the ability to combine soft skills such as communication and hard, technical skills that previously only belonged to a select group of tech-savvy individuals. Students need to learn how to be adaptive, dynamic, and versatile just as their future workplace is likely to be to contribute in a positive and meaningful way (Bentley University, 2016).

Modern standards are shaping the classroom environment and are preparing the future workforce by teaching how technology may complement the learner instead of the learner being in competition with it (McGivney & Winthrop, 2016). Standards identify the knowledge, skills, and understandings that students need to acquire as they progress throughout their journey of learning (Marshall, 2013). Ultimately, students in the classroom are expected to do more than recall information and should be equipped with the knowledge and skills to excel in a service-oriented economy as technology has

transformed the manufacturing sector (Autor & Dorn, 2013; Martin, 2016; World Economic Forum, 2016).

Two recent technological trends have influenced teaching and learning: the explosion and constant growth of information and learning, and the increase of technologies to access this information (McTighe & Curtis, 2016). Technology has changed the context for thinking as teachers must now consider how technology impacts transdisciplinary outcomes such as the 21st-century skill, collaboration. Due to technology, the context of collaborating has dramatically changed as technology allows collaboration to take place anywhere, anytime. Ubiquitous collaboration allows for the sharing of projects and increases productivity on a global scale and employers are actively seeking candidates with this workplace competency (Manpower Group, 2015).

As technology is ever changing, so will the knowledge and skills needed to be a successful collaborator, critical thinker, creator, and communicator (McGivney & Winthrop, 2016). In summary, technology is not an ends to a means nor should it be viewed as a standalone. The appropriate use of technology can be an avenue to 21st-century learning and be used to enhance learning and increase student achievement (McTighe & Curtis, 2016).

The 21st-Century Learning Framework

The Partnership for 21st Century Learning (P21) created a framework that was developed to illustrate and teach students what knowledge and skills are needed in order to be successful in the 21st-century. The P21 framework consists of 21st-century student outcomes and support systems and uses interdisciplinary themes such as global awareness, financial, civic, health, environmental, information, media, and information

communication technology (ICT) literacies that should be woven into the curriculum. Life and career skills such as flexibility, initiative, social skills, productivity, and leadership skills are also identified as part of the framework in order for students to be able to traverse complex work and life environments (P21, n.d.-b.).

P21 (n.d.-a) defined 21st-century skills as “what students need to succeed in today’s globally and digitally interconnected world” (para. 7). P21 advocated that students need 21st-century skills to bridge the gap between what is learned in school and what is needed in the workplace. In order to address this gap, P21 recommended to align the classroom and real-world environments by blending the “three R’s” (reading, writing and arithmetic) and “four C’s.” The four C’s, composed of creativity, critical thinking, collaboration, and communication, are a part of the learning and innovation skills outcomes (P21, n.d.-a).

Creativity

Plucker, Beghetto, and Dow (2004) defined creativity as “...the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context” (p. 90). Students need to be able to think creatively for themselves as well as work creatively with their peers. They need to be effective with idea creation techniques such as brainstorming, mind mapping, and storyboarding. Students should also be reflective with their own ideas, effectively communicate their ideas to their peers, and be open to feedback. Finally, students should have a growth mindset viewing failure as a learning opportunity and have an understanding that creativity and innovation take time to develop and implement (P21, 2015).

Critical Thinking

Bloom's taxonomy is a known model of critical thinking that educators frequently utilize. The taxonomy consists of six hierarchical categories of cognitive skills: knowledge, comprehension, application, analysis, synthesis, and evaluation. Other researchers including Norris (1985) defined critical thinking as "rationally deciding what to do or believe" (p. 40) and Sternberg (1986) defined it as "the mental processes, strategies, and representations people use to solve problems, make decisions, and learn new concepts" (p. 3).

P21 (n.d.-c) separated this outcome into four individual segments: Reason Effectively, Systems Thinking, Judgements and Decisions, and Solve Problems. Reasoning techniques such as inductive, deductive, and systematic appropriate to the situation are necessary skills in order to be successful with reasoning. Systems thinking requires the learner to analyze outcomes by how parts of the whole interact with a complex system. Students should make judgements and decisions by effectively analyzing and evaluating evidence, arguments, claims, beliefs, and alternative points of view. They (students) should have the skills to synthesize and make connections based on their analysis and be able to reflect on their processes and learning experiences. Students also need to be skilled problem solvers. This is accomplished by solving different kinds of unfamiliar problems in both conventional and innovative ways and having the ability to ask clarifying questions that lead to better solutions (P21, 2015).

Collaboration

Working effectively and efficiently with others is a vital skill-set to have in today's service-oriented economy. Organizations are placing an emphasis on working in

team-based structures. Stuart and Dahm (1999) found that these structures are relying on networks of cross-functional teams that share a deep technological focus and capability (P21, 2015) and Kotter (1995) reinforced the importance of teams when used as a guiding coalition in change management. Workers in the U.S. economy need skills that go past the traditional three R's as technology has automated routine tasks and jobs have been outsourced. A survey from the American Management Association (2010) found 72.3% of responses agreed and strongly agreed that collaboration and team building are skills deemed as priorities for employee development. Roschelle and Teasley (as cited in Plucker et al. 2015) defined collaboration as “coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem” (p. 1). P21 expects students to show the ability to effectively and respectfully work in diverse teams and exercise flexibility and willingness in working towards a common goal. Students also should be an active and effective contributor to the team, sharing responsibility for collaborative work, and recognizing the contributions of individual team members (P21, 2015).

Communication

Communication is a necessary 21st-century skill that has not received the same amount of attention or research as compared to critical thinking and creativity. As a result the definition of communication is broad as it has been applied in multiple areas and contexts such as mass communication (McQuail, 2010), computer-mediated communication (Walther, 1996), and interpersonal communication (Jensen, 2013; P21, 2015).

P21 expects students to be able to communicate clearly. This includes articulating thoughts and ideas in different manners including oral, written, and nonverbal forms. Students should be able to effectively listen in order to analyze meaning, knowledge, values, attitudes, and intentions. Communication has more than one purpose: students should be able to communicate for multiple purposes to inform, instruct, motivate, and persuade. The modern workplace expects employees to effectively communicate in a diverse environment and be able to utilize multiple media and technologies in an effective manner (Dilley, Fishlock, & Plucker, 2015).

To summarize, P21 created a framework for 21st-century education consisting of learning and innovation skills, which include the four C's: critical thinking, communication, collaboration, and creativity. The framework was created with assistance from educators and business leaders, and it defines the knowledge and skills students need to be successful in work and life. The framework also serves as a guide for aligning assessments, curriculum, instruction, professional development, and learning environments to 21st-century outcomes (P21, 2015). This framework ultimately helped with the effective integration of 21st-century skills inside the classroom and is also evident in the ISTE Standards for Educators and Students (P21, n.d.-b; Stoeckl, 2017).

International Society for Technology in Education (ISTE) Standards for Educators

The International Society for Technology in Education (ISTE) standards are used by school districts, buildings, and classrooms across the United States and around the world. The ISTE standards serve as a framework for educators to reexamine teaching and learning, create contemporary learning environments, and guide in the redesign of teaching and learning in the classroom for the digital age (ISTE, n.d.-b). ISTE designed

five sets of standards for: (a) students, (b) educators, (c) education leaders, and (d) coaches. The 2017 ISTE Standards for Educators included seven standards: (a) Learner, (b) Leader, (c) Citizen, (d) Collaborator, (e) Designer, (f) Facilitator, and (g) Analyst.

Compared to prior revisions of the ISTE Standards for Educators, current thinking has shifted regarding the way technology should be used in the classroom (Crompton, 2017). As previous iterations of the standards focused on the potential of the digital tools and building capacity in educators on how to use them, it became evident that teachers knew how to use the tool but lacked training on how to use the tool for learning and incorporation into lesson and unit design. This led to standard revisions with a focus on moving away from the tool all together, which opened the door to using technology in a replicating manner instead of an innovative manner. Ultimately, this drove the current set of ISTE Standards for Educators and incorporated terms such as innovation, disruption, and evolution (Crompton, 2017).

The current standards provide educators direction when making decisions pertaining to curriculum, instruction, professional learning, and the use of technology in the classroom and are not solely standards for technology. The research in this study specifically reviewed the Designer and Facilitator 2017 ISTE Standards for Educators as the Designer and Facilitator are key standards in ensuring quality technology integration at the classroom level. The Designer standard was chosen as it has a focus on making learning personal for students and assisting teachers as they prepare instruction for a student-centered classroom. The Facilitator standard expects for teachers to highly engage students and place the responsibility of learning upon them. Students are asked to collaborate with their peers as part of the learning process. This Facilitator standard

promotes that teachers use technology as a tool to reinforce student success and highly connects to the expectations of the 2016 ISTE Standards for Students expectations, which include collaboration, communication, critical thinking, and creativity. These skills are also found as key tenants from the P21 (n.d.-b) framework.

Designer standard. The Designer standard defined how educators “design authentic, learner-driven activities and environments that recognize and accommodate learner variability” (ISTE, n.d.-a, Designer section, para. 1). Indicators for this standard included the:

(5a) use technology to create, adapt and personalize learning experiences that foster independent learning and accommodate learner differences and needs; (5b) design authentic learning activities that align with content area standards and use digital tools and resources to maximize active, deep learning; and (5c) explore and apply instructional design principles to create innovative digital learning environments that engage and support learning. (ISTE, n.d.-a)

To illustrate the Designer Standard 5a, teachers should seek out how to incorporate student interests and curiosity as a means to the learning process; champion student voice and choice by using technology; and answer how technology may address and accommodate various learning needs. Collaboration, communication, critical thinking, and creativity exist in this sub indicator as the efficiency and functionality of technology to be used to personalize learning experiences and meet students’ unique learning needs (Crompton, 2017).

Additional ideas for the Designer Standard 5a included creating opportunities for students to create and manage their own personal learning goals; providing opportunities

for students to take ownership of their own learning; and approaching learning concepts from a new perspective (Crompton, 2017). Marzano (2017) reinforced the importance of this standard/indicator by noting the importance of motivating and inspiring students by expecting them to create their own learning goals. He included academic goal setting, personal projects, and growth mindset cultivation strategies as a means towards improved learning. Hattie (2012, 2017) found the influences on student achievement were on average .40, the equivalent to 1 year of schooling, and recommended using interventions above the .40 hinge point. His review of learning goals versus no goals yielded a .68 effect size; self-reported grades, 1.33, indicated additional evidence of the importance of students being motivated by being part of the goal-setting for their own learning. Hattie correlated the effect size of student, curricula, home, school, classroom, and teacher influences. He studied the effect size of implementing technologies such as information communications technology (ICT), technology with elementary and high school students, technology with learning needs students, one-on-one laptops, and the use of PowerPoint. Hattie's research found the effect size of ICT to be 0.47; technology with elementary students, 0.44; technology with high school students 0.30; technology with learning needs students, 0.57; one-on-one laptops, 0.16; and the use of PowerPoint, 0.26. The results implied that the effectiveness of technology use for student achievement varies and reinforces the need for successful technology integration as teachers bring together the TPACK intersections of CK, PK, and TK.

Designer Standard 5b was steeped in active and deep learning and contains core elements of 21st-century learning such as collaboration, critical thinking, and communication. As teachers progress towards the student-centered classroom they must

align and implement curriculum, pedagogy, and assessments and apply technology in a manner that best delivers each student's individual learning needs (ISTE, n.d.-a).

Designer Standard 5b focused on evaluating how digital tools meet content standards; the review of how students use technology for creation and not consumption; and seeking out how a digital tool is to be used to extend learning in a content area even if the tool is not openly related. Tips for this indicator included the design of learning opportunities emphasizing creative problem-solving instead of depending on drill-and-practice methods; networking with other educators for creating active learning experiences; assisting students in selecting tools that best align to their learning goal; incorporating a design challenge task; and networking with other schools and educators who are effective with deeper or authentic learning strategies (Crompton, 2017).

Leveraging digital tools assists with active, deep learning as students use technology to understand and show evidence and mastery of content knowledge while simultaneously demonstrating crucial 21st-century skills such as critical thinking, collaboration, and communication. Designer Standard 5b called for active, deep learning, which in turn allows for the transfer of these 21st-century transdisciplinary skills (ISTE, n.d.-a). Hattie (2017) correlated problem-based learning as a .30 effect size; problem-solving teaching, .67; and student concentration/persistence/engagement, .56, supporting the notion of the need to focus on conceptual understanding to ensure active, deep learning. Marzano (2017) unpacked cognitively complex tasks as tasks that include numerous mental steps and the incorporation of content in new ways. He included strategies such as experimental inquiry tasks, problem-solving tasks, and student-designed tasks as strategies for engaging students in cognitively complex tasks.

Furthermore, Designer Standard 5c focused on how blended or online learning may be used to support learning, analyze learning environments to leverage student learning, and review instructional design principles and ideas to enhance instruction. Equally important were the corresponding tips for the standard. Crompton (2017) recommended networking with other professionals regarding strategies for online, blended, and active learning environments; expanding the professional learning network through webinars, edcamps, and conferences; using digital tools and tested resources and strategies for effective online, blended, or face-to-face learning; visiting colleagues to seek out practices that may be replicated; and modifying one lesson by integrating an uncomplicated online learning activity allowing time for students to reflect on this experience while meeting face-to-face in class. In a review of 35 studies, Darling-Hammond, Hyler, and Gardner (2017) found a positive relationship between development of teachers, their practices, and student outcomes. Seven components of effective professional development were identified in the study, including collaboration. High-quality professional development supports job-embedded collaboration by creating spaces for teachers to share their ideas work together in their learning (Darling-Hammond et al., 2017).

Collaboration allows for educators to dialogue about best practices and allows for opportunities to improve learning experiences and environments as Designer Standard 5c suggested. Teachers must think critically about learning conditions, such as the classroom environment, as Designer Standard 5c challenged teachers to rethink the physical space of the room and how to incorporate new models of learning such as blended and online learning (Crompton, 2017; ISTE, n.d.-a). Marzano (2017) referenced the physical layout

of the classroom. Strategies for optimal layout included planning areas for group work, planning learning centers, considering computers and technology equipment, and involving students in the design process.

A 2010 meta-analysis compared blended learning to face-to-face instruction and found that blended learning had an effect size of .35 (Magana & Marzano, 2014). Hattie (2017) identified one-on-one laptops to have a small, positive impact on student achievement with a .16 effect size. Hattie also found technology is best utilized when it serves as a supplement to instruction as opposed to a replacement for instruction. When used as a supplement, computer-assisted instruction yielded an effect size of .45 and had an effect size of .30 when used as a replacement for the teacher's instruction (Magana & Marzano, 2014; Marzano, 2017). Hattie also analyzed the use of digital media that designated a blended approach: interactive video, .52; audiovisual methods, .22; and simulations, .33 (Magana & Marzano, 2014). Pairing these technological influences with effective instruction may provide the best gain in student achievement in the classroom.

Facilitator standard. Whereas the Designer Standard focused upon best practices and providing opportunities for students to be successful in a digital world, the Facilitator Standard emphasized that students have a voice and choice in all facets of the learning process. The Facilitator Standard defined that “educators facilitate learning with technology to support student achievement of the ISTE Standards for Students” (ISTE, n.d.-a, Facilitator section, para 1). The Facilitator Standard consisted of four indicators:

(6a) foster a culture where students take ownership of their learning goals and outcomes in both independent and group settings; (6b) manage the use of technology and student learning strategies in digital platforms, virtual

environments, hands-on makerspaces, or in the field; (6c) create learning opportunities that challenge students to use a design process or computational thinking to innovate and solve problems; and (6d) model and nurture creativity and creative expression to communicate ideas, knowledge, or connections. (ISTE, n.d.-a)

Facilitator Indicator 6a explored how a change in teacher practice can empower student ownership of their learning goals and outcomes, collaborating with students to determine and assess their learning goals, and reflecting on positive group experiences to replicate for students. Similarly, ideas for this standard included the sharing of 2016 ISTE Standards for Students with the class encouraging the use of “I” statements; creating ways to share responsibility with students; teaching students how to self-assess their own learning; using group roles so students manage their own learning; collaborate using online projects; and using collaboration contracts for the guiding of student groups (Crompton, 2017).

Cooperative learning, predetermined buddies, peer tutoring, and structured grouping were recommended by Marzano (2017) as strategies to engage students that support the Facilitator Standard 6a. For example, peer tutoring works well with direct instruction as struggling students are paired with students who understand the content. Predetermined buddies work well for deepening content and allow for the teacher to quickly transition to student practice and compare group responses as students were previously paired through a prior activity. The 21st-century skills, critical thinking, communicating, and collaboration, exist in 6a by requiring students to begin to take ownership of their learning by working independently or in group settings (ISTE, n.d.-a).

Hattie (2017) also supported the concepts defined in Facilitator Standard 6a by noting the importance of using a meta-cognitive/self-regulated learning strategy of evaluation and reflection resulting in an effect size of .75, which indicated a positive effect on student learning. Marzano (2017) also emphasized the importance of focusing on students setting their own goals. Motivation and inspiration occur when students feel the connection to their future and being a part of something important. Strategies include academic goal setting, which resulted in students creating long-term goals with the steps needed to complete them, and altruism projects. When the strategy is effectively implemented, teachers should see students engaged with community members in meaningful ways, students working on projects of their own design, and student class descriptions mentioning motivating or inspiring.

Facilitator Standard 6b reflected upon identifying systems for managing technology, understanding the potential and alignment of digital tools to learning goals, and assessing teacher comfort level of designing and managing in different domains. This indicator recommended the use of completing online research for strategies for managing technology in various domains, having students set their own rules for technology used in different domains, seeking examples of colleagues using technology in different capacities, utilizing peer coaching, and introducing online forums to students while modeling how to collaborate online (Crompton, 2017).

Supporting the importance of Facilitator Standard 6b, Hattie (2017) noted that influences such as positive classroom management resulted in an effect size of .35 and effectively implementing technology such as teaching with online and digital tools with an effect size of .29. These results indicated a positive impact on student learning.

Marzano (2017) included strategies for expanding the ownership of rules and procedures for students in classrooms. Strategies of writing a class pledge, using a small set of rules and procedures, generating rules and procedures with students, and using posters and graphics could be helpful in assisting students in the appropriate use of technology inside and outside the classroom.

Facilitator Standard 6c focused on the teacher's understanding of computational thinking and design processes. It asked students to solve problems that are meaningful and incorporated the use of both computational thinking and design processes in the same lesson or unit (Crompton, 2017). Teachers and students exercise critical thinking skills when implementing challenging design processes such as a human-centered design process and project-based learning (ISTE, n.d.-a). The Common Core State Standards Initiative (n.d.) identified key shifts in mathematics including pursuing conceptual understanding, procedural skills and fluency, and application with equal intensity. To help students have success with the standards educators needed to pursue the components of rigor, which include conceptual understanding, procedural skills and fluency, and application (Common Core Standards Initiative, n.d.). Crompton (2017) had additional suggestions for Facilitator indicator 6c for teachers including researching computational thinking resources developed by ISTE, sharing of real-world design processes with students, selecting and implementing a design process with students, instilling a persevering culture when solving problems in the classroom, and designing and sharing a computational thinking learning activity for the teacher's grade and content area.

Hattie (2017) referenced many aspects of Facilitator Standard 6c and showed in his research the positive effects of many similar practices. His work noted the importance

of problem-based learning with a .26 effect size; problem-solving teaching with an effect size of .68, student concentration/persistence/engagement with an effect size of .56, and peer tutoring resulting in an effect size of .53. Marzano (2017) supported this concept by noting the importance of unpacking cognitively complex tasks as expectations that include numerous mental steps and the incorporation of content in new ways. He also advocated strategies such as experimental inquiry tasks, problem-solving tasks, and student-designed tasks for engaging students in cognitively complex tasks.

Facilitator Standard 6d explored the following: shifting learning from consuming to creating, demonstrating student work to large audiences for real-world impact, and identifying the value of creativity and sharing of student work for education. Tips for this indicator included asking students to demonstrate the use of digital tools to exhibit mastery, dialoguing with students about their learning goals and about which digital tools best suit the sharing of their learning, seeking feedback for one student project outside of the school, having students share their thinking online, and designing and incorporating creative projects where students use content area knowledge and reflect upon the process and significance of their work (Crompton, 2017).

Creativity and communication were cultivated in Facilitator Indicator 6d as students strive towards their learning goals, use technology to demonstrate their learning, and seek feedback from outside sources (Crompton, 2017; ISTE, n.d.-a). Marzano (2017) recommended the use of personal projects, students working with their teacher to establish academic goals, and mindfulness practice as strategies for motivating and inspiring students. Review strategies such as cumulative review, questioning, demonstration, and presenting problems are ways of evaluating content and providing

students the opportunity to recall what was previously taught and learned. Hattie (2017) referenced conditions of the Facilitator Standard 6d and showed in his research the positive effects of similar practices as he correlated evaluation and reflection as a strategy emphasizing meta-cognitive/self-regulated learning to have an effect size of .75.

The 2017 ISTE Standards for Educators were constructed around learning and not digital tools. These standards provide a focus and opportunity for students to have access to a modern and relevant learning environment. Clear standards also identify what students should know and be able to do. The 2017 ISTE Standards for Educators bring forth a vision to implement deep and transformative learning to students; they were designed for educators by educators and are used to empower and unleash the learning and creativity of students. The Designer and Facilitator ISTE Standards for Educators provide teachers with key expectations to consider as they plan and design lessons.

Despite defining 21st-century learning and unpacking the Designer and Facilitator 2017 ISTE Standards for Educators, teachers also need a framework that shows the relationship of content, pedagogy, and technology to connect the teaching of standards and 21st-century competencies. The TPACK framework allows educators to see the interconnection of technology and teaching and aims for purposeful integration, reflection, and evaluation of the degree or effectiveness of the use of technology in the lesson.

Technological Pedagogical Content Knowledge (TPACK)

Technological frameworks assist educators with the effective integration of technology and teaching. TPACK applied through the design thinking process can assist teachers in developing students' 21st-century competencies (Koh, Chai, Benjamin, &

Hong, 2015) and the intersections of TPACK are important in teaching 21st-century competencies. Brown, Neal, and Fine (2011) reviewed how designing lessons with Technological Pedagogical and Content Knowledge (TPACK) assists with the insertion of the 21st-century thinking skills and sought connections between the two. This work indicated that the prevailing critical thinking instructional strategy needed to design effective lessons by preservice teachers was teacher questioning, inquiry-based learning strategies, open-ended questions, problem or project-based learning, and the use of PowerPoint for presentations.

Teachers need to understand the content, including standards such as ISTE, and competencies such as P21, and then transfer the content through proper pedagogical and technological applications. Without the domains of TPACK, students may miss an opportunity to demonstrate their own understanding and application of learning. Silva (2009) stated that placing “an emphasis on what students can do with knowledge, rather than what units of knowledge they have, is the essence of twenty-first century skills” (p. 630). As technological tools, instructional strategies, modern standards, and content come and go, teachers who understand TPACK can leverage the complexities of mixing content, technology, and pedagogy and apply them in specific contexts leading to quality teaching (Mishra, Koehler, & Henriksen, 2011).

TPACK was introduced to the educational field as a framework for integrating technology with content and pedagogy (Koehler et al., 2013). The TPACK framework recognizes the three bodies of teachers’ knowledge and the interactions among them described as CK (content knowledge), PK (pedagogical knowledge), and TK (technological knowledge; Koehler et al., 2013). CK is the teacher’s expert knowledge in

the given subject area or may be referred to as the what teachers teach including the facts, concepts, and theories of a given discipline. CK implies that the teacher knows what and when to teach and is likely comfortable with content knowledge. (Common Sense Education, 2016; Crompton, 2016; Koehler et al., 2013). PK is how teachers teach while using their expert knowledge of the art and science of teaching. Teachers who are proficient in this body of knowledge know how to transfer knowledge using different assessments, instructional strategies, and learning theories. Being successful with the components of PK allows the teacher to create meaningful and relevant learning experiences for their students (Common Sense Education, 2016; Crompton, 2016; Koehler et al., 2013). TK is the understanding of available technologies in teaching and learning, and represents teacher knowledge about the tools including how to select, use, and integrate technology into the curriculum (Crompton, 2016). Koehler et al. (2013) stated that TK is more difficult to define as compared to CK and PK because technology is ever changing and penning a definition of technology would be obsolete by the time the definition was published. Instead, Koehler et al. recommended defining TK with a definition proposed by the National Research Council Committee on Information Technology Literacy (1999), which defined fluency with information technology this way:

Persons understand information technology broadly enough to apply it productively at work and in their everyday lives, to recognize when information technology can assist or impede the achievement of a goal, and to continually adapt to changes in information technology. (p. 15).

It is worth noting that people may have an abundance of technological knowledge, but they may not necessarily be able to apply it in the context of education. Technological knowledge does not imply to focus solely upon the hardware, rather emphasizes the quality of the content available through digital resources (Crompton, 2016).

At the intersections of CK, PK, and TK are the interactions of each body of knowledge: PCK (Pedagogical Content Knowledge), TCK (Technological Content Knowledge), TPK (Technological Pedagogical Knowledge), and TPACK (Technology, Pedagogy, and Content Knowledge). PCK occurs when Content and Pedagogical Knowledge are combined. When used effectively PK and CK complement one another, allowing for CK to transfer to the student as the CK and PK outcome are aligned (Common Sense Education, 2016; Crompton, 2016).

Using the example of teaching a student to properly strike a golf ball may demonstrate a crude (nontechnological) PCK example. Explaining the elements necessary to effectively strike a golf ball might define a CK outcome. By incorporating PK, the students can leverage a hands-on instructional strategy after the teacher models how to hold a golf club and demonstrates what a proper backswing, impact position, and follow-through look like. CK, or the what, is transferred through the how, also known as PK (Common Sense Education, 2016; Crompton, 2016).

In this example the student learns what a properly struck golf ball is and then transfers this content knowledge through the modeling and demonstrating of PK activities. The teacher can then follow with additional input and reinforcement, providing for deeper learning and assessment opportunities for the original CK outcome. The student will be engaged in a deep level of critical thinking for this knowledge and skill to

transfer. Assessing critical thinking does not only apply to “school” but also in everyday life and issues significant to the community. Providing an opportunity for critical thinking in conjunction with real-world contexts not only makes learning relevant but also is a recommendation of P21 (Dilley, Kaufman, Kennedy, & Plucker, 2015).

According to Koehler et al. (2013), TCK “is an understanding of the manner in which technology and content influence and constrain one another” (p. 16). Within TCK teachers must master more than the content they teach; they must also understand how the subject matter can be modified by utilizing particular technologies (Koehler et al., 2013). TCK is used to further understanding of a topic. Using the previous golf analogy, students could use a recording device such as an iPhone or iPad using interactive software to review their backswing, impact position, and follow-through.

TPK “is an understanding of how teaching and learning can change when particular technologies are used in particular ways” (Koehler et al., 2013, p. 16). For the teacher this means how to best choose and manage the selection of technology for students and implies that TK and PK are effectively used together (Common Sense Education, 2016; Crompton, 2016). Continuing with the golfing example, a student could utilize software such as Hudl Technique Golf to evaluate and improve their golf swing, and document and share their findings while seeking feedback about their backswing, impact position, and follow-through from peers and experts in the field.

Twenty-first-century skills such as creativity, critical thinking, collaboration, and communication are actively engaged in this TPK example; the use of technology facilitates additional feedback for students that was previously unavailable. The delivery of 21st-century skills, such as communication, is inserted when using the TPACK

framework at the lesson design phase. As teachers design lessons they should determine what type of communication the students will develop and use, such as oral, written, or visual, and think about the assessment of the communication in the student's work. In the above example, the audience would include a community of golfers, amateurs and experts, who in addition to the teacher could provide an assessment and feedback for the student's progress (Dilley et al., 2015).

In conclusion, TPACK reminds teachers to focus on content and pedagogy first, technology second, and provides a framework for successful integration of 21st-century skills and technology in the classroom (Common Sense Education, 2018; Crompton, 2016; Sheninger, 2016). TPACK additionally provides a framework to ensure the ISTE Standards are the outcome for effective classroom technology integration. The TPACK framework should guide teachers to effectively design and facilitate a lesson that integrates technology in order to promote high levels of student learning.

Effective Classroom Technology Integration

Students learn when technology is used to enhance and support good teaching practices, and learning is hampered when technology is used with ineffective instructional strategies (Magana & Marzano, 2014). Adding technology into the classroom does not guarantee an increase in student achievement. Using technology to replace teachers and/or futile teaching practices magnifies the ineffectiveness of the teacher's pedagogical problems and will lead to lower learning outcomes in students (Mohammed, 2018; Vega, 2016).

The U.S. Department of Education, Office of Education Technology's (2014) *Learning Technology Effectiveness* brief explained how complex integrating technology

can be. When referencing a healthcare analogy regarding improving health in hospitals, the brief discussed how improving patient health requires more than drugs and x-ray machines. The authors further expanded by saying that seeing sustained improvement of patient behavior requires defined treatment regimes, trained professionals, and the implementation of best practices. Integrating technology into the classroom is similar to the above analogy. Implementing technology implies it will be added into an existing system that includes numerous elements. These elements must all work together in unison in order for the technology to be effective. The authors further outlined technology can better enable learning when:

- (a) it provides a unique, new capability that supports human learning processes
- and (b) interventions are designed to embed that capability within an integrated system that provides the support students and their teachers need to enact the learning within the curriculum. (Shear et al., p. 14, 2014)

In order for successful technology integration to take place, teachers need to be well versed in what Prensky (2010) referred to as the “verbs” and “nouns” of teaching. Prensky identified verbs as skills students need to “learn, practice, and master” (p. 45) (such as understanding and communicating) and nouns are the tools students use to learn and practice these skills. The digital tools included presentation software such as PowerPoint, e-mail, YouTube, and other digital resources that are ever changing. Prensky urged educators to see the verbs as being the fundamental pedagogy for learning that changes little, if any, and nouns (21st-century tools) as something that will constantly change throughout our lifetimes. Prensky summarized the connection of the noun and verb by illustrating the use of PowerPoint: “PowerPoint is a tool (noun) for presenting

(verb). But it will likely be replaced in our students' lifetimes...by other, better, presentation tools" (p. 46).

Leftwich, Glazewski, Newby, and Ertmer (as cited in Hechter & Vermette, 2013) emphasized the importance of helping teachers find out how technology may enhance their curriculum as compared to having an expectation that technology should change the essence of teaching and learning. This was identified as a starting point for teachers, but the ultimate goal was to figure out how to move teachers towards student-centered practices. Ottenbreit-Leftwich, Glazewski, Newby and Ertmer (2010) recommended that new technology use should be purposeful and aligned to the teacher's value beliefs regarding teaching and learning.

Becker (2000) found in order for technology integration to be successful with students, teachers' pedagogies need to align with student projects that are collaborative and interesting. The Designer standard of the 2017 ISTE Standards for Educators most closely aligned to this finding and provided guidance for educators when designing authentic, learner-driven activities (ISTE, n.d.-a). Collaborative projects can assist in the development of teachers' implementing a TPACK framework. Instructional modeling, collaborative lesson study, peer coaching, and collaboratively developing and vetting curriculum are generated at the PCK intersection of TPACK (Harris, 2016). Schools should have a definition of collaboration including the purpose of collaboration and if it is viewed as a process, its own outcome, or a combination of both. When teachers call for collaboration in the classroom they should identify if they are interested in lone student outcomes, group outcomes, or both, student and group outcomes (Plucker, Kennedy, & Dilley, 2015).

Lee, Waxman, Wu, Michko, & Lin (2013) suggested that collaboration is an important factor when learning with technology. Educators can better assess collaboration by using technology to capture group interactions and applying technology that interprets verbal communication and group decision-making automatically (Lai, DiCerbo, & Foltz, 2017). To be successful in this domain, they recommended that educators should include challenging activities, instructional conversation, joint productivity, or collaboration in teaching and learning with computers (Lee et al., 2013).

Prensky (2010) recommended partnering with students and defined partnering as the way of working together to produce and ensure student learning in the 21st century. Partnering includes the roles of the teacher as coach and guide, goal setter and questioner, learning Designer, control shifter, context provider, and rigor provider. He later added to the definition by saying that the teacher's goal of partnering is not to tell. In the partnering pedagogy, Prensky stated that it is the job of the student to use technology as the teacher coaches and models the use of technology for effective learning. For this to occur Prensky recommended teachers focus on things they already do but develop a deeper level of expertise in questioning, rigor, and feedback for students. Fullan (2013) emphasized that technology and pedagogy should revolve around the roles of both students and teachers, while Sheninger (2016) iterated that students must always be at the center of the process when using technology for learning. Determining how technology will allow students to arrive at learning outcomes during the design phase of the lesson should guide planning. Focusing on pedagogy first and technology second will ensure effective technology implementation (Sheninger, 2016).

Tamim, Bernard, Borokhovski, Abrami, and Schmid (2011) found that technology integration has the best effect when it is used to support student learning in the outcome rather than being used as a method for direct instruction. Tamim et al. (as cited in Lee et al., 2013) found that technology was best used for basic skills and factual learning, a necessary step for students to be able to use technology at a deeper level such as demonstrating their knowledge by creation of projects. The authors argued that the cognitive outcome identified, project-based learning, produced the highest effect in learning because it helped learners to see the part/whole relationship, and it inspired students to locate information, seek out facts, modify findings, and collaboratively work with their peers.

The Designer and Facilitator ISTE Standards for Educators coincided with this finding. Designer Standard 5b recommended the use of designing authentic learning activities that go beyond the walls of classrooms by including problem-solving, critical thinking, effective communication, and collaboration skills. The Facilitator Standard 6c implied that students should use project-based learning as a design process during their learning opportunities (ISTE, n.d.-a). Student cognitive outcomes can be increased by having students (a) collaborate in small or paired groups with computers, (b) develop instructional elements that are sense-making in context, and (c) and build student basic skills and help them see the interconnectedness of subject knowledge in a project-based learning (Lee et al., 2013, p. 140).

Students should also have a sense of the digital tools available to them and know which tool best fits the need for the desired outcome. Wadmany and Kliachko (2014) identified technology contributions and recommended classroom practices. Findings

included that technology increases flexibility in learning, demonstrates learning, allows for collaborative learning, differentiates and personalizes teaching and reduces learning gaps, and allows for learning to carry on beyond the school walls and time of day. The research findings also aligned to the Designer and Facilitator 2017 ISTE Standards for Educators (ISTE, n.d.-a) and 21st-century learning outcomes such as critical thinking, communication, collaboration, and creativity (P21, n.d.-b). Practices included using a learning management system to store curriculum and allow for problem-solving, introducing collaborative web tools such as Google Docs, implementing augmented reality, and writing a personal blog on which other students can provide feedback to create interaction.

Antecedents such as instructional strategies, learning conditions, and teacher routines are fundamental to instruction and are more instrumental than having or not having certain hardware such as devices in the classroom. Adding technology into the classroom does not guarantee an increase in student achievement. Using technology to supplant teachers or to make up for ineffective practices almost guarantees poorer outcomes in achievement. Teachers should heed the notion that it is not what (technology) is used, but how it (technology) is used that counts for student learning. More importantly, a review of how students and teachers benefit from using technology to develop knowledge and skills is warranted while recognizing that successful integration is aligned to changes in teacher practices, curriculum, and assessments (Mohammed, 2018; Vega, 2016).

Technology integration should be based upon student outcomes while keeping the focus of teaching to the verb. Research suggests placing an emphasis on what students

can do with their knowledge, aligning teacher pedagogies with collaborative projects that spark the interest of the students, and moving the teacher away from the role of the knowledge expert to a facilitator who partners in learning with the students as successful ways to integrate technology in the classroom. Technological frameworks such as TPACK serve as a guide for how, when, and where technology should be incorporated within the curriculum (Becker, 2000; Prensky, 2010; Silva, 2009). Standards such as ISTE denoted the intended outcomes expected when the TPACK framework is effectively implemented. Barriers, however, still exist to effectively integrate technology in the classroom.

Barriers to Technology Integration

There are many barriers to using technology in the classroom. Daniel (2012) compared integrating technology in the classrooms of today with the integration of film, radio, and television in the early 1900s. Cuban (1986) stated that the technology of the 1900s was not fully integrated for the same reasons technology has not been fully integrated into the classroom, which include the lack of time, equipment, funding, and technological training (Daniel, 2012). Staples et al. (2005) identified a technological challenge for schools was to keep hardware functioning and maintained.

Byrd-Jones (2011) reasoned that while a great amount of resources such as time, effort, and money have gone towards improving accessibility to technology in the classroom, not much has changed with regard to how the teacher actually incorporates it into their curriculum. Kalota and Hung (2012) noted that teachers are often left to their own when it comes to implementing technology in the classroom due to a lack of training and time constraints. Gorder's (2008) teacher perceptions study found that teachers are

better using technology for their own productivity and use it to help deliver content more so than using it for teaching and learning.

A South African study (Ramorola, 2014) revealed barriers that secondary teachers faced when effectively integrating technology into teaching and learning. The researcher concluded that teachers were not qualified in technology integration and that effectively integrating technology requires planning, sufficient time, dedication, and enough resources. The same study found little evidence where technology was being used for lessons engaging in collaborative and critical thinking outcomes (Ramorola, 2014). Ramorola (2014) identified several concerns: (a) the lack of a common policy for technology integration into teaching and learning; (b) a fear of using technology; (c) using “age” as an excuse to master the new technology, ultimately leading to a concern of technophobia; (d) a lack of fiscal resources for an adequate budget for maintenance of hardware; (e) a lack of teachers qualified in technology integration; (f) maintenance and technical problems; (g) risk and security problems; (h) poor parental involvement; (i) insufficient time; and (j) computer jargon.

Hsu (2016) identified other barriers including students’ lack of computer skills, teachers’ lack of training in technology, teachers’ lack of time to implement technology-integrated lessons, and teachers’ lack of technical support. Ottenbreit-Leftwich et al. (2010) listed barriers such as a lack of time and resources, school culture, teacher abilities, and teacher beliefs. Hechter and Vermette (2013) surveyed 430 K-12 teachers and found that technology-related barriers included inadequate access, time, resources, training, budget, and support.

Ertmer (2005) found that one of the largest determining factors of successful technology integration in classrooms was teacher beliefs. Teachers have varying attitudes towards the use of technology. Teachers found to have a superficial attitude towards technology do not reexamine and change their teaching practices and miss any opportunity that digital tools make available. Lewis and Sanchez (2012) noted a consensus that technology is important, however the actual use of it inside the classroom is limited. Other studies have highlighted more reasons for teachers not wanting to use technology inside the classroom. These included teachers' dispositions, computer proficiency, years of experience, and readiness (Lewis & Sanchez, 2012), and a lack of specific and ongoing training. In a mixed methods study, Burke (2014) found that not all teachers felt prepared and confident for technology integration in the classroom. It was also noted that teachers were willing to try to incorporate technology in the classroom but felt unprepared to do so.

Furthermore, another challenge is that technology is constantly changing. Williams, Fougler, and Wetzel (2009) recommended that preparation programs continue to teach about new technologies. Programs should teach teachers how to learn new technologies on their own and implement them in eloquent ways. Although there are many barriers to effective technology integration, effective leaders who understand change management can help build capacity in teachers and become successful in maneuvering any technology initiative.

Ertmer (1999) identified first- and second-order barriers to technology integration. Brickner (as cited in Ertmer, 1999) summarized first-order changes as changes that incrementally adjust current practice and do not challenge underlying beliefs. When

applied to the context of integrating technology, first-order barriers included the lack of access to computers, software, time, and support.

Ertmer (1999) described second-order barriers as changes that challenge beliefs about current practice, ultimately guiding to new goals, structures, or roles. Second-order technological barriers are personal beliefs about teaching, views about computers, teacher routines, and the unwillingness to change. Ertmer noted that first-order barriers can be removed by providing training and securing additional resources; however, confronting second-order barriers means challenging the belief systems and behaviors of the individual and institution. It is worth noting that the removal of first-order barriers does not mean all teachers will integrate technology. This is due to the teacher's second-order beliefs about integrating technology because second-order barriers are intrinsic, unique, and personal to each teacher leader.

Tsai and Chai (2012) classified design thinking, a lesser known third-order barrier to technology integration for teachers. Tsai and Chai (as cited in Hechter & Vermette, 2013) summarized design thinking as the teacher's ability to meet the instructional needs of groups of learners by creating contextual learning materials and activities. The researchers found that even when positive conditions exist for successful integration, the teacher may not be successful in integrating technology due to the third-order dynamic nature of the students and classroom (Hechter & Vermette, 2013). Tsai and Chai (2012) concluded that there will continue to be barriers when integrating technology; however, building design capacity in teachers is a critical task to successfully integrating technology in classrooms. Understanding change management and recognizing barriers such as teacher beliefs, time, fear of using technology, lack of resources, and technical

support reveal how many barriers exist and how complex integrating technology can be. Nevertheless, overcoming barriers to effective technology integration is still possible.

Barriers can be overcome by (a) having a shared vision and technology integration plan, (b) overcoming the scarcity of resources, (c) changing attitudes and beliefs, (d) conducting professional development, (e) reconsidering assessments (Hew & Brush, 2007) and (f) building design capacity in teachers (Tsai & Chai, 2012). Teachers who believe in partnering in the learning with students and implementing constructivist teaching practices tend to accept and adopt new technology and media for the purpose of teaching and learning (Wadmany & Kliachko, 2014). Ertmer et al. (2012) found that teachers whose attitudes and beliefs support technology integration, and who had the knowledge and skills to carry out their beliefs, were more likely to experience success regardless of the barriers they faced.

While technology is not at the forefront of teacher preparations programs, technology is completely changing education (Stobaugh & Tassell, 2011). Preparing teachers to incorporate technology has been a challenge for preservice programs and still acts as a barrier today. As referenced in the report from the U.S. Congress Office of Technology Assessment (1995), many students who graduated from preservice preparation programs did so with limited knowledge about effectively using technology in the classroom. The report found that most of the teachers felt inadequately prepared to use a computer in their classroom, and teachers who used technology did so in “drill and practice” activities and provided tutorials for the students. The report also stated that teachers must know how to engage technology in their classroom and not focus primarily on learning the technologies.

A survey based on perceptions of computer skills revealed that preservice teachers perceived their own computer skills as less than average in 14 areas (Fleming et al., 2007). Even though 96% of those surveyed owned a computer, they still felt inadequately prepared to incorporate technology (Fleming et al., 2007). Koch (2009) noted preservice teachers were not ready for technology integration in the classroom due to several factors including limited exposure of university teachers modeling the use of technology.

Albee (as cited in Webb & Jurica, 2013) found that preparing teachers is difficult due to specific technology skills are yet to be identified and there is a lack of modeling of the effective use of technology by the instructors. Preservice teachers lack sufficient pedagogical skills and have had few, if any, opportunities to apply their knowledge of technology integration in the classroom (Liu, Tsai, & Huang, 2015). Preservice teachers typically receive one or two technology classes in the overall preparation curriculum (Webb & Jurica, 2013). There is not enough preparation—and time—to connect authentic learning experiences for teachers by only having a couple of classes. For example, Matherson, Wilson, and Wright (2014) found a gap between the emphasis of TPACK and its actual implementation in the classroom. The authors believed the gap might exist due to what preservice teachers were taught in their coursework and what they were expected to know and do (as in-service educators) in a real classroom environment.

As TPACK demonstrated what teachers needed to know about technology integration, the ISTE Standards for Educators demonstrated what effective teachers do with technology integration. Both frameworks assist teachers in various ways; for

example, when creating curriculum and preparing new teachers the TPACK framework provides guidance as they strive to learn the content knowledge, pedagogical knowledge, and technological knowledge and skills needed for their new careers (DeSantis, 2016). The ISTE standards provide the expectations to strive for in effectively integrating technology. TPACK and ISTE standards provide opportunities to support the work of teachers to effectively integrate technology and overcome potential barriers.

Summary

Technology has incrementally crept into classrooms throughout the history of education beginning with lessons printed on wooden paddles to each student having access to a mobile device through building and district 1:1 initiatives (Maylahn, 2018; Purdue University, n.d.; Sharp, 2016). As technology advanced in the workplace and reshaped the economy, schools began to rethink how teachers taught with technology and focused on preparing students to be successful in the 21st-century economy. The 2017 ISTE Standards for Educators and the TPACK framework assisted with the transition towards a student-centered environment as teachers began to focus on effective technology integration in the classroom and consequently helped with the overcoming of barriers to successful technology integration.

Chapter Two summarized history of technology and education; identified the impact of technology on the economy, classroom, and workforce; summarized 21st-century learning; introduced the 2017 ISTE Standards for Educators and the TPACK framework; outlined effective classroom technology integration; and identified barriers to successful technology integration. Chapter Three will outline the selection process used to identify the administrators and teachers in Missouri who participated in this study and

will present the data for the areas of concern (in this study). Chapter Four will present the findings of the study and Chapter Five will summarize the findings of the research and present the implications of the study.

CHAPTER THREE

METHODOLOGY

Introduction

There was a lack of research regarding the effective implementation of the Technological Pedagogical and Content Knowledge (TPACK) framework and the perceived outcomes of effective technology facilitation and design at the classroom level as defined by the 2017 ISTE Standards for Educators in the state of Missouri. The purpose of this survey research, quantitative study was to identify perceptions, determine differences in perceptions, and identify how effective the implementation of a framework such as the Technological Pedagogical and Content Knowledge (TPACK) connects to classroom technology integration of design and facilitation as defined by selected 2017 International Society for Technology in Education (ISTE) Standards for Educators.

The researcher selected quantitative survey research as it “determines and reports the way things are; it involves collecting numerical data to test hypotheses to answer questions about the current status of the subject of the study” (Gay et al., 2009, p. 9). The TPACK framework and selected 2017 ISTE Standards for Educators were foundational elements to this study. The researcher obtained permission to use a TPACK self-assessment survey created by Schmidt et al. (2009; See Appendices B and C) and an Adopting the ISTE Standards survey (See Appendices D and E) in order to collect data for this study. Five hundred eighteen Missouri school districts were included in this study.

Research Questions

The researcher examined data yielded from surveyed building administrators and teachers on content, pedagogical, and technological development of teachers, and selected 2017 ISTE Standards for Educators. This study was designed to investigate the following research questions:

1. What is the difference in perceptions of the implementation of the TPACK framework between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?
2. What is the difference in perceptions of the implementation of the 2017 ISTE Designer and Facilitator Standards between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?

This study was designed to investigate the following hypotheses:

H₀1. There is no statistically significant difference in building administrators' and teachers' perceptions of TPACK.

H₀2. There is no statistically significant difference in building administrators' and teachers' perceptions of the selected ISTE Standards.

Participants

The individual participants in this study were building administrators and teachers in the state of Missouri. The researcher determined participants of the study to be all public school districts across the state of Missouri using the Missouri Department of Elementary and Secondary Education's database, Missouri Comprehensive Data System (MCDS). The researcher generated the *School District List* report and obtained principal

contact information using the “School Building List” report as of October 2018. The districts across the state varied in size, socioeconomic status, and assessed valuation.

Participants were informed that data would be collected, personal identifiable information would be kept confidential, and the results of the study would be published at the end of the study. The following steps were taken so any identifiable information remained confidential: responses were logged on separate data sheets and all responses were properly disposed of at the completion of the study. Building-level principals were e-mailed an invitation letter to participate in the data collection (See Appendix F). Building administrators were asked to select and forward the survey to one teacher (See Appendix G) in the building who demonstrated the effective use of technology in the classroom as determined by classroom observations of teachers who infused technology for the purpose of deeper learning in at least two of the following six descriptors: the use of technology that allows for students to

- (a) communicate inside and outside of their school;
- (b) work collaboratively inside and outside of their school;
- (c) use appropriate software for collaboration such as Skype, Google Hangout, e-mail;
- (d) use technology to bring value to student work that could not be accomplished without technology;
- (e) use technology as a means whose use did not overshadow or take away from learning;
- and (f) use technology in an appropriate and empowering way. (McLeod & Graber, 2019, pp. 16-18)

Building administrators and teachers were presented with a description of the survey and were provided an opportunity to decline participating, as well as an option to opt out of the research at any time. Participation was voluntary, and participants

consented to the study by completing the survey instrument. All responses were collected and hosted through QuestionPro. Data gathered from the study were purged and deleted from the QuestionPro server upon completion of the research. There was little to no risk to participants in the research. Information regarding the purpose of the study, voluntary participation, anonymity, and confidentiality was provided in the e-mail invitation to participate. The “School Building List” report was used to e-mail a survey invitation using QuestionPro to each building administrator who was (a) asked to select and forward the survey to a teacher who demonstrated the effective use of technology, (b) complete the survey as an observational assessment about their selected teacher, and (c) allow for the nominated teacher to complete the survey focusing on their own perceptions around the TPACK domains and selected 2017 ISTE Standards for Educators.

Research Setting

Participants in this study were teachers and building administrators from all public Pk-12 school districts varying in assessed valuation, free and reduced status, enrollment, and location in the state of Missouri and were located by using the Missouri Comprehensive Data System (MCDS) portal at the Department of Elementary and Secondary Education’s (DESE) Web site. Demographic questions for participants included institution name, primary job role, grade level, years in education, and area of specialization, which were included to further analyze the data.

Research Design

The researcher used an online quantitative survey, Comparing Administrator and Teacher Perceptions of Technology Integration Using the TPACK Framework and 2017 ISTE Standards for Educators, to identify differences in perceptions of building

administrators and teachers regarding the TPACK domains and selected 2017 ISTE Standards for Educators and looked for relationships of the TPACK domains and selected 2017 ISTE Standards for Educators.

A quantitative design was used for this research utilizing both descriptive and inferential statistics. Following the protection of human participant's guidelines of Southwest Baptist University, a request for review was submitted to the Research Review Board for approval to give the survey to approximately 2,254 building administrators for this study. There was minimal to no risk to participants in this study. Building-level administrators were e-mailed an invitation letter to participate in the data collection.

Building administrators were asked to select and forward the survey to a teacher who they believed demonstrated the effective use of technology in the classroom. This was evident by the teacher who used technology that allowed for students to

(a) communicate inside and outside of their school; (b) work collaboratively inside and outside of their school; (c) use appropriate software for collaboration such as Skype, Google Hangout, e-mail; (d) use technology to bring value to student work that could not be accomplished without technology; (e) use technology as a means whose use did not overshadow or take away from learning; and (f) use technology in an appropriate and empowering way. (McLeod & Graber, 2019, pp. 16-18)

The building administrator completed the survey as an observational assessment about their selected teacher and allowed the nominated teacher to complete the survey focusing on their own perceptions around the TPACK domains and selected 2017 ISTE Standards for Educators. The e-mail included instructions for completing the survey and

a link to the survey instrument. Building administrators and teachers were given the opportunity to accept or decline participation by clicking the embedded link in the e-mail. Upon the researcher's receipt of approval in December of 2018, participant recruitment and data collection began.

After selection, the survey instrument was completed by both the teacher (See Appendix H) and building administrator (See Appendix I). Building administrators responded with their perception of the nominated teacher's TPACK domains and ISTE implementation. Teachers responded with their own self-assessment of TPACK domains and ISTE implementation using a 5-point Likert scale with criterion ranging from *strongly disagree* to *strongly agree*. The researcher chose to use QuestionPro software to create the online survey. The survey questions were taken, with permission, from a combination of Schmidt et al. (2009), who created the Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers and ISTE's Adopting the Standards.

The survey was distributed on January 7, 2019, by contacting building administrators and requesting invitation e-mails to be delivered to selected teachers. One week later, the researcher contacted the building administrators via e-mail to request a reminder e-mail be forwarded. Finally, 2 weeks later, January 21, 2019, the window for survey participation was closed and no further responses were collected. The researcher used QuestionPro to store the data.

Sampling Selection

A purposive sample consisting of building administrators and teachers located in the state of Missouri was used to find the survey population. Gay et al. (2009) defined

purposive sampling as “the process of selecting a sample that is believed to be representative of a given population” (p. 134). Using the “*School Building List*” report, located on the Missouri Department of Elementary and Secondary Education’s Missouri Comprehensive Data System portal, (MCDS), a list of school districts including building administrators in Missouri was generated. This consisted of 2,254 building administrators from Pk-12 public schools. If all building administrators participated in the study with a selected teacher, an additional 2,254 teachers would be included in the population, providing a potential population of 4,508 participants. Patten (2017) recommended a sample size of 354 (n) for a population (N) of 4,500 as a measure to increase precision.

After the initial distribution of the survey, 138 participants were bounced back as their e-mail addresses were undeliverable or the school district required consent and the participants were excluded from the study. Of the 2,116 building administrators who were e-mailed the survey request, 205 building administrators viewed the survey, 115 started the survey and 67 administrators completed the survey while 47 dropped out for a building administrator completion rate of 58.26%. Building administrators were requested to forward the survey to their nominated teacher and used McLeod and Graber’s (2019) technology infusion shift for the purposive nomination criteria. Of the 205 building administrators who viewed the survey, 87 teachers started the survey, 61 teachers completed the survey, while 26 dropped out for a teacher completion rate of 70.11%. The final participation survey response rate was 3%. This was calculated by combining the 61 teacher and 67 building administrator responses and dividing the population (N) of 4,232, which included a building administrator and nominated teacher for each of the public Pk-12 school districts in the state of Missouri.

Instrumentation

The researcher administered a survey instrument to identify content, pedagogical and technological domains utilized by teachers and the Designer and Facilitator 2017 ISTE Standards for Educators. The researcher requested and gained permission to use the work of Schmidt et al. (2009), who created the Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers survey instrument for the TPACK portion of the questionnaire. The validated instrument, written in coordination with the original TPACK authors, Mishra and Koehler (2006), allowed for TPACK domain research to continue as the original survey instrument was developed for preservice teachers preparing to become Pk-6 or Pk-3 teachers.

Schmidt et al. (2009) recommended expanding the research to secondary teachers as this would increase the value of this instrument. The instrument was unique in that it measured self-assessment of TPACK development as opposed to attitudes or use and integration of technology, as prior research has been completed for these constructs. Schmidt et al. determined reliability statistics to find problematic items in each of the seven subscales. Questionable items that reduced the reliability coefficient in subscales were removed. After removing problematic items, the researchers ran an additional factor analysis on the remaining items in each subscale.

Internal consistency reliability (coefficient alpha) ranged from .75 to .92 for the seven subscales. The internal consistency of TK was .82; CK domain consisting of mathematics, .85; social studies, .84; science, .82; literacy, .75; PK, .84; PCK, .85; TCK, .80; TPK, .86; and TPACK, .92. Schmidt et al. (2009) assessed each TPACK section

using Cronbach's alpha reliability technique for internal consistency. Schmidt et al. further investigated construct validity for each knowledge domain using principal components factor analysis with varimax rotation within each knowledge domain and Kaiser normalization. Construct validity was investigated using principal components factor analysis with varimax rotation within each knowledge domain and Kaiser normalization. A factor analysis was then completed on the items within each subscale.

The researcher selected the Designer and Facilitator 2017 ISTE Standards for Educators as an additional section in the survey instrument. Questions for the ISTE Designer and Facilitator items were created for this study as there was not an existing survey available combining both, TPACK and the selected 2017 ISTE Standards for Educators. The ISTE Designer and Facilitator standards and corresponding subindicators were tested for reliability and validity through a pilot survey. A pilot group of approximately 100 participants who shared similar characteristics of the desired survey group was used to validate and examine each of the ISTE survey items. After completion of the ISTE pilot, survey questions were reviewed for construct validity using the principal component analysis (PCA). The PCA revealed a single strong construct. The instrument reliability conducted on SPSS resulted in a Cronbach's alpha of .920 for the seven ISTE items. The pilot survey was delivered on December 12, 2018 and concluded December 14, 2018. Questions were evaluated prior to delivery to participants as the construct of questions were written that would measure one topic and were not double barreled.

Building administrators responded with their perception of the nominated teacher's level of utilization of the TPACK domains and selected ISTE Standards.

Teachers responded with their own self-assessment of their current practice of effective implementation of the TPACK domains and Designer and Facilitator ISTE Standards using a 5-point Likert scale with criterion ranging from *strongly disagree* to *strongly agree*. Questions pertaining to the selected 2017 ISTE Standards for Educators originated from ISTE's Adopting the Standards online survey and were used in this research with permission by ISTE (See Appendix E).

Participants took approximately 15 minutes to complete the two sections of the survey: TPACK framework and the selected 2017 ISTE Standards for Educators. The first section of the survey instrument consisted of TPACK domains and contained 47 items for measuring teacher self-assessment of the seven TPACK domains—7 TK items, 12 CK items, 7 PK items, 4 PCK items, 4 TCK items, 5 TPK items, and 8 TPACK items—answering each question on the following 5-point Likert scale:

1. *Strongly disagree*
2. *Disagree*
3. *Neither agree nor disagree*
4. *Agree*
5. *Strongly agree*

The second section of the survey instrument consisted of the selected 2017 ISTE Standards for Educators and contained nine items. Building administrators were asked to respond with their perception of the nominated teacher's ISTE implementation of the Designer and Facilitator standards. Nominated teachers were asked to respond with their own self-assessment of ISTE implementation of the Designer and Facilitator standards, consisting of selected standards and indicators: two Designer items, four Facilitator

items, and two ISTE adoption items. The Designer and Facilitator standards were selected by the researcher as they aligned closely to 21st-century classroom outcomes and TPACK domains.

Data Analysis

Data were collected via e-mail using QuestionPro software and then transferred to Statistical Package for the Social Sciences (SPSS) software for statistical analysis. Demographic data were evaluated to illustrate the characteristics of the participants in this study. Descriptive and inferential statistics were used to analyze the items in the survey. Each section of the survey corresponded to both research questions. The independent variables in this study were the building administrators and teachers. The TPACK framework and the Designer and Facilitator ISTE Standards for Educators were the dependent variables. Further data analysis utilized the inferential statistic *t* test on each item at the $p < 0.05$ level. Before delivery of the *t* test, the researcher verified the data could be analyzed using an independent *t* test by (a) measuring the dependent variable on a continuous scale; (b) verifying the independent variable consisting of two categorical, independent groups; (c) ensuring different participants were in only one group; (d) observing for no significant outliers; (e) observing the distribution of the dependent variable for each group of the independent variable; and (f) analyzing the homogeneity of variances (Laerd Statistics, n.d.).

Research Questions 1 and 2

Survey responses from building administrators and teachers regarding their perceptions of the use of the TPACK domains and the Designer and Facilitator ISTE standards were tested with an independent-samples *t* test. The two-tailed *t* test was

selected as it determined “whether two groups of scores are significantly different at a selected probability level” (Gay et al., 2009, p. 335). The researcher first studied the differences in perceptions of building administrators and teachers on TPACK and separately studied the perceptions of the ISTE Designer and Facilitator standards. The researcher conducted the appropriate post hoc tests to determine the “effect size.” The null hypothesis was tested at the $p < 0.05$ level.

This study was designed to investigate the following research questions:

1. What is the difference in perceptions of the implementation of the TPACK framework between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?
2. What is the difference in perceptions of the implementation of the 2017 ISTE Designer and Facilitator Standards between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?

This study was designed to investigate the following hypotheses:

H₀₁. There is no statistically significant difference in building administrators’ and teachers’ perceptions of TPACK.

H₀₂. There is no statistically significant difference in building administrators’ and teachers’ perceptions of the selected ISTE Standards.

Summary

This chapter outlined the process and methodology for this study. A survey was developed and sent to building administrators and teachers in order to identify TPACK domains and selected 2017 ISTE Standards for Educators readiness. The data garnered by

the instrument provided pertinent TPACK and ISTE self-assessment information and perceptions of integrating technology in the classroom by building administrators and teachers.

Chapter One identified the demand for change in the way we are teaching today's students and overviewed how we must leverage technology with pedagogy. Chapter Two summarized the history of technology and education; identified the impact of technology on the economy, classroom, and workforce; summarized 21st-century learning; introduced the ISTE Standards for Educators and the TPACK; outlined effective classroom technology integration; and identified barriers to successful technology integration. Chapter Four will present the findings of the study and Chapter Five will summarize the findings of the research and present the implications of the study.

CHAPTER FOUR

DATA ANALYSIS

Introduction

There was a lack of research regarding the effective implementation of the TPACK framework and the perceived outcomes of effective technology facilitation and design at the classroom level as defined by the 2017 ISTE Standards for Educators in the state of Missouri. The purpose of this survey research, quantitative study was to identify perceptions, determine differences in perceptions, and identify how effective the implementation of a framework such as TPACK connects to classroom technology integration of design and facilitation as defined by selected 2017 ISTE Standards for Educators. This chapter presents the findings from this survey research, quantitative study.

In Chapter Three, the researcher presented the methodology of the study and described the participants, research setting, research design, sampling selection, instrumentation, and data analysis. Descriptive and inferential statistics were used to analyze the items in the survey and were presented in this chapter to address the questions and hypotheses of this study. Descriptive statistics were used to present the data while inferential statistics were used to infer what the data revealed about the participants' perceptions of the TPACK framework and ISTE readiness. Data are presented in this chapter to identify if a difference existed between building administrators' and teachers' perceptions of the implementation of the TPACK framework and the difference in perceptions of the implementation of the 2017 ISTE Designer and Facilitator Standards between building administrators and teachers.

Quantitative data analysis was used to investigate answers to the research questions and corresponding null hypotheses based upon the surveys distributed by the researcher. To gain additional insight to the study, building administrators and teachers answered qualitative questions that further expanded the relevance of the study. The researcher used a TPACK self-assessment survey, with permission, created by Schmidt et al. (2009) and included piloted questions aligned to the Designer and Facilitator 2017 ISTE Standards for Educators. With permission, questions from the Adopting the ISTE Standards survey were also used for this study. The goal of the researcher was to expand the body of research regarding the effective implementation of the TPACK framework and the perceived outcomes of effective technology facilitation and design at the classroom level as defined by the 2017 ISTE Standards for Educators in the state of Missouri.

Research Questions

The analysis of data revolved around two research questions for the study:

RQ1. What is the difference in perceptions of the implementation of the TPACK framework between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?

RQ2. What is the difference in perceptions of the implementation of the 2017 ISTE Designer and Facilitator Standards between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?

Null Hypotheses

This study was designed to investigate the following null hypotheses:

H₀1. There is no statistically significant difference in building administrators' and teachers' perceptions of TPACK.

H₀2. There is no statistically significant difference in building administrators' and teachers' perceptions of the selected ISTE Standards.

Demographics

The researcher determined participants of the study to be building administrators and teachers from public school districts across the state of Missouri. The researcher used the Missouri Department of Elementary and Secondary Education's database, Missouri Comprehensive Data System (MCDS), to generate the *School District List* report and obtained building principal contact information using the October 2018 list. The districts across the state varied in size, socioeconomic status, and assessed valuation.

The participants were Pk-12 building administrators and teachers in public school districts across the state of Missouri. The majority of responding administrators, 21, represented districts with student enrollment sizes of 1,001-3,000 students and 20 teachers represented districts with a student enrollment of 0-1,000. Forty school districts with an enrollment of 0-1,000 were represented and 50 administrators and teachers reported having at least 11-20 years of experience in education.

Demographic questions were asked to both groups of participants. Questions pertaining to adoption and use of the ISTE Standards, access and utilization to educational technology, district enrollment, importance of a technological framework such as TPACK, grade level(s) represented, years in education, and area of specialization were identified. Findings of these questions assisted in the identification of a context for

technology access and use in the classroom as well as the level of implementation of the 2017 ISTE Designer and Facilitator Standards across the state of Missouri.

The building administrators responded at 98.51% that they had access to educational technology at school and teachers responded with 98.33% for the same survey item. Also noted in the responses was that 98% of administrators and teachers reported that desktops, laptops, Chromebooks, and iPads were hardware tool types used at their building or district.

Deeper analysis of demographic questions revealed that 90% of administrators and teachers used a learning management system (LMS). This data revealed that 52% of responses indicated that neither the 2017 nor 2008 version of the ISTE Standards for Educators were being used in their school building/district. For districts that had adopted or had considered adopting the standards, 29% responded stating the standards would be used as part of curriculum or professional development expectations. A summary of both groups of participants is presented below.

Participants

Building administrators. Of the 67 building administrators who responded, 24 were in buildings that had adopted or would adopt the 2017 ISTE Standards for Educators, 10 had adopted the 2008 ISTE Standards for Educators, and 32 had not adopted any ISTE Standards for Educators. Seventeen administrators used the ISTE Standards for curriculum or professional development, 17 administrators used the ISTE Standards for instructional planning; 23 used them for technology improvement planning, and 13 noted “other” uses that included five qualitative comments. A theme of not implementing the standards in any current school plan emerged from the comments as

responding administrators reported they did not use the standards. Technological framework responses varied and were disparate. A combination of 50 open responses from administrators and teachers was received regarding the importance of having a district-determined instructional technology framework, such as TPACK. The question garnered results that 60% of administrators and teachers found a framework, such as TPACK, to be of value and important as it could promote learning and deeper understandings. Responses also indicated the use of a building plan for the use of technology as there was not a district level provided plan and there was an acknowledgement that a framework would help the hit-or-miss lesson design. Participants also recognized a framework such as TPACK could assist in professional learning but stated that it currently was not a district priority. Finally, responses concluded that a framework such as TPACK was not as important as state standards, or important in general, and one participant had never heard of TPACK before this survey. This demographic information indicated administrators in the study were from various levels and sizes of schools and districts, had a variety of years of experience, and were more specialized in the area of English and language arts and “other” areas.

Building administrators reported that 98.51% had access to educational technology at school. Hardware use reported by building administrators included desktops, laptops, Chromebooks or iPads; interactive panels, such as Mimio, SMART, or Promethean; and projectors. Software use included efficiency software such as e-mail, Google Suite (G Suite), and Microsoft Office. Google Sites was the highest used portfolio platform as responded by 60.42% of administrators. Administrators reported that 43.28% of buildings were using an LMS other than Canvas or Blackboard.

Teachers. Teacher responses echoed their building administrator’s sentiments towards the ISTE Standards and TPACK framework. Of the 61 teachers responding, 21 were in buildings that had adopted or would adopt the 2017 ISTE Standards for Educators, three had adopted the 2008 ISTE Standards for Educators, and 34 had not adopted any ISTE Standards for Educators. Twenty teachers used the ISTE Standards for curriculum or professional development, 16 teachers used the ISTE Standards for instructional planning, 11 used them for technology improvement planning, and 12 indicated “other” uses and included five qualitative comments. A theme of not implementing the standards in any current school plan emerged from those comments. Technological framework responses from teachers varied as well. Responses ranged from no framework being used to a framework such as TPACK being somewhat important to very important, and some saw the importance, however, it was not being used at their district. Teachers also identified that a framework such as TPACK could assist with professional development and instructional planning.

Teacher demographic information indicated teachers in the study were from various levels and sizes of schools and districts, had a variety of years of experience, and were more specialized in the area of social studies and “other” areas. Teachers reported that 98.33% had access to educational technology at school. Hardware use reported by teachers included desktops, laptops, Chromebooks or iPads; interactive panels, such as Mimio, SMART, or Promethean; and projectors. Software use included efficiency software such as e-mail, Google Suite (G Suite), and Microsoft Office. Google Sites was the highest used portfolio platform as responded by 58.02% of teachers. Teachers

reported that 62.5% of buildings were using an LMS other than Canvas or Blackboard. These teacher categorical figures were within a range of 3% of their administrative peers.

Data Analysis

A survey was used to measure building administrator and teacher perceptions of how effective the implementation of a framework such as TPACK connects to classroom technology integration of design and facilitation as defined by selected 2017 ISTE Standards for Educators. The first scale, TPACK framework, measured building administrator and teacher perceptions regarding the implementation of the TPACK framework. A second scale identified building administrator and teacher perceptions regarding the implementation of the Designer and Facilitator 2017 ISTE Standards for Educators. The survey results were analyzed to interpret the perceptions of both groups of participants. Demographic data were evaluated to illustrate the characteristics of the participants in this study. Each section of the survey corresponded to both research questions. The independent variables in this study were the building administrators and teachers. The TPACK framework and the Designer and Facilitator ISTE Standards for Educators were the dependent variables.

Sampling Procedures

A purposive sample consisting of building administrators and teachers located in the state of Missouri was used by the researcher to find the survey population. The researcher used the *School Building List* report, located on the Missouri Department of Elementary and Secondary Education's Missouri Comprehensive Data System portal, MCDS, to generate a list of school districts including building administrators in Missouri. This consisted of 2,254 building administrators from Pk-12 public schools. The survey

was distributed on January 28, 2019, to 2,254 participants. One hundred thirty-eight participants' e-mail addresses were undeliverable, or the school district required consent and the participants were excluded from the study, reducing the population to 2,116 building administrators. After the delivery of the initial survey, four survey reminders were sent, and the survey closed on March 1, 2019.

Data Cleaning

The building administrator and teacher surveys were downloaded from the QuestionPro survey distribution web site and saved in the Microsoft Excel format. Responses were categorized into two groups, TPACK and ISTE values, and entered in a separate Excel document. Forty-seven survey item responses for 67 TPACK building administrators were individually added and entered as a combined score. Forty-seven survey item responses for 61 TPACK teacher responses were individually added and entered as a combined score. The researcher performed the same data entry method for the seven ISTE survey items; 67 ISTE building administrator survey item responses were summed and entered as a combined score. Sixty-one ISTE teacher survey item responses were summed and entered as a combined score in a separate column on the Excel sheet. The scores for both groups were then uploaded and analyzed in SPSS for statistical analysis. Forty-seven building administrator responses were dropped from the study as the survey was opened but never finished. Building administrators completed with a 59.13% completion rate with an average time of 8 minutes to complete the survey. The teacher survey yielded a 70.11% completion rate with an average time of 15 minutes to complete the survey while 26 surveys were removed and considered a dropout as the survey was opened but never finished.

The researcher indicated 67 building administrators responded to the survey for a 3% response rate, which was not as high of a return as the researcher hoped for. The samples for building administrators and teachers were reflective, however, due to the low response rate, it was not generalizable for all public Pk-12 school districts in the state of Missouri. One reason for the low response rate may have been survey fatigue as 47 building administrators and 26 teachers began the survey and never finished. Poor survey timing and a lack of incentive to complete the survey were other potential reasons for the low return. It was also assumed that the e-mail addresses of building administrators used were valid and the surveys were delivered to the participants' inboxes and not delivered to spam or junk mail. Even with the low return the researcher believed the study was useful as it increased the body of research for the effective implementation of the TPACK framework and addressed the lack of research regarding the implementation of the Designer and Facilitator 2017 ISTE Standards for Educators in Missouri classrooms. Districts of varying sizes were represented in the return. Forty school districts with an enrollment of 0-1,000, 38 districts with an enrolment of 1,001-3,000, 23 districts with an enrollment of 3,001-5,000, eight districts with an enrollment of 5,001-10,000, and 14 districts with an enrollment of 10,001+ responded to the survey.

Research Questions

The analysis of data revolved around two research questions for the study and were categorized as the TPACK framework and selected 2017 ISTE Standards for Educators:

RQ1. What is the difference in perceptions of the implementation of the TPACK framework between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?

RQ2. What is the difference in perceptions of the implementation of the 2017 ISTE Designer and Facilitator Standards between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?

Null Hypotheses

This study was designed to investigate the following null hypotheses:

H₀₁. There is no statistically significant difference in building administrators' and teachers' perceptions of TPACK.

H₀₂. There is no statistically significant difference in building administrators' and teachers' perceptions of the selected ISTE Standards.

Research Question 1

There were 67 administrator and 61 teacher participants. An independent-samples *t* test was run to determine if there was a difference in the perceptions of the implementation of the TPACK framework between building administrators and teachers. This section also compared the group statistics of building administrators and teachers using an independent-samples *t* test to determine if there was a significant difference at the $p > 0.05$ level. Tables 1-4 contain the statistics for research question 1

What is the difference in perceptions of the implementation of the TPACK framework between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?

Descriptive statistics. The researcher observed each of the TPACK domains and compared the two groups of participants. Building administrator were requested to nominate a teacher who was perceived to be effective with technology and the high mean may reflect that request. Administrator appraisal and teacher self-assessment of TPACK results are shown in Table 1.

Table 1

TPACK Domain Analysis

TPACK Domain	Administrator	Teacher
Technology Knowledge (TK)	4.58	4.35
Content Knowledge (CK)	4.11	4.19
Pedagogical Knowledge (PK)	4.61	4.58
Pedagogical Content Knowledge (PCK)	4.14	4.08
Technological Content Knowledge (TCK)	4.06	4.1
Technological Pedagogical Knowledge (TPK)	4.56	4.43
Technological Pedagogical Content Knowledge (TPACK)	4.29	4.27

Administrators rated their nominated teachers higher in 5 of 7 of the domains, TK, PK, PCK, TPK, and TPACK, while teachers self-assessed higher in CK and TCK. The administrator-to-teacher mean differences of TK, PCK, and TPK domains were found to be greater than the 0.05 value: TK, .23; PCK, .06; and TPK, .13. The largest difference in the mean was the TK domain, administrator 4.58 and teacher 4.35.

The domain analysis suggested that administrator appraisal of teacher TK was higher than the teacher mean. The PK domain contained the highest mean for both administrators and teachers, 4.61 and 4.58; the lowest mean for the administrator group was TCK at 4.06 and the teacher group was PCK at 4.08.

Table 2 presented the TPACK mean and standard deviation for the perception of TPACK implementation. Administrators completed an appraisal of their nominated

teacher for perceptions of TPACK implementation while the teacher completed a self-assessment of TPACK implementation.

Table 2

TPACK Group Statistics

Group		<i>N</i>	Mean	Std. Deviation	Std. Error Mean
TPACK Value	Administrator	67	202.40	17.37	2.12
	Teachers	61	201.66	16.60	2.13

The results for administrators were ($M = 202.40$, $SD = 17.37$) compared to teachers ($M = 201.66$, $SD = 2.13$), with no statistically significant difference, $M = 0.75$ (mean difference).

Inferential statistics. Table 3 shows that the data were assessed for normality.

The assessment of data for normality is essential for statistical tests as normal data is an assumption in a parametric test.

Table 3

TPACK Tests of Normality

Group		Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	<i>df</i>	Sig.	Statistic	<i>df</i>	Sig.
TPACK Value	Administrator	0.069	67	.200	0.976	67	0.211
	Teachers	0.099	61	.200*	0.978	61	0.339

Assumptions testing was run for the *t* test. Scores for each level of groups were normally distributed, as assessed by Shapiro-Wilk test ($p > .05$), and there was homogeneity of variances, as assessed by Levene's test for equality of variances ($p = .861$). The significance value of the Shapiro-Wilk Test was greater than 0.05 and the data were found normal.

An independent-samples *t* test was run to determine if there were statistically significant differences between the means of TPACK implementation perceptions between administrators and teachers; the results are in Table 4.

Table 4

TPACK Independent-samples Test

	<i>t</i>	<i>df</i>	Sig. (2- tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Equal variances assumed	0.25	126.00	0.80	0.75	3.01	-5.21	6.70
Equal variances not assumed	0.25	125.69	0.80	0.75	3.00	-5.20	6.69

A 95% confidence interval (CI) was used for the mean difference. The *t* test resulted with a 95% CI [5.21, 6.70], $t(126) = .248$, $p = .804$, $d = .04$ (effect size). Moreover, the effect size of $d = 0.04$ suggested low practical significance. Cohen (1988) categorized effect size as < 0.2 , very small; 0.2, small; 0.5, medium; and 0.8, large. Therefore, the researcher failed to reject the null hypothesis as there was no difference in perceptions of the implementation of the TPACK framework between building administrators and teachers.

Research Question 2

There were 67 administrator and 61 teacher participants. An independent-samples *t* test was run to determine if there were perceptions of the implementation of the 2017 ISTE Designer and Facilitator Standards between building administrators and

teachers. This section compared the group statistics of building administrators and teachers using an independent-samples *t* test to determine if there was a significant difference at the $p > 0.05$ level. Tables 5-8 contain the group statistics for research question 2:

What is the difference in perceptions of the implementation of the 2017 ISTE Designer and Facilitator Standards between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?

Inferential statistics. Table 5 identified the administrator and teacher summary score for the Designer and Facilitator Standards by calculating the means for each standard. Three survey items for the Designer standard, Items 5a-5c, and four survey items for the Facilitator Standard, 6a-6d, were averaged for the combined standard score.

Table 5

ISTE Designer and Facilitator Group Summary

	Group Summary of Standards		
	Administrator	Teacher	Difference
Designer Standard (5a-5c)	4.464	4.366	0.098
Facilitator Standard (6a-6d)	4.463	4.169	0.294
Difference	0.001	0.197	

The building administrator average score for the Designer Standard and subindicators was 4.46 while the teacher average for the standard and subindicators was 4.37. The building administrator average score for the Facilitator Standard and subindicators was 4.46 while the teacher average for the standard and subindicators was 4.17. The researcher found of interest that the teachers scored their self-assessment lower as compared to their building administrator responses in the ISTE section with a

difference of .10 and .29 between the Designer and Facilitator Standards. Table 5 showed the group comparison of the two standards.

Administrators completed an appraisal of their nominated teacher for perceptions of ISTE Designer and Facilitator Standards while the teacher completed a self-assessment of the ISTE Designer and Facilitator Standards. The mean and standard deviation for the perception of the 2017 ISTE Designer and Facilitator Standards for Educators by each group are presented in Table 6.

Table 6

ISTE Group Statistics

Group		<i>N</i>	Mean	Std. Deviation	Std. Error Mean
ISTE Value	Administrator	67	31.19	3.59	0.44
	Teachers	61	29.79	3.34	0.43

The results for administrators was ($M = 31.19$, $SD = 3.59$) compared to teachers ($M = 29.79$, $SD = 3.34$), with a statistically significant difference, $M = 1.41$ (mean difference), 95% CI [.19, 2.62], $t(126) = 2.29$, $p = .024$, $d = .40$ (effect size).

Data were assessed numerically for normality as shown in Table 7. The assessment of data for normality is essential for statistical tests as normal data is an assumption in a parametric test.

Table 7

ISTE Tests of Normality

Group		Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	<i>df</i>	Sig.	Statistic	<i>df</i>	Sig.
ISTE Value	Administrator	0.144	67	0.001	0.876	67	0.000
	Teachers	0.146	61	0.002	0.950	61	0.014

Scores for each level of groups were not normally distributed, as assessed by Shapiro-Wilk's test ($p < .05$), but the Q-Q plots show that the expected normal to observe values were nearly linear. Thus, the researcher proceeded with the t test. There was homogeneity of variances, as assessed by Levene's test for equality of variances ($p = .861$). An independent-samples t test was run to determine if there were statistically significant differences between the implementation of the 2017 ISTE Designer and Facilitator standards between building administrators and teachers, as shown in Table 8.

Table 8

ISTE Independent-samples Test

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Equal variances assumed	2.29	126.00	0.02	1.41	0.61	0.19	2.62
Equal variances not assumed	2.30	125.93	0.02	1.41	0.61	0.20	2.62

The 95% CI for the difference between building administrators and teachers had a lower bound of .19 and an upper bound of 2.62. Therefore, the researcher rejected the null hypothesis as there was a difference in perceptions of the implementation of the 2017 ISTE Designer and Facilitator standards between building administrators and teachers.

Descriptive statistics. The researcher observed each of the Designer and Facilitator standards and compared the two groups of participants. Table 9 shows both

standards and subindicators by participant group as displayed by the differences between the group means. The researcher analyzed each sub indicator for implementation.

Table 9

ISTE Designer and Facilitator Standards Summary

	Designer Standard			Facilitator Standard			
	5a	5b	5c	6a	6b	6c	6d
Administrator	4.46	4.49	4.44	4.52	4.48	4.36	4.49
Teacher	4.44	4.39	4.26	4.25	4.18	3.95	4.30
Difference	0.02	0.10	0.18	0.28	0.30	0.41	0.19

After further analysis of the seven ISTE survey items, only one sub indicator, 5a, had less than a .05 difference in mean while the remaining six items revealed at least a 10% difference between the difference in means of the group responses. Facilitator Subindicators 6b and 6c yielded a margin of at least 30% between the difference in perceptions of the administrator and teacher group responses for creating learning opportunities using a design process and computational thinking (ISTE, n.d.-a). Tables 10 and 11 unpack each standard in detail.

Each group individually assessed the ISTE Designer Standard and subindicators. The Designer standard shown in Table 10 revealed the differences between the means of the perceptions in the design of authentic, learner-driven activities and environments that recognize and accommodate learner variability (ISTE, n.d.-a).

Table 10

<i>ISTE Designer Subindicators</i>		
ISTE Designer Subindicators	Administrator	Teacher
5a: Use technology to create, adapt, and personalize learning experiences that foster independent learning and accommodate learner differences and needs.	4.46	4.44
5b: Design authentic learning activities that align with content area standards and use digital tools and resources to maximize active, deep learning.	4.49	4.39
5c: Explore and apply instructional design principles to create innovative digital learning environments that engage and support learning.	4.44	4.26

There was a .10 difference between the administrator and teacher groups when analyzing this standard. When reviewing each sub indicator, the largest difference in responses came from Subindicator 5c, with a .18 difference in the mean of the two groups. The researcher inferred the gap was due to a lack of professional development and implementation in modern instructional design principles that use technology to better support student learning, such as the use of a blended learning environment.

The ISTE Facilitator Standard and subindicators were individually assessed by each group. The Facilitator Standard assumed educators facilitate learning with technology to support student achievement of the ISTE Standards for Students (ISTE, n.d.-a). Table 11 shows how the corresponding subindicators 6b and 6c revealed a .30 and .41 difference in the means between the two groups.

Table 11

<i>ISTE Facilitator Subindicators</i>		
ISTE Facilitator Subindicators	Administrator	Teacher
6a: Foster a culture where students take ownership of their learning goals and outcomes in both independent and group settings.	4.52	4.25
6b: Manage the use of technology and student learning strategies in digital platforms, virtual environments, hands-on makerspaces or in the field.	4.48	4.18
6c: Create learning opportunities that challenge students to use a design process and computational thinking to innovate and solve problems.	4.36	3.95
6d: Model and nurture creativity and creative expression to communicate ideas, knowledge or connections.	4.49	4.30

Table 11 revealed large gaps in perceptions of the management and use of technology, student learning strategies in digital platforms, and creating learning opportunities using a design process or computational thinking for problem-solving. The gaps found in the Facilitator Standard reiterate the challenge of opening teachers' mindsets to shift from the traditional, pedagogical role of information provider to the role of knowledge facilitator. Teachers in the study were not readily seeing themselves as a facilitator of student learning. To assist with this transition, teachers must know how to create a culture where students take ownership of their own learning, have a system in place for the management of technology, increase their comfort level of teaching in different environments, use relevant and meaningful problems, and shift learning from consuming to producing (ISTE, n.d.-a). The combined ISTE Standards score, including both the Designer and Facilitator Standards, for the administrator group was 4.46 and the teacher group was 4.25. This was a difference between the means of .21 for the participant groups.

Summary

As TPACK asserted what effective technology integrators know, the ISTE Standards claimed what effective technology integrators do (DeSantis, 2016). The data from the survey reported that there was no statistically significant difference in perceptions of the implementation of the TPACK framework between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools. However, some of the specific domains were perceived as being implemented differently between principals and teachers in the study. Research Question 2 indicated a statistically significant difference found in the perceptions of the implementation of the 2017 ISTE Designer and Facilitator Standards between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools. Chapter Four presented the demographics of the participants of this quantitative study and an analysis of the data. The researcher had 67 building administrators and 61 teachers participate in the study who were selected by a purposive sampling technique.

Chapter One identified the demand for change in the way we are teaching today's students and overviewed how we must leverage technology with pedagogy. Chapter Two summarized the history of technology and education; identified the impact of technology on the economy, classroom, and workforce; summarized 21st-century learning; introduced the ISTE Standards for Educators and the TPACK framework; outlined effective classroom technology integration; and identified barriers to successful technology integration. Chapter Three outlined the selection process used to identify the administrators and teachers in Missouri who participated in this study and presented the

data for the areas of concern (in this study). Chapter Four presented the findings of the study and Chapter Five will summarize the findings of the research and present the implications of the study.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

Introduction

Chapter One identified the demand for change in the way we are teaching today's students and overviewed how we must leverage technology with pedagogy. Chapter Two summarized the history of technology and education; identified the impact of technology on the economy, classroom, and workforce; summarized 21st-century learning; introduced the ISTE Standards for Educators and the TPACK framework; outlined effective classroom technology integration; and identified barriers to successful technology integration. Chapter Three outlined the selection process used to identify the administrators and teachers in Missouri who participated in this study and presented the data for the areas of concern (in this study). Chapter Four presented the findings of the study. Chapter Five summarized the findings of the research and presented the implications current educators should consider for improving technology integration at the classroom level. It also provided recommendations for future related studies. The findings provided educators key insights gained from analyzing data captured from the survey. These data are then connected to professional implications for improving technological educational practice as it relates to the implementation of a TPACK framework and ISTE Standards. From this research, additional ideas evolved for expanding these findings through future studies.

Research Questions

The researcher used the following questions and null hypotheses to direct the study:

RQ1. What is the difference in perceptions of the implementation of the TPACK framework between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?

H₀₁. There is no statistically significant difference in building administrators' and teachers' perceptions of TPACK.

RQ2. What is the difference in perceptions of the implementation of the 2017 ISTE Designer and Facilitator Standards between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?

H₀₂. There is no statistically significant difference in building administrators' and teachers' perceptions of the selected ISTE Standards.

Summary of Findings

The purpose of this survey research, quantitative study was to identify perceptions, determine differences in perceptions, and identify how effective the implementation of a framework such as TPACK connects to classroom technology integration of design and facilitation as defined by selected 2017 ISTE Standards for Educators. The researcher wanted to address the lack of research regarding teacher and building administrator perceptions of the effective implementation of the TPACK framework and classroom design and facilitation as defined by the 2017 ISTE Standards for Educators in Missouri classrooms. The following sections present the summary of

findings for each of the research questions along with related conclusions that connect to current educational research or fill gaps in current literature.

Research Question 1 findings. Research Question 1 was, “What is the difference in perceptions of the implementation of the TPACK framework between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools?” The data revealed that TPACK results for administrators was ($M = 202.40$, $SD = 17.37$) compared to teachers ($M = 201.66$, $SD = 2.13$), with no statistically significant difference, $M = 0.75$ (mean difference), 95% CI [5.21, 6.70], $t(126) = .248$, $p = .804$, $d = .04$ (effect size). This question revealed no statistically significant difference in building administrators’ and teachers’ perceptions of TPACK, therefore, the researcher failed to reject the null hypothesis as there was no significant difference in perceptions of the implementation of the TPACK framework between building administrators and teachers.

While there was no statistically significant difference between the overall perceptions of TPACK between administrators and teachers, data revealed variation in the means of the two groups’ perceptions for some of the TPACK subdomains. The highest mean for both groups, pedagogical knowledge (PK), did not surprise the researcher. This TPACK domain contained teacher practices such as performance assessment, differentiation and personalization of teaching, instructional strategies, and classroom management techniques, which should be familiar and practiced almost daily by teachers and recognized by administrators.

Administrators reported a PK value of 4.61 value and teachers indicated 4.58. The difference in perception was further noted when comparing these results to the ISTE

Designer Standard 5a participant responses. This Designer Standard, which addressed using technology for personalizing learning experiences, was evident as a difference of less than 0.20 between the two groups' means, indicating both teachers and administrators perceived these selected teachers had a high level of pedagogical knowledge. Since building administrators identified teachers for the study that met the criteria of using technology in an empowering way, it can be inferred teachers with strong pedagogical knowledge were selected for participation. Teachers with the general skill of personalizing learning appeared to transfer these strengths to effective pedagogy skills when using technology, as was indicated in the PK results.

The difference in means of the technological content knowledge (TCK) sub domain between administrators and teachers was 0.04 and was the second lowest sub domain for the teacher group and the lowest sub domain score for administrators. This finding was somewhat contrary to participant responses to ISTE Designer Standard 5b, which indicated relatively high means of 4.49 (administrators) and 4.39 (teachers). This standard focused on authentic learning activities aligned to content areas through use of appropriate technologies were being implemented at relatively high levels.

The low TCK mean score corresponded to similar findings from Bas and Senturk's (2018) study of TPACK of in-service teachers. Teachers who excel in the TCK domain understand that there is more to master than only the content they teach; they understand how their subject matter can be modified by utilizing particular technologies (Koehler et al., 2013). The TCK findings infer there may be a need for both administrators and teachers to build their capacity for the understanding of how

technology and content impact and constrain each other in promoting high levels of student learning (Mishra & Koehler, 2006).

For teachers to be successful with integrating technology and increasing student learning, they need professional development activities that build TCK capacity (Matherson et al., 2014). Mishra (as cited in Green, 2014) recommended approaching professional development by first identifying problems of practice (which answers why teachers are learning about technology) such as engagement, motivation, and critical thinking prior to teaching the tool. The need for TCK capacity requires that teachers keep focused on the goal of deep learning regardless of whether or not technology is being utilized. This finding created the concern that technology integration may be mistakenly seen as creating authentic activities that are promoting conceptual understanding but in reality it could become a barrier to deep learning without training and support. When integrating technology in the classroom it is important for teachers to do so for the educational benefits that technology may deepen understanding of content, instead of doing so for the sake of using technology (Magana & Marzano, 2014; Mohammed, 2018; Vega, 2016). It would also be apparent that the school principal should also engage in these professional development activities in order to support and evaluate teachers effectively within the classroom setting.

The technological knowledge (TK) sub domain revealed the largest gap between the groups with a difference of 0.23 found in the sub domain. Administrators reported a 4.58 value, higher than their nominated teachers, 4.35, in this sub domain. This may be connected to how administrators see their nominated teachers using technology in the classroom during classroom observations as they believe it is being used effectively.

Administrators were asked to nominate teachers for participation that demonstrated a high level of technology integration, so these leaders already viewed their nominated teachers as being strong in this area. The TK survey items referred to knowledge about various technologies including troubleshooting, ease of learning about technology, and staying up to date with technology. These items may not have been observed by administrators who may have just assumed the teacher had these skills. This assumption may have inflated the administrator's appraisal since he or she nominated a teacher who he or she believed was already a strong user of technology. This result indicated the importance for administrators to have conversations with teachers where they ask them to self-reflect on their strengths and gaps related to using technology effectively.

TK is a critical domain as it represents teacher knowledge about the tools including how to select, use, and integrate technology into the curriculum. It is worth noting that people may have an abundance of TK, however, may not necessarily be able to apply it in the context of teaching and learning (Crompton, 2016). This finding denoted the importance of administrators using an objective evaluation of teacher technology integration practices. Administrators must observe in classrooms with a purpose of seeing application of the TK sub domain. A lack of TK and TCK, as mentioned earlier, by the teacher may impact student performance as the design of instruction might miss opportunities for deepening student learning in specific content areas.

The results from the TCK and TK components of the TPACK framework appeared to support the importance of technology integration for promoting student learning as opposed to it just being a tool for teachers' personal use (Benton-Borghini,

2013; Young et al., 2013). Teachers and administrators need to be aware that some tenets of the TPACK can highly assist educators as they are left to figure out how to effectively integrate technology with the continued expectation of many stakeholders to have technology integration inside and outside of classrooms.

Research Question 2 findings. Research Question 2 was “What is the difference in perceptions of the implementation of the 2017 ISTE Designer and Facilitator Standards between building administrators and teachers identified as having strong technology skills in Missouri Pk-12 public schools?” Data revealed that the ISTE results for administrators was ($M = 31.19$, $SD = 3.59$) compared to teachers ($M = 29.79$, $SD = 3.34$), with a statistically significant difference, $M = 1.41$ (mean difference), 95% CI [.19, 2.62], $t(126) = 2.29$, $p = .024$, $d = .40$ (effect size). Cohen (1988) categorized effect size as < 0.2 , very small; 0.2, small; 0.5, medium; and 0.8, large. Cohen stated that a “medium effect of .5 is visible to the naked eye of a careful observer” (p. 26). The near-medium effect size quantified the size of the difference between building administrator and teacher perceptions. This question did reveal a statistically significant difference in building administrators’ and teachers’ perceptions of the selected ISTE Standards in the null hypothesis, therefore, the researcher rejected the null hypothesis as there was a difference in perceptions of the implementation of the 2017 ISTE Designer and Facilitator standards between building administrators and teachers.

As the Facilitator Standard revealed a difference of .30 between the two groups, this implied a lack of confidence in a teacher’s perception of his/her own practice or knowledge in the role of the Facilitator of learning versus that of one that delivers information. A statistically significant difference was found for this research question and

allowed the researcher to infer that this difference in administrator and teacher perceptions of the Facilitator standard may be due to the nature of the subindicators of each standard. Subindicator 6b measured the ability of the teacher's support of students who were learning in a variety of face-to-face or digital environments. Subindicator 6c referred to the creation of learning opportunities for students using a design process and computational thinking for problem-solving and innovation.

A need for professional learning related to this Facilitation standard and Subindicators 6b and 6c would be a warranted finding since teachers are being asked to make a pedagogical shift from direct instruction to a facilitator of learning in the classroom. Additionally, the finding supported the need for ongoing professional learning focused on the Designer standards for administrators and teachers. The 5c standard revealed the largest gap of the three Designer subindicators between administrators and teachers. These results indicated professional learning must be provided that promotes best practices for instructional design and pedagogies that support student learning in a digital world. This professional learning would include opportunities for teachers to learn processes and structures for creating inquiry-based lessons utilizing technology. Teachers in these settings would benefit from coaching and mentoring experiences from expert teachers or administrators where they are provided feedback regarding their efforts in supporting learners with these types of lesson designs and through a facilitation approach. Administrators need to also engage in professional learning related to this type of technology-inquiry approach to the classroom so they can help improve the capacity and support their teachers' efforts in effective design and facilitation instruction.

Designing professional development around integrating technology within the context of the teacher's classroom through practice, reflection, and sharing of teaching practices will help the teacher become more successful with effective integration in the classroom. Finally, learned professional development must be practiced and integrated in classrooms moving past consuming information during professional development activities to have the greatest impact on student achievement (Matherson et al., 2014).

Demographic findings conclusion. Demographic response rates regarding the accessibility to technology indicated a majority of participants in the study did have access to technology with 98.51% of building administrators responding they did have access and teachers responded with 98.33% for the same survey item. There was a 0.26 difference in the mean of this sub indicator by administrators and teachers. This statistic indicated technology is prevalently available and it is realistic for school leaders to expect teachers to utilize it to support learning. Again, emphasizing the need to provide high-quality professional development around effective pedagogy and content to ensure the technology is promoting deep learning.

Also encouraging for the possibility of technology being an effective tool for improving learning was the response rate of 90% of administrators and teachers indicating the availability of a learning management system (LMS). It is apparent teachers have access to the LMS, but the high response led the researcher to question if administrators and teachers maximized the LMS to create innovative digital learning environments and support blended learning as defined by ISTE Designer Standard 5c.

Educators responded that 52% used neither the 2017 nor 2008 version of the ISTE Standards for Educators in their school building/district. For districts that had adopted or

considered adopting the standards, 29% responded to the demographic question that standards would be used as part of curriculum or professional development expectations.

A lack of awareness of a framework such as TPACK and standards such as the 2017 ISTE Standards for Educators may exist based upon the responses of the building administrators and teachers in this study. As identified in demographic questions, responses indicated that this was the first time some participants had been introduced to TPACK while other responses indicated no plan to use the ISTE Standards.

With such a high rate of access to technology this further justified how teachers and building administrators need to build their own capacity on how to effectively utilize it, in addition to reviewing their pedagogical practice, in order to best prepare students for the economy and workforce as this finding reinforced the gap of digital access and digital use. The data suggested there was ample opportunity to the accessibility of technology, however, the adoption and implementation of standards, a technological framework, and aligned professional learning may be lagging behind.

Professional Implications

Educational leaders can drop professional implications from this study, which are presented below.

Implication 1. Without the successful implementation of the TPACK domains, students may miss an opportunity to demonstrate their own understanding and application of learning. Data reflected a disconnect between administrator perceptions and how teachers self-assessed their level of TK. The statistical difference implied that administrators are overconfident in teacher use of technology. This false sense of security may lead to a lack of further specific training in the TK domain for teachers.

Subsequently, technology may become a hidden barrier as administrators believe technology is being used towards deeper learning at a high level but in reality teachers are lacking confidence in their own skills.

The TK and TCK responses from teachers indicate a need for (a) partnership of administrator and teacher learning focused on the theory and application of TPACK in the classroom setting, (b) improved foundational understanding of TPACK domains for administrators to effectively support and evaluate teachers, and (c) support and curricular resources for teachers to successfully incorporate TPACK practices as they design lessons where they plan, implement, and assess the effectiveness of their teaching with technology.

Implication 2. The most dramatic interpretation of statistical data came from the ISTE Facilitator Standard and corresponding Subindicators 6a-6d. The data implied this standard may be second-order change as teachers and administrators revealed a lack of knowledge and comprehension of transferring learning responsibilities from the teacher to the student (Marzano, Waters, & McNulty, 2005). Teachers must begin transitioning their technology integration practice from one where information is delivered to students to a role of a facilitator of learning. For a teacher to become a successful facilitator, he or she must partner with students in the learning process as the students begin to have a voice and choice in what and how they want to learn (Hattie, 2012). While serving as the content expert, teachers simultaneously create a culture where students are challenged and become responsible for their own learning (Marzano, 2017). Teachers use and manage technology in multiple digital platforms, use a design process to challenge

student thinking, and use creativity to communicate and demonstrate learning (ISTE, n.d.-a).

Technology can be leveraged by the teacher to assist in the Facilitator role. As teachers gain confidence in the TK, TCK, and TPK domains of TPACK, they will begin to see that technology compliments their teaching. Teachers will benefit from training in how to use strong questioning techniques for inquiry. The ISTE Standards, when used effectively, can increase the use of communication, collaboration, critical thinking, and creativity skills across classrooms and help shape the path in creating modern learning environments (ISTE, 2016). The ISTE Standards are important as they provide direction when making instructional design decisions and this information should be used by school leaders to determine a focus for professional learning.

The researcher recommended that school leaders take the following actions: (a) create a sense of urgency for the implementation of the ISTE Standards and TPACK framework in their schools and districts; (b) build capacity for improving technology integration practice with a focus on design and facilitation; (c) build capacity in teachers for second-order change as the Facilitator Standard challenges and changes the traditional role and pedagogies of the teachers; and (d) unleash the potential of digital technologies to leverage content-focused learning in a facilitated, student-driven manner that supports deeper learning of content.

Implication 3. There was an overwhelming majority of responses indicating accessibility and use of hardware technology and learning management systems. Nearly half of the respondents had not approved or adopted 2017 or 2008 ISTE Standards for Educators, which reinforced that the Standards were not identified as a priority for

Missouri classrooms. The researcher recommended to (a) align teaching and learning towards the ISTE Standards while using a framework such as TPACK for the effective implementation and monitoring of teaching with technology, and (b) inspect the depth of utilization of hardware technology and the learning management system in a blended learning environment.

Recommended Future Research

The purpose of this survey research, quantitative study was to identify perceptions, determine differences in perceptions, and identify how effective the implementation of a framework such as TPACK connects to classroom technology integration of design and facilitation as defined by selected 2017 ISTE Standards for Educators. The information generated from this research may be of value to school administrators and teachers when planning for the effective use of technology in the classroom while suggesting direction for future research and professional learning. To continue and improve the research in this area, the researcher recommends the following:

1. Replicate the study and focus on all teachers in a building versus just those nominated by their building administrator as being a strong technology user to get more of a holistic response to the research questions.
2. Replicate the study but with a qualitative focus by interviewing and observing administrators and teachers to gain a deeper perspective of the challenges of effectively developing TPACK skills and ISTE Standards implementation in the classroom.

3. Design a study that aligns and crosswalks the TPACK framework to the 2017 ISTE Standards for Educators. This study could provide evidence focused on the relationships of a TPACK sub domain and ISTE sub indicator within a given standard. For example, does a low TCK value in TPACK correlate to a low Designer 5b score in ISTE?
4. Conduct a study that would review student achievement data of schools that are effectively implementing TPACK and the ISTE Standards and compare to schools not using TPACK and the ISTE Standards to see if a difference in achievement exists.
5. Expand the research to include charter schools as a means of comparing public schools and private schools TPACK development and 2017 ISTE Standards for Educators implementation.

Summary

A goal for this study was to increase the body of research in the state of Missouri regarding the effective implementation of the TPACK framework and the perceived outcomes of effective technology facilitation and design at the classroom level as defined by the 2017 ISTE Standards for Educators in the state of Missouri. The research allowed for administrators and teachers to reflect on their current assessment and appraisal of TPACK facilitation and ISTE implementation. The researcher found no significant difference in the perceptions of the implementation of the TPACK framework between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools. The researcher did find a significant difference in the perceptions of the implementation of the 2017 ISTE Designer and Facilitator Standards

between building administrators and teachers identified as having strong technology skills in Missouri PK-12 public schools.

The findings shed light on how the TPACK framework was being facilitated in classrooms and how the ISTE Standards for Educators were being implemented to a degree in districts across the state of Missouri. Effectively implementing technology into the classroom is no small chore and countless barriers to successful integration exist (Cuban, 1986; Daniel, 2012; Ertmer, 1999; Ertmer et al., 2012; Hechter & Vermette, 2013; Hew & Brush, 2007; Hsu, 2016; Kalota & Hung, 2012; Lewis & Sanchez, 2012; Ramorola, 2014; Staples et al., 2005; Tsai & Chai, 2012; Zhao et al., 2006). However, the TPACK framework and the 2017 ISTE Standards for Educators can assist administrators and teachers as they navigate through these barriers as the standards serve as a framework and provide an opportunity for educators to reexamine teaching and learning, create contemporary learning environments, and guide in the redesign of teaching and learning in the classroom for the digital age (ISTE, n.d.-b).

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Appendix A

Informed Consent

TITLE OF STUDY

Comparing Administrator and Teacher Perceptions of Technology Integration Using the TPACK Framework and 2017 ISTE Standards for Educators.

PRINCIPAL INVESTIGATOR

Scott Shellhorn

Doctoral Student at Southwest Baptist University

██████████@sbuniv.edu

PURPOSE OF STUDY

You are being asked to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information. The purpose of this survey research, quantitative study was to identify perceptions, determine differences in perceptions, and identify how effective the implementation of a framework such as the Technological Pedagogical and Content Knowledge (TPACK) connects to classroom technology integration of design and facilitation as defined by selected 2017 International Society for Technology in Education (ISTE) Standards for Educators.

STUDY PROCEDURES

This study is a quantitative study, using an anonymous survey tool to collect responses. All survey questions will be accessed through Question Pro; the survey will be open for responses for a duration of approximately two weeks. It is estimated that it will take respondents approximately 10 minutes to complete the survey.

RISKS

There are no known risks related to this research, and all information collected will remain anonymous. You may decline to answer any or all questions and you may terminate your involvement at any time if you choose.

BENEFITS

While there is no immediate or direct benefit you for your participation in this study, the hope is that the data from this research will help identify perceptions and practices of technology integration inside the classroom. Furthermore, the research will assist the dialogue and practice between building administrators and teachers regarding the purposeful use of technology in the classroom. It is the researcher's hope that the responses generated from the study will provide contextual evidence of the current use of technology in classrooms and the alignment, or lack of alignment, to curriculum and instruction, and allow for learning conversations with accompanying professional learning to occur on this topic.

CONFIDENTIALITY

Your responses to the survey will be anonymous. Please do not include any identifying information when completing your survey. Data gathered from the study were purged and deleted from the QuestionPro server upon completion of the research.

CONTACT INFORMATION

This study was reviewed and approved by the SBU Research Review Board. If you have questions at any time about this study, you may contact the researcher whose contact information is provided on the first page, or the Research Review Board Chair, Dr. Duke Jones, at 417-328-1742, or RRB@sbuniv.edu.

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. This consent form will be included in all survey emails sent to building administrators and teachers. By continuing to the survey, itself, you are thereby consenting to participate in the research. You are free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher.

Appendix B

TPACK Survey Instrument Request

October 29, 2017

Name: Denise A. Schmidt
Institution: Iowa State University
Department: Department of Curriculum and Instruction
Address: N031B Lagomarcino Hall, Center for Technology in Learning
and Teaching
City/State/Zip: Iowa State University, Ames, IA 50011

Dear Dr. Schmidt:

I am a doctoral student from Southwest Baptist University in Bolivar, Missouri writing my dissertation titled *Comparing Administrator and Teacher Perceptions of Technology Integration Using the TPACK Framework and 2017 ISTE Standards for Educators*, under the direction of my dissertation committee chaired by Dr. Renee Waters, who can be reached at [REDACTED]@sbuniv.edu

I would like your permission to use the Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers printed in the Winter 2009-2010 edition of the *Journal of Research on Technology in Education*, 42(2), 123-149, survey/questionnaire instrument in my research study to be used with in-service teachers. I would like to use and print your survey under the following conditions:

- I will use the surveys only for my research study and will not sell or use it with any compensated or curriculum development activities.
- I will include the copyright statement on all copies of the instrument.
- I will send a copy of my completed research study to your attention upon completion of the study.

If these are acceptable terms and conditions, please indicate so by replying to me through e-mail: [REDACTED]@sbuniv.edu

Sincerely,

Scott Shellhorn
Doctoral Candidate

Appendix C

TPACK Survey Instrument Approval

Scott Shellhorn

From: Crawford, Denise A [SOE] [REDACTED]
Sent: Monday, October 30, 2017 1:45 PM
To: Scott Shellhorn
Subject: Re: Survey Instrument Request

Hi Scott,
Thank you for your interest in our TPACK survey! We give you our permission to use the survey in your study. It looks extremely interesting! Good luck!

Best,
Denise Crawford

Denise A. Schmidt-Crawford
Director and Associate Professor
Center for Technology in Learning and Teaching
School of Education
Iowa State University
0624A Lagomarcino Hall
515.294.9141
[REDACTED]

President, Society for Information Technology and Teacher Education (SITE)
Apple Distinguished Educator (2003)

Appendix D

ISTE Adopting the Standards Request

10/30/2017 Lebanon R-3 School District Mail - [REQUEST] Research of ISTE Educator Standards Adopted & Implemented for Educators in the State of M...



Scott Shellhorn <[REDACTED]>

[REQUEST] Research of ISTE Educator Standards Adopted & Implemented for Educators in the State of Missouri

Scott Shellhorn <[REDACTED]>
To: standards@iste.org

Sat, Oct 28, 2017 at 10:17 AM

I am completing my doctoral dissertation researching teacher and administrator perceptions on the use effective use of technology in classrooms. My survey instrument will include TPACK practices and the identification and implementation of the ISTE Standards for Educators (in the state of Missouri). As I build this instrument I would like permission to use/modify the "Adopting the Standards" survey questions found at: <http://www.iste.org/standards/standards/adopting-the-standards>

As the researcher I would be willing to share the findings of the research with ISTE as a means to further recognize the work and mission of ISTE. If this would be acceptable and if ISTE has any information on educators in Missouri using the ISTE Standards for Educators that could help with this study I would greatly appreciate it.

In Education,
Scott

Scott Shellhorn
Lebanon R3 Schools
Director of Technology

Appendix E

ISTE Adopting the Standards Approval

10/30/2017 Lebanon R-3 School District Mail - [REQUEST] Research of ISTE Educator Standards Adopted & Implemented for Educators in the State of M...



Scott Shellhorn <[REDACTED]>

[REQUEST] Research of ISTE Educator Standards Adopted & Implemented for Educators in the State of Missouri

Sarah Stoeckl [REDACTED]
To: Scott Shellhorn [REDACTED]

Mon, Oct 30, 2017 at 10:21 AM

Hello Scott – Yes, consider this official permission to use the ISTE Standards for Educators in your dissertation and research (with attribution) and to modify the adoption survey questions for your project. Please do share you research with ISTE when it's completed and best wishes on the dissertation process!

Sarah

--

SARAH STOECKL, PHD
Senior Project Manager, ISTE Standards

503.765.7368
iste.org



Connected learning.
Connected world.

Appendix F

Building Administrator Survey E-mail Invitation

E-mail List: Missouri Administrators and Teachers
Survey: Comparing Administrator and Teacher Perceptions of Technology Integration using the TPACK framework and 2017 ISTE Standards for Educators
From: [REDACTED]@sbuniv.edu
Subject: Technology Integration Survey
E-mail Mode: Plain Text

Hello,

I am researching principals' and teachers' perceptions of effective technology integration in the classroom and need your help in doing so by completing the attached survey. The survey contains 30 questions and should take about 10 minutes to complete. The survey is beneficial to administrators and teachers as the survey focuses on the interconnection of content, pedagogy, and technology.

Results of this survey will potentially identify types of training and professional learning that are needed for the purposeful use of technology; introduce new teaching strategies that equip teachers to purposefully teach with technology; allow for comparisons of varying school districts based upon enrollment; identify types of educational technology that is accessible and utilized; and ultimately reveal how building administrators and teachers perceive the design and facilitation of content, pedagogy, and technology in the classroom. The study may also be shared in your individual buildings, PLCs, and professional conversations as a medium for dialogue regarding why, how, and what technology should be paired with teaching.

As a building administrator, would you be willing to (a) select one teacher who you believe is effective with technology integration in your building; (b) forward the teacher survey to your selected teacher (using this invitation letter and URL link below); and (c) complete the building administrator survey about your selected teacher? Teachers who are effective with technology are determined by classroom observations and are teachers who infuse technology for the purpose of deeper learning in at least two of the following six descriptors:

The use of technology that allows for students to (a) communicate inside and outside of their school; (b) work collaboratively inside and outside of their school; (c) use appropriate software for collaboration such as Skype, Google Hangout, e-mail, etc.; (d) use technology to bring value to student work that could not be accomplished without technology; (e) use technology as a means and the use does not overshadow or take away from learning; and (f) use technology in an appropriate and empowering way (McLeod & Graber, 2019, pp. 16-18).

Your identifying information will be kept confidential. Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. By continuing to the survey, itself, you are thereby consenting to participate in the research. You are free to withdraw at any time and without giving a reason. Individuals may contact Dr. Duke Jones at 417-328-1742 or rrb@sbuniv.edu with any concerns of this study.

After completion of the study, the results will be available for examination at <http://www.sbuniv.edu> (University Libraries, Graduate Education Ed.D. Dissertations). Your input is needed and greatly appreciated! Please complete the survey as soon as you can. Contact [REDACTED]@sbuniv.edu with any questions.

PRINCIPALS

Please click on this link to complete the survey about your selected teacher:
<https://www.questionpro.com/t/AOzTOZdhzn>

TEACHERS

Please have your selected teacher complete the teacher survey at the URL below:
<https://www.questionpro.com/t/AOzTOZdhtd>

In Education,
Scott Shellhorn

Appendix G

Teacher Survey E-mail Invitation

E-mail List: Missouri Administrators and Teachers
Survey: Comparing Administrator and Teacher Perceptions of Technology Integration using the TPACK framework and 2017 ISTE Standards for Educators
From: [REDACTED]@sbuniv.edu
Subject: Technology Integration Survey
E-mail Mode: Plain Text

Good Morning,

Your building principal has selected you as someone who effectively integrates technology while teaching. Will you please complete the linked online survey regarding perceptions of technology integration of classroom teachers? The survey contains 30 questions and should take about 10 minutes to complete. The survey is beneficial to administrators and teachers as the survey focuses on the interconnection of content, pedagogy, and technology.

Results of this survey will potentially identify types of training and professional learning that are needed for the purposeful use of technology; introduce new teaching strategies that equip teachers to purposefully teach with technology; allow for comparisons of varying school districts based upon enrollment; identify types of educational technology that is accessible and utilized; and ultimately reveal how building administrators and teachers perceive the design and facilitation of content, pedagogy, and technology in the classroom. The study may also be shared in your individual buildings, PLCs, and professional conversations as a medium for dialogue regarding why, how, and what technology should be paired with teaching.

Your identifying information will be kept confidential. Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. By continuing to the survey, itself, you are thereby consenting to participate in the research. You are free to withdraw at any time and without giving a reason. Individuals may contact Dr. Duke Jones at 417-328-1742 or rrb@sbuniv.edu with any concerns of this study.

After completion of the study, the results will be available for examination at <http://www.sbuniv.edu> (University Libraries, Graduate Education Ed.D. Dissertations).

Your input is needed and greatly appreciated! Please complete the survey as soon as you can. Contact [REDACTED]@sbuniv.edu with any questions.

Please click on this link to complete the survey:

Please have your selected teacher complete the teacher survey at the URL below:
<https://www.questionpro.com/t/AOzTOZdhtd>

In Education,
Scott Shellhorn

Appendix H

Teacher Survey Instrument

Comparing Administrator and Teacher Perceptions of Technology Integration Using the TPACK Framework and 2017 ISTE Standards for Educators

The survey is divided into two parts: the TPACK framework and selected 2017 ISTE Standards for Educators. The purpose of the TPACK section is to identify practices of technology integration for learning. Survey questions are adapted with permission from the Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers, written by Schmidt, Baran, Thompson, Mishra, Koehler, & Shin. (2009).

Selected ISTE 2017 Standards for Educators and indicators will be used for the second section of the survey. The purpose of the ISTE section is to identify perceptions and beliefs regarding designing and facilitating a student-driven learning environment.

Comparing Administrator and Teacher Perceptions of Technology Integration Using the TPACK Framework and 2017 ISTE Standards for Educators		
For the purposes of this questionnaire, technology is referring to digital technology/technologies—that is, the digital tools we use such as computers, laptops, iPods, handhelds, interactive whiteboards, software programs, etc. <u>Please answer all of the questions</u> , and if you are uncertain of or neutral about your response, you may always select “neither agree nor disagree.” Teachers: please rate your level of implementation for each item below in your classroom based upon your own practice.		
Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA		
Technology Knowledge (TK) Technology knowledge refers to the knowledge about various technologies, ranging from low-tech technologies such as pencil and paper to digital technologies such as the Internet, digital video, interactive whiteboards, and software programs (Schmidt et al., 2009).		
1.	I know how to solve my own technical problems.	SD D N A SA
2.	I can learn technology easily.	SD D N A SA
3.	I keep up with important new technologies.	SD D N A SA
4.	I frequently play around with the technology.	SD D N A SA
5.	I know about a lot of different technologies.	SD D N A SA
6.	I have the technical skills I need to use technology.	SD D N A SA

7.	I have had sufficient opportunities to work with different technologies.	SD D N A SA
<p>Content Knowledge (CK) Content knowledge is the “knowledge about actual subject matter that is to be learned or taught” (Mishra & Koehler, 2006, p. 1026). Teachers must know about the content they are going to teach and how the nature of knowledge is different for various content areas (Schmidt et al., 2009). Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA</p>		
Mathematics		
8.	I have sufficient knowledge about mathematics.	SD D N A SA
9.	I can use a mathematical way of thinking.	SD D N A SA
10.	I have various ways and strategies of developing my understanding of mathematics.	SD D N A SA
Social Studies		
11.	I have sufficient knowledge about social studies.	SD D N A SA
12.	I can use a historical way of thinking.	SD D N A SA
13.	I have various ways and strategies of developing my understanding of social studies.	SD D N A SA
Science		
14.	I have sufficient knowledge about science.	SD D N A SA
15.	I can use a scientific way of thinking.	SD D N A SA
16.	I have various ways and strategies of developing my understanding of science.	SD D N A SA
Literacy		
17.	I have sufficient knowledge about literacy.	SD D N A SA
18.	I can use a literary way of thinking.	SD D N A SA
19.	I have various ways and strategies of developing my understanding of literacy.	SD D N A SA
<p>Pedagogical Knowledge (PK) Pedagogical knowledge refers to the methods and processes of teaching and includes knowledge in classroom management, assessment, lesson plan development, and student learning (Schmidt et al., 2009).</p>		

Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA		
20.	I know how to assess student performance in a classroom.	SD D N A SA
21.	I can adapt my teaching based upon what students currently understand or do not understand.	SD D N A SA
22.	I can adapt my teaching style to different learners.	SD D N A SA
23.	I can assess student learning in multiple ways.	SD D N A SA
24.	I can use a wide range of teaching approaches in a classroom setting.	SD D N A SA
25.	I am familiar with common student understandings and misconceptions.	SD D N A SA
26.	I know how to organize and maintain classroom management.	SD D N A SA
<p>Pedagogical Content Knowledge (PCK) Pedagogical content knowledge refers to the content knowledge that deals with the teaching process (Shulman, 1987). Pedagogical content knowledge is different for various content areas, as it blends both content and pedagogy with the goal being to develop better teaching practices in the content areas (Schmidt et al., 2009). Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA</p>		
27.	I can select effective teaching approaches to guide student thinking and learning in mathematics.	SD D N A SA
28.	I can select effective teaching approaches to guide student thinking and learning in literacy.	SD D N A SA
29.	I can select effective teaching approaches to guide student thinking and learning in science.	SD D N A SA
30.	I can select effective teaching approaches to guide student thinking and learning in social studies.	SD D N A SA
<p>Technological Content Knowledge (TCK) Technological content knowledge refers to the knowledge of how technology can create new representations for specific content. It suggests that teachers understand that, by using a specific technology, they can change the way learners' practice and understand concepts in a specific content area (Schmidt et al., 2009). Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA</p>		
31.	I know about technologies that I can use for understanding and doing mathematics.	SD D N A SA

32.	I know about technologies that I can use for understanding and doing literacy.	SD D N A SA
33.	I know about technologies that I can use for understanding and doing science.	SD D N A SA
34.	I know about technologies that I can use for understanding and doing social studies.	SD D N A SA
<p>Technological Pedagogical Knowledge (TPK) Technological pedagogical knowledge refers to the knowledge of how various technologies can be used in teaching, and to understanding that using technology may change the way teachers teach (Schmidt et al., 2009). Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA</p>		
35.	I can choose technologies that enhance the teaching approaches for a lesson.	SD D N A SA
36.	I can choose technologies that enhance students' learning for a lesson.	SD D N A SA
37.	My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.	SD D N A SA
38.	I am thinking critically about how to use technology in my classroom.	SD D N A SA
39.	I can adapt the use of the technologies that I am learning about to different teaching activities.	SD D N A SA
<p>Technological Pedagogical Content Knowledge (TPACK) Technological pedagogical content knowledge refers to the knowledge required by teachers for integrating technology into their teaching in any content area. Teachers have an intuitive understanding of the complex interplay between the three basic components of knowledge (CK, PK, TK) by teaching content using appropriate pedagogical methods and technologies (Schmidt et al., 2009). Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA</p>		
40.	I can teach lessons that appropriately combine mathematics, technologies, and teaching approaches.	SD D N A SA
41.	I can teach lessons that appropriately combine literacy, technologies, and teaching approaches.	SD D N A SA
42.	I can teach lessons that appropriately combine science, technologies, and teaching approaches.	SD D N A SA
43.	I can teach lessons that appropriately combine social studies, technologies, and teaching approaches.	SD D N A SA

44.	I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.	SD D N A SA
45.	I can use strategies that combine content, technologies, and teaching approaches that I learned about in my coursework in my classroom.	SD D N A SA
46.	I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my school and/ or district.	SD D N A SA
47.	I can choose technologies that enhance the content for a lesson.	SD D N A SA
<p>2017 ISTE Standards for Educators <i>Please evaluate each indicator regarding the Designer and Facilitator standards. Please record your rating for each indicator by using the scale below:</i></p> <p>Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA</p>		
<p>Designer Educators design authentic, learner-driven activities and environments that recognize and accommodate learner variability. Educators:</p>		
48.	(I can) use technology to create, adapt, and personalize learning experiences that foster independent learning and accommodate learner differences and needs.	SD D N A SA
49.	(I can) design authentic learning activities that align with content area standards and use digital tools and resources to maximize active, deep learning.	SD D N A SA
50.	(I can) explore and apply instructional design principles to create innovative digital learning environments that engage and support learning.	SD D N A SA
<p>Facilitator Educators facilitate learning with technology to support student achievement of the ISTE Standards for Students. Educators:</p>		
51.	(I can) foster a culture where students take ownership of their learning goals and outcomes in both independent and group settings.	SD D N A SA
52.	(I can) manage the use of technology and student learning strategies in digital platforms, virtual environments, hands-on makerspaces, or in the field.	SD D N A SA

53.	(I can) create learning opportunities that challenge students to use a design process and computational thinking to innovate and solve problems.	SD D N A SA
54.	(I can) model and nurture creativity and creative expression to communicate ideas, knowledge, or connections.	SD D N A SA
55.	Which set/s of <i>ISTE Standards for Educators</i> has your building/district adopted or is considering adopting? a) ISTE Standards for Educators (2017) b) ISTE Standards for Educators (2008) c) None of the above	
56.	How do you use or plan to use the <i>ISTE Standards for Educators</i> ? a) As part of curriculum or professional development expectations b) For instructional planning c) For technology improvement planning d) Other (please specify)	

57. Do you have ***access*** to educational technology at school? If yes, proceed to the next question, 58. If no, proceed to question 60.

- Yes
- No

58. If yes, check all of the educational technology “types” that apply to your school:

- **Efficiency Software such as:**
 - e-mail
 - Google Suite (G Suite)
 - Microsoft Office
 - Other
- **Portfolio Platform such as:**
 - Bulb
 - SeeSaw
 - Google Sites
 - Other
- **Learning Management System such as:**
 - Canvas
 - Blackboard
 - Schoology
 - Other
- **Hardware Tools such as:**
 - Interactive panel and/or boards such as Mimio, SMART and Promethean
 - Desktops/Laptops/Chromebooks/iPads
 - Projector
 - Other

59. What “types” of school provided educational technology do you utilize at school (check all that apply):

- **Efficiency Software such as:**
 - e-mail
 - Google Suite (G Suite)
 - Microsoft Office
 - Other
- **Portfolio Platform such as:**
 - Bulb
 - SeeSaw
 - Google Sites
 - Other
- **Learning Management System such as:**
 - Canvas
 - Blackboard
 - Schoology
 - Other
- **Hardware Tools such as:**
 - Interactive panel and/or boards such as Mimio, SMART and Promethean
 - Desktops/Laptops/Chromebooks/iPads
 - Projector
 - Other

60. School District Student Enrollment

- 0-1,000
- 1,001-3,000
- 3,001-5,000
- 5,001-10,000
- 10,001+
- Unsure

61. How important is having a district-determined instructional technology framework, such as TPACK, as teachers design and facilitate effective lessons with the incorporation of purposeful technology?

62. Institution (School District) Name

63. What is your primary job role?

- a) Teacher
- b) Building Administrator

64. What grade level(s) do you represent?

- a) PK, K, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, Other

65. Total years in education:

- a) 0-4
- b) 5-10
- c) 11-20
- d) 21+

66. Area of Specialization

- a. Art
- b. Career & Technical Education
- c. Special Education
- d. English and Language Arts
- e. Foreign Language
- f. Health
- g. History
- h. Mathematics
- i. Music
- j. Physical Education
- k. Science
- l. Social Studies
- m. Speech/Theater
- n. Other

Appendix I

Building Administrator Survey Instrument

Comparing Administrator and Teacher Perceptions of Technology Integration Using the TPACK Framework and 2017 ISTE Standards for Educators

The survey is divided into two parts; the TPACK framework and selected 2017 ISTE Standards for Educators. The purpose of the TPACK section is to identify practices of technology integration for learning. Survey questions are adapted with permission from the Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers, written by Schmidt, Baran, Thompson, Mishra, Koehler, & Shin. (2009).

Selected ISTE (2017) Standards for Educators and indicators will be used for the second section of the survey. The purpose of the ISTE section is to identify perceptions and beliefs regarding designing and facilitating a student-driven learning environment.

Comparing Administrator and Teacher Perceptions of Technology Integration Using the TPACK Framework and 2017 ISTE Standards for Educators		
<p>For the purposes of this questionnaire, technology is referring to digital technology/technologies—that is, the digital tools we use such as computers, laptops, iPods, handhelds, interactive whiteboards, software programs, etc. <u>Please answer all of the questions</u>, and if you are uncertain of or neutral about your response, you may always select “neither agree nor disagree.” Administrators: please rate your nominated teachers’ level of implementation for each item below in his or her classroom based upon your classroom observations of your nominated teacher.</p> <p>Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA</p>		
<p>Technology Knowledge (TK) Technology knowledge refers to the knowledge about various technologies, ranging from low-tech technologies such as pencil and paper to digital technologies such as the Internet, digital video, interactive whiteboards, and software programs (Schmidt et al., 2009).</p>		
1.	My nominated teacher knows how to solve his or her own technical problems.	SD D N A SA
2.	My nominated teacher can learn technology easily.	SD D N A SA
3.	My nominated teacher keeps up with important new technologies.	SD D N A SA
4.	My nominated teacher frequently plays around with technology.	SD D N A SA

5.	My nominated teacher knows about a lot of different technologies.	SD D N A SA
6.	My nominated teacher has the technical skills needed to use technology.	SD D N A SA
7.	My nominated teacher has had sufficient opportunities to work with different technologies.	SD D N A SA
<p>Content Knowledge (CK) Content knowledge is the “knowledge about actual subject matter that is to be learned or taught” (Mishra & Koehler, 2006, p. 1026). Teachers must know about the content they are going to teach and how the nature of knowledge is different for various content areas (Schmidt et al., 2009). Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA</p>		
Mathematics		
8.	My nominated teacher has sufficient knowledge about mathematics.	SD D N A SA
9.	My nominated teacher can use a mathematical way of thinking.	SD D N A SA
10.	My nominated teacher has various ways and strategies of developing his or her understanding of mathematics.	SD D N A SA
Social Studies		
11.	My nominated teacher has sufficient knowledge about social studies.	SD D N A SA
12.	My nominated teacher can use a historical way of thinking.	SD D N A SA
13.	My nominated teacher has various ways and strategies of developing his or her understanding of social studies.	SD D N A SA
Science		
14.	My nominated teacher has sufficient knowledge about science.	SD D N A SA
15.	My nominated teacher can use a scientific way of thinking.	SD D N A SA
16.	My nominated teacher has various ways and strategies of developing his or her understanding of science.	SD D N A SA

Literacy		
17.	My nominated teacher has sufficient knowledge about literacy.	SD D N A SA
18.	My nominated teacher can use a literary way of thinking.	SD D N A SA
19.	My nominated teacher has various ways and strategies of developing his or her understanding of literacy.	SD D N A SA
<p>Pedagogical Knowledge (PK) Pedagogical knowledge refers to the methods and processes of teaching and includes knowledge in classroom management, assessment, lesson plan development, and student learning (Schmidt et al., 2009). Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA</p>		
20.	My nominated teacher knows how to assess student performance in a classroom.	SD D N A SA
21.	My nominated teacher can adapt his or her teaching based upon what students currently understand or do not understand.	SD D N A SA
22.	My nominated teacher can adapt his or her teaching style to different learners.	SD D N A SA
23.	My nominated teacher can assess student learning in multiple ways.	SD D N A SA
24.	My nominated teacher can use a wide range of teaching approaches in a classroom setting.	SD D N A SA
25.	My nominated teacher is familiar with common student understandings and misconceptions.	SD D N A SA
26.	My nominated teacher knows how to organize and maintain classroom management.	SD D N A SA
<p>Pedagogical Content Knowledge (PCK) Pedagogical content knowledge refers to the content knowledge that deals with the teaching process (Shulman, 1987). Pedagogical content knowledge is different for various content areas, as it blends both content and pedagogy with the goal being to develop better teaching practices in the content areas (Schmidt et al., 2009). Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA</p>		
27.	My nominated teacher can select effective teaching approaches to guide student thinking and learning in mathematics.	SD D N A SA

28.	My nominated teacher can select effective teaching approaches to guide student thinking and learning in literacy.	SD D N A SA
29.	My nominated teacher can select effective teaching approaches to guide student thinking and learning in science.	SD D N A SA
30.	My nominated teacher can select effective teaching approaches to guide student thinking and learning in social studies.	SD D N A SA
<p>Technological Content Knowledge (TCK) Technological content knowledge refers to the knowledge of how technology can create new representations for specific content. It suggests that teachers understand that, by using a specific technology, they can change the way learners' practice and understand concepts in a specific content area (Schmidt et al., 2009). Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA</p>		
31.	My nominated teacher knows about technologies that he or she can use for understanding and doing mathematics.	SD D N A SA
32.	My nominated teacher knows about technologies that he or she can use for understanding and doing literacy.	SD D N A SA
33.	My nominated teacher knows about technologies that he or she can use for understanding and doing science.	SD D N A SA
34.	My nominated teacher knows about technologies that he or she can use for understanding and doing social studies.	SD D N A SA
<p>Technological Pedagogical Knowledge (TPK) Technological pedagogical knowledge refers to the knowledge of how various technologies can be used in teaching, and to understanding that using technology may change the way teachers teach (Schmidt et al., 2009). Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA</p>		
35.	My nominated teacher can choose technologies that enhance the teaching approaches for a lesson.	SD D N A SA
36.	My nominated teacher can choose technologies that enhance students' learning for a lesson.	SD D N A SA
37.	My nominated teachers' teacher education program has caused him or her to think more deeply about how technology could influence the teaching approaches he or she uses in their classroom.	SD D N A SA

38.	My nominated teacher thinks critically about how to use technology in his or her classroom.	SD D N A SA
39.	My nominated teacher can adapt the use of the technologies that he or she is learning about to different teaching activities.	SD D N A SA
<p>Technological Pedagogical Content Knowledge (TPACK) Technological pedagogical content knowledge refers to the knowledge required by teachers for integrating technology into their teaching in any content area. Teachers have an intuitive understanding of the complex interplay between the three basic components of knowledge (CK, PK, TK) by teaching content using appropriate pedagogical methods and technologies (Schmidt et al., 2009). Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA</p>		
40.	My nominated teacher can teach lessons that appropriately combine mathematics, technologies, and teaching approaches.	SD D N A SA
41.	My nominated teacher can teach lessons that appropriately combine literacy, technologies, and teaching approaches.	SD D N A SA
42.	My nominated teacher can teach lessons that appropriately combine science, technologies, and teaching approaches.	SD D N A SA
43.	My nominated teacher can teach lessons that appropriately combine social studies, technologies, and teaching approaches.	SD D N A SA
44.	My nominated teacher can select technologies to use in their classroom that enhance what they teach, how they teach, and what students learn.	SD D N A SA
45.	My nominated teacher can use strategies that combine content, technologies, and teaching approaches that he or she learned about in their coursework in their classroom.	SD D N A SA
46.	My nominated teacher can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my school and/or district.	SD D N A SA
47.	My nominated teacher can choose technologies that enhance the content for a lesson.	SD D N A SA
<p>2017 ISTE Standards for Educators <i>Please evaluate each indicator regarding the Designer and Facilitator standards. Please record your rating for each indicator by using the scale below:</i></p>		

Strongly Disagree=SD Disagree=D Neither Agree/Disagree=N Agree=A Strongly Agree=SA		
Designer Educators design authentic, learner-driven activities and environments that recognize and accommodate learner variability. Educators:		
48.	My nominated teacher can use technology to create, adapt, and personalize learning experiences that foster independent learning and accommodate learner differences and needs.	SD D N A SA
49.	My nominated teacher can design authentic learning activities that align with content area standards and use digital tools and resources to maximize active, deep learning.	SD D N A SA
50.	My nominated teacher can explore and apply instructional design principles to create innovative digital learning environments that engage and support learning.	SD D N A SA
Facilitator Educators facilitate learning with technology to support student achievement of the ISTE Standards for Students. Educators:		
51.	My nominated teacher can foster a culture where students take ownership of their learning goals and outcomes in both independent and group settings.	SD D N A SA
52.	My nominated teacher can manage the use of technology and student learning strategies in digital platforms, virtual environments, hands-on makerspaces, or in the field.	SD D N A SA
53.	My nominated teacher can create learning opportunities that challenge students to use a design process and computational thinking to innovate and solve problems.	SD D N A SA
54.	My nominated teacher can model and nurture creativity and creative expression to communicate ideas, knowledge, or connections.	SD D N A SA
55.	Which set/s of <i>ISTE Standards for Educators</i> has your building/district adopted or is considering adopting? a) ISTE Standards for Educators (2017) b) ISTE Standards for Educators (2008) c) None of the above	

56.	<p>How do you use or plan to use the <i>ISTE Standards for Educators</i>?</p> <ul style="list-style-type: none"> a) As part of curriculum or professional development expectations b) For instructional planning c) For technology improvement planning d) Other (please specify)
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57. Do you have access to educational technology at school? If yes, proceed to the next question, 58. If no, proceed to question 60.

- Yes
- No

58. If yes, check all of the educational technology “types” that apply to your school:

- **Efficiency Software such as:**
 - e-mail
 - Google Suite (G Suite)
 - Microsoft Office
 - Other
- **Portfolio Platform such as:**
 - Bulb
 - SeeSaw
 - Google Sites
 - Other
- **Learning Management System such as:**
 - Canvas
 - Blackboard
 - Schoology
 - Other
- **Hardware Tools such as:**
 - Interactive panel and/or boards such as Mimio, SMART and Promethean
 - Desktops/Laptops/Chromebooks/iPads
 - Projector
 - Other

59. What “types” of school provided educational technology do you utilize at school (check all that apply):

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 - Other
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 - SeeSaw
 - Google Sites
 - Other

- **Learning Management System such as:**
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- 0-1,000
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- 3,001-5,000
- 5,001-10,000
- 10,001+
- Unsure

61. How important is having a district-determined instructional technology framework, such as TPACK and/or ISTE Standards, as teachers design and facilitate effective lessons with the incorporation of purposeful technology?

62. Institution (School District) Name

63. What is your primary job role?

- a) Teacher
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64. What grade level(s) do you represent?

PK, K, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, Other

65. Total years in education:

- a) 0-4
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- c) 11-20
- d) 21+

66. Area of Specialization

- a) Art
- b) Career & Technical Education
- c) Special Education
- d) English and Language Arts
- e) Foreign Language
- f) Health
- g) History

- h) Mathematics
- i) Music
- j) Physical Education
- k) Science
- l) Social Studies
- m) Speech/Theater
- n) Other