Ohio Principals' Perceptions on Their Technology Literacy

by

Christopher J. Rateno

Submitted in Partial Fulfillment of the Requirements

for the Degree of

Doctor of Education

in the

Educational Leadership

Program

YOUNGSTOWN STATE UNIVERSITY

May, 2019

Ohio Principals' Perceptions on Their Technology Literacy

Christopher J. Rateno

I hereby release this dissertation to the public. I understand that this dissertation will be made available from the OhioLINK ETD Center and the Maag Library Circulation Desk for public access. I also authorize the University or other individuals to make copies of this thesis as needed for scholarly research.

Signature:

Christopher J. Rateno, Student Date

Approvals:

Dr. Jane Beese, Dissertation Chair Date

Dr. Charles Vergon, Committee Member Date

Dr. Lauren Cummins, Committee Member Date

Dr. Xin Liang, Committee Member Date

Dr. Sal Sanders, Dean of Graduate Studies Date

ABSTRACT

The purpose of this study was to examine the self-reported competency level of Ohio principals in each of the five 2018 ISTE Standards Education Leader domains, measured by the 2018 Principal Technology Leadership Survey. This study also sought to investigate if the differences in self-reported technology leadership competency correlated to a principal's demographic characteristics or the current level of technology implementation in the school building. This study used a quantitative, descriptive survey design to assess the perceived level of competency of each of the five domains of the ISTE Standards-EL of Ohio principals. Results from this study indicate that Ohio principals display relatively equal proficiency in all domains of the technology leadership standards. Results also showed that principal personal and school demographic factors do not significantly correlate to self-reported domain mastery. Finally, this study indicated a statistically significant correlation between the level of use of a recent technology initiative and the principal's self-reported proficiency in each of the five domains of the 2018 ISTE Standards-EL. Further research implications are also discussed.

ACKNOWLEDGEMENTS

I am extremely grateful for all of the help, support, and guidance I have received from many throughout this journey. First and foremost, I would like to thank my Dissertation Chair, Dr. Jane Beese for all of her time, effort, and encouragement throughout the dissertation process. I would also like to thank my dissertation committee, Dr. Lauren Cummins, Dr. Xin Liang, and Dr. Charles Vergon, for all of their assistance. Thank you to my parents Robert and Linda Rateno for your continued support and motivation to reach my goal. Finally, to my wife, Kate, and kids, Karianne and Robby, I am eternally grateful for all of your understanding and cheerleading throughout, by especially reminding me, “Rateno’s don’t quit” during the challenging times. I love you all very much and appreciate all you have done as I have worked to earn my degree.

“It’s not a faith in technology. It’s faith in people.” Steve Jobs

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Today's students are empowered to view their world in a multimedia experience powered by technology. They can take virtual reality field trips to ancient ruins, watch videos of real time political uprisings, design authentic simulations of complex science experiments, and more. Furthermore, students can post their artwork, essays, movies, opinions, and more for an audience of over three billion people with access to the internet to judge and provide feedback (McLeod & Shareski, 2018; Sheninger, 2014). Schools today are tasked with preparing these students to be successful in a world that is rapidly changing and digitally interconnected. The customary, tried and true methodologies of teaching students "the way we've always done it" are insufficient to meet the demands for success in the 21st century workplace (Chang, 2012).

When leveraged strategically, the integration of technology has shown to have a positive impact on student achievement, student engagement in learning, and the acquisition of 21st century skills (McLeod & Shareski, 2018; Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011). Educational technology refers to personal computers and other internet connected devices for the purpose of this study. It also includes software, digital media, social networks, email, and other communication technologies (McLeod, 2005). Effective technology use in the 21st century classroom supports high quality, individualized instruction designed to foster the essential 21st century skills of critical thinking, creativity, collaboration, and communication. In this approach, teachers utilize computer devices for more than simple internet research and word processing for impactful learning to occur (Keengwe, Schnellert, & Mills, 2012).

Students are engaged with technology to create, explore, and problem solve. Using authentic, real world scenarios, students have a voice in what concepts they master and how they demonstrate their mastery for others to provide feedback (McLeod & Shareski, 2018).

The United States Office of Educational Technology updated the National Technology Plan in 2017 to reimagine the role of technology in education. The new National Technology Plan recommends educational technology be embedded as a support to high quality instructional practices. It also calls for a vision of implementation to be utilized by leaders as well as the establishment of appropriate infrastructure (U.S. Dept. of Education: Office of Educational Technology, 2017).

The incorporation of computing technology in the K-12 classroom has a positive impact on student learning in multiple subject areas, especially when the technology is leveraged in support of high quality instruction and not as a replacement for high quality instruction (ISTE, 2016; Tamim et al., 2011; U.S. Dept. of Education: Office of Educational Technology, 2017). Classroom technology is most impactful when pedagogy is focused on creating meaningful and relevant student experiences (Sheninger, 2014).

The field of educational technology is evolving from the lessons supported by the filmstrip or video recording organized in a centralized media center to an individualized complex, data saturated, interconnected world that is constantly changing. Old educational technology was easily managed, yet this new paradigm is so vast and changing that skilled technology leadership is paramount (Kowch, 2013). This pedagogical shift to the successful integration of technology into daily instructional practices requires building leaders to recognize and lead the needed changes in instructional practices. Skilled leaders need to have a system prepared to adapt to the evolving technology field (Cabellon & Brown, 2017). The rapid expansion of technology in schools is subject to a myriad of implementation barriers, one of which can include building level leadership (Hew & Brush, 2007).

A principal's technology leadership competency has a greater impact on teaching and learning than the presence of increased computing devices alone (Anderson & Dexter, 2005; Chang, 2012). Previous research has shown that the building principal's level of technology leadership impacts the effective use and integration of technology by both teachers and students (Afshari, Bakar, Wong, Samah, & Fooi, 2008; Schrum & Levin, 2016). Literature focused on the principalship shows that building level leaders need to be systemic change agents for successful integration of educational technology.

In 2002, the International Society for Technology in Education (ISTE), formed the Collaborative for Technology Standards for School Administrators (TSSA) and released the first set of standards for public school administrators, the National Standards for Public School Administrators or 2002 NETS-A. Technology standards provide a framework of minimum expectations to establish proficiency in the implementation and efficient use of educational technology for student benefits. These standards were revised in 2009 and renamed in 2018 to the International Society for Technology in Education Standards for Education Leaders (2108 ISTLE Standards-EL) to reflect transformative leadership practices with an emphasis on systematic improvement (Burns-Metcalf, 2012; Sykora, 2009).

Statement of the Problem

The rapid pace of technological change has made discovering and implementing new technologies for student learning an imperative task of building level leaders (Larson, Miller, & Ribble, 2010). The 2018 ISTE Standards-EL provides a framework for technological leadership that is divided into five domains of technology proficiency which principals can use to facilitate an appropriate 21st century educational environment for all students. The five domains of the standards are: 1) equity and citizenship advocate, 2) visionary planner, 3) empowering leader, 4) systems designer, and 5) connected learner (ISTE, 2018). The addition of technology standards to an already full job description adds a layer of responsibility many principals feel unprepared or unqualified to implement throughout their buildings. Prior research shows that it is critical principals are proficient in these technology standards to improve global ready citizens (Larson et al., 2010).

The purpose of this study was to examine the level of mastery of the 2018 ISTE Standards-EL in Ohio building principals. The 2018 ISTE Standards-EL have divided the concept of technology leadership into domains, but research on both the mastery of the domains and the connection between leadership competencies and available student technology is lacking (Richardson, Bathon, Flora, & Lewis, 2012). This study addressed the gap in existing literature. The research problem therefore was to investigate the self-reported competency level of Ohio principals in each of the five 2018 ISTE Standards Education Leader domains: Equity and citizenship advocate, visionary planner, empowering leader, systems designer, connected learner measured by the 2018 Principal Technology Leadership Survey. This study also sought to investigate if the differences in self-reported technology leadership competency correlated to a principal's demographic characteristics or the current level of technology implementation in the school building.

Theoretical Framework

Technology, at its core, is constantly changing and upgrading at a rapid pace. Digital leaders who effectively impact technological integration in their schools must possess a growth mindset. In her work on self-theories Carol Dweck (2000) described two frameworks for understanding intelligence and achievement that impact the way people view their ability to master new challenges. The first, entity theory, arises from the belief that intelligence is a fixed trait (Dweck, 2000). Dweck's (2000) second theory, incremental theory, arises from the belief that intelligence and skills are malleable. These self-theories on mindset are important when viewed within the lens of technology integration because of the nature of technology. Those with an incremental belief of their traits are more apt to adjust to the technology and develop and grow new skills. This skill development is best fostered within a culture that encourages and nurtures change.

Establishing a culture of change is critical to the success of technology integration within any school. Michael Fullan (2013b) described the change theory as successful implementation of something new across an organization. In order to move people towards a new direction, organizational leadership must be highly motivational, collaborative amongst all stakeholders in the organization, and filled with feedback regarding the change.

An established culture of change is essential for the successful integration of technology in education. When a thorough understanding of change knowledge is combined with a pedagogy focused on individual student learning and technology integrated throughout K-12, educators will be able to provide the necessary foundations and skills required for success in the global economy (Fullan, 2013b). The advancement of technology allows for the development of these 21st century skills including effective communication, local and global collaboration, individualized critical thinking, and creativity.

It is the comprehensive understanding of both Fullan's technology integration with Dweck's self-theories that will assist a building leader in the successful and purposeful implementation of technology in the K-12 classroom. To be a successful technology leader, a principal must embrace the notion that skills and knowledge can increase incrementally with appropriate work by both teachers and students while constantly recognizing that the change process involved in this shift requires a focused vision and specific supports along the way (Dweck, 2000; Fullan, 2013)

Research Questions

The calls for action in the 2017 National Technology Plan align well with the 2009 NETS-A and 2018 ISTE Standards-EL. Thus, principal competence in the 2018 ISTE Standards-EL is critical for 21st century school success. This study investigated Ohio principals' mastery of the ISTE Standards-EL and the relationship between self-reported standards mastery, demographic variables, and availability of student technology at a school. The research questions studied were:

1. What is the self-reported competency level of Ohio principals in each of the five 2018 ISTE Standards Education Leader domains: Equity and citizenship advocate, visionary planner, empowering leader, systems designer, and

connected learner measured by the 2018 Principal Technology Leadership Survey (ISTE, 2018)?

2. Are differences in technology leadership competency correlated to demographic characteristics: gender, years in the principalship, age, has the participant earned a degree, license, certificate, or endorsement in technology or a technology-related field school level, school environment, poverty level, and school size?
3. Is there a significant relationship between the technology leadership competency of principals as defined by the ISTE Standards-EL based with the current level of technology implementation levels of use on a recent technology initiative (Hall, Dirksen, & George, 2006)?

Research Design

Procedures

The purpose of this study was to explore principals' self-assessed competencies of their technology leadership in relationship to the 2018 ISTE Education Leaders standards. These standards define the necessary technology skills for educational leaders. This study used a quantitative, descriptive survey design to assess the perceived level of competency of each of the five domains of the ISTE Standards-EL of Ohio principals. The revised Principal's Technology Leadership Survey (PTLS), modified from the original Principal's Technology Leadership Assessment with permission by the researcher, was used along with a set of demographic questions.

The UCEA Center for the Advanced Study of Technology Leadership in Education (CASTLE) developed the Principals Technology Leadership Assessment

(PTLA) based on the 2002 NETS-A standards (McLeod, 2005). The 2006 PLTA survey provides 35 statements related to the six domains of 2002 NETS-A standards with five levels of leadership involvement in each (Duncan, 2011). Permission was gained from the author of the 2006 PTLA to modify the instrument into the 2018 instrument. The 2018 PTLS is organized by 2018 ISTE Standards-EL leadership standard. Each standard has at least one statement which a participant answers that correlates to a specific indicator for that standard. Each of the statements in the PTLA is organized in an ordinal response format with choices being (1) *Not at all,* (2) *Minimally*, (3) *Somewhat*, (4) *Significantly*, and (5) *Fully* (McLeod, 2005; Trochim & Donnelly, 2008). Participants scored in each area with a response of somewhat set at a midline zero and range of +2 to -2. Individual indicator statements under the standard were averaged to find a standard score for each of the six original standards (Banoglu, 2011; McLeod, 2005)

The 2018 ISTE Standards-EL are further supported by 22 descriptive indicators. Collectively these standards and indicators describe what an accomplished technology educational leader knows and does. Given all the other demands of school principals, these standards represent the ideal, not minimum, standard (McLeod, 2005). The 2018 PLTA provides an opportunity to define the relative strengths and challenges for each of the five standards in Ohio principals.

The demographic questions asked at the end of the survey include gender, years as a principal in five year increments up to 20 years of experience, age, school grades in building, school environment, and school size as measured by average daily membership. Participants were also asked to describe the level of implementation of a recent technology initiative in their school (Hall et al., 2006). The researcher combined the

PTLA with the demographic questions into one online questionnaire so that participants were able to complete the instrument in approximately one 15-minute sitting.

The online demographic questions and PTLA survey were accessed through an embedded SurveyMonkey link contained in the invitation to participate sent to Ohio public school district building principals as identified in the Ohio Educational Directory System (OEDS). The invitation was sent to the identified OEDS email from the researcher's YSU email address and had an embedded survey tab that took participants straight to an online 2018 PTLS. The survey remained open for three weeks.

Data from the PTLA and demographic questions were organized and analyzed for descriptive purposes. General descriptive statistics were computed for each of the five domains of the 2018 PTLS as well as to provide some base information on how Ohio principals who participated in the study self-report regarding their technology leadership abilities.

The self-reported mean scores on each of the five domains of the 2018 ISTE Standards-EL were compared to the demographic and level of technology implementation identified. The data then examined using a factor analysis of variance to determine if any significant relationships existed between perceived levels of competence on the 2018 ISTE Standards-EL standards and demographic characteristics and student technology access (Salkind, 2013).

Significance of the Study

The study of principals' level of competence related to educational technology is important for several reasons. The 2018 ISTE Standards-EL provides a nationally recognized set of criteria for school administrators to meet. Effective principals have a direct impact on student achievement, and part of the 21st century building leader's responsibilities is successful technology integration.

This study adds to the body of research on technology leader preparation using the 2018 ISTE Standards-EL. To date there is a limited amount of research that seeks to define competencies of the 2018 ISTE Standards for Education Leaders. Results from this study could prove to assist school districts in planning for technology infrastructure and professional learning. The relationship between levels of use of a recent technology initiative and principal technology leadership skills will serve as evidence for distribution of resources to professional learning or infrastructure. The results from this study can also be utilized by Ohio administrator licensure programs to provide relevant coursework aimed at candidate mastery of the 2018 ISTE Standards-EL.

Assumptions and Limitations

This study was limited in the actual sample by only drawing from Ohio principals and, therefore, has the potential to not be representative of all principals. In addition, the use of a convenient sample methodology and online delivery might not produce a representative sample of all subgroups. This could present a challenge to the external validity that will be mitigated using an appropriate sample size. Results from this study may not be appropriate and representative of administrators throughout all states and other countries. This design of this study was such that other researchers could replicate it in other states, which, in turn, would strengthen the external validity of the study.

This study assumed the 2018 PTLS was as reliable as the original instrument and truly measured the competency of each of the five domains of 2018 ISTE Standards-EL. The accumulated data were limited to responses provided by survey participants on the

2018 PTLS. Survey participant answers could not be fully controlled and therefore this presented a challenge to the face validity of the PTLA and the internal validity of the study specifically in the areas of leniency error, halo effect error, and recency error (McLeod, 2005; Trochim & Donnelly, 2008).

The instructions page of the 2018 PTLS specifically described leniency error, halo effect error, and recency error to the participant along with suggestions for trying to reduce the errors in completing the instrument. Leniency error refers to a participant providing a higher rating than they truly deserve because they either feel other participants are doing the same, they have relatively low standards, or do not feel like providing a poor assessment of their skills (McLeod, 2005). In the halo effect phenomenon, participants may respond to the questionnaire in a manner of how they hope they are acting instead of in a manner that is truly representative of their practice (McLeod, 2005). Finally, recency error refers to the participant basing responses on their most recent behavior instead of the past year in total.

In addition, the assumption was made that participants believe in the positive impact technology has on student learning and work to implement educational technology in their respective schools. The researcher assumed that study participants value the incorporation of technology skills in the classroom. The researcher was also using the assumption that building level leaders have some autonomy regarding technology integration and implementation within their respective building.

Definitions and Terms

1-1 Program – A school program in which every student is provided an internet enabled device (i.e., laptop, chromebook, iPad) to use both during the school day and at home (Sauers & McLeod, 2012). This differs from traditional computer labs, mobile labs, or carts in which devices are available for student use during the school day only.

Bring your own device programs - Programs where students utilize personal mobile technology to access a school's wireless infrastructure (Sheninger, 2014).

Building level leader - For this study building level leader is used interchangeably with principal or any person who is performing the duties and authorities as expressing Ohio Revised Code 3319.02 ("Lawriter - ORC," n.d.).

Digital age learning culture - Learning environment based on educational innovation and focused on the continuous improvement of digital learning. The frequent use of technology is both promoted and modeled across the curriculum (ISTE, 2009)

Digital citizenship - The understanding of the social, ethical, and legal responsibilities and issues related to digital technology implementation (ISTE, 2009).

Educational leader - For this study educational leader is used interchangeably with principal or any person who is performing the duties and authorities as expressing Ohio Revised Code 3319.02 ("Lawriter - ORC," n.d.).

Educational technology - Personal computers and other internet connected devices. It also includes software, digital media, social networks, email, and other communication technologies (McCleod, 2005).

Excellence in professional practice - Leader who promotes an environment centered around growth and professional learning related to the study and use of technology and digital resources (ISTE, 2009)

Levels of Use/Implementation (LoU) – Eight different profiles that represent different behaviors and patterns that can be observed as users develop new skills in the incorporation of an innovation or change (Hall et al., 2006).

National Educational Technology Standards for Administrators (NETS-A) - Nationally recognized set of standards for school leaders developed by the International Society for Technology in Education. The standards provide a framework for principals to support technology implementation in schools (ISTE, 2009).

Principal - K-12 building level leader who performs duties and responsibilities as defined in Ohio Revised Code 3319.02 ("Lawriter - ORC," n.d.). For this study head principals, associate principals, vice principals, and assistant principals are categorized as principals.

Systemic improvement - principals provide digital age leadership to support continuous improvement through the implementation of digital resources and technology (ISTE, 2009).

Technology leadership - set of leadership skills which encompass planning, evaluating, and coordinating educational technology towards the improvement of teaching and learning (Juraime, n.d.).

Visionary leadership - the implementation of a shared vision for the implementation of educational technology. A visionary leader uses digital resources to support instructional practices throughout the school. A visionary leader implements a technology throughout the strategic planning process (ISTE, 2009).

Summary

Schools in the information age can no longer rely on traditional teacher-centered pedagogy to prepare students for the rapidly changing future (Chang, 2012). Today's students are as much digital content creators as they are digital content consumers (McLeod & Shareski, 2018; Sheninger, 2014). Classrooms and teaching methods need to shift to create a positive learning environment; however, many school leaders lack the necessary preparation to facilitate this change. In an effort to provide a framework of necessary competencies for school administrators, ISTE created and revised the NETS-A standards and ISTE Standards-EL to fit the systems thinking approach needed for successful integration.

This study sought to determine building level leaders' perceptions of their technology competency as related to 2018 ISTE Standards-EL. The quantitative study surveyed principals throughout Ohio. The 2018 PLTA addressed the five domains of the ISTE Standards-EL including 1) equity and citizenship advocate, 2) visionary planner, 3) empowering leader, 4) systems designer, and 5) connected learner. It further sought to show any statistical relationships between school principal demographics, and levels of implementation of a recent technology initiative with ISTE Standards-EL competency.

Results from this study are intended to inform educational decision makers on the importance of providing appropriate professional learning in the areas of technology leadership for building level leaders. Additionally, results can be used by Ohio principal licensing institutions for continued development of principal preparation and development programs. Increasing the technology leadership skillset of building level leaders will have a direct impact on student learning.

CHAPTER II

LITERATURE REVIEW

If you research the mission or vision statement of a typical school district in the United States of America, there is a good chance it charges the educational leadership to prepare students to be successful in a global economy or have a positive contribution in an interconnected world. In his book *The Global Achievement Gap*, Tony Wagner (2014) questioned, whether or not, typical district leadership is meeting their mission and calls for the restructuring of American schools in an effort to teach all students how to think critically and not simply memorize facts and events. Today's students are digital natives who have access to unlimited information in the palm of their hands in the form of a smart device. It is with these digital devices, that students need to be engaged in their learning, empowered to be creative, and direct their own learning (Sheninger, 2014). The 21st century economy is an information-based digital economy that requires students to be able to communicate and collaborate on a global scale (McLeod & Shareski, 2018; Sheninger, 2014; Wagner, 2014). Modern technology allows this communication to readily occur on a daily basis in the classroom. Using social media, video conferencing, and other technology advances, students are in contact with a global audience on a daily basis (McLeod & Shareski, 2018). It is the responsibility of the principal to lead the change in buildings so pedagogy is student focused providing students the essential skills critical for success in a global economy.

The role of the building leader is to construct a vision for the appropriate use of technology and provide needed supports and resources for all stakeholders to meet it. The new pedagogy for digital natives must shift from the teacher teaching how to operate specific technology or applications to using technology to facilitate a deeper understanding and knowledge. In the current industrialized educational system, technology is leveraged to reinforce specific concepts or the use of specific applications to deliver the approved curriculum (Wagner, 2014). This minimalist view does not take advantage of the vast opportunities that technology affords learners (McLeod & Shareski, 2018). The pedagogical shift to leveraging technology as a tool for learning facilitation, requires an educational leader who is willing to support his/her teachers throughout the change process (November, 2013; Sheninger, 2014). Effective educational technology initiatives are not device centric, but people centric, as they are the ones who create the environment for learning (Schrum & Levin, 2016).

Subsequently, a culture of change will replace traditional technology use and pedagogy with technology integrated throughout the curriculum and aligned to standards, utilizing research-based best practices to meet the mission or vision statement of schools across the country (Fullan, 2013b; November, 2013; Wagner, 2014). This shift in approach to technology in the classroom is most effective when implemented with a clear vision for technology integration and adequately supported with ongoing professional development (Machado & Chung, 2015).

Mindset Theory

Administrators who effectively impact technological integration in their schools must be open to change. An underlying assumption of this openness is a growth mindset. In her work on self-theories Carol Dweck (2000) described two frameworks for understanding intelligence and achievement that impact the way people view their ability to master new challenges. The first, entity theory, arises from the belief that intelligence is a fixed trait (Dweck, 2000). This self-theory can limit an individual's belief in their ability to change and learn new concepts as they feel they do not have the same intelligence or skills compared to others. When entity theorists experience failure, it is a direct result of not being smart enough or having the innate skills required for the task (Dweck, 2000). Relating this theory specifically to technology integration, entity theorists can feel as if their skills with technology are limited as they view themselves as digital immigrants and very different from the digital natives they teach. Technology is rapidly changing, and new devices or software require constant new learning and adjustments. Entity theorists who struggle with the integration of the new or different systems and devices feel their skills and knowledge are limited as they are "just not good with technology."

Dweck's (2000) second theory, incremental theory, arises from the belief that intelligence and skills are malleable. Incremental theorists believe that intelligence and achievement can be increased and through effort view change as a challenge and the failures that come along the way to reaching the change as setbacks which can be overcome through work and perseverance (Dweck, 2000). Incremental theorists view the integration of a technology as a journey to embrace with their students as they work though the challenges that arise along the way (Dweck, 2000). They believe they can obtain and learn new skills in areas of technology that they have not mastered or currently struggle with.

Dweck's (2000) self-theories of mindset are important when viewed with the lens of technology integration within the academic setting because technology is constantly changing and improving. Those with an incremental belief of their traits are more apt to adjust to the technology, develop, and grow new skills. This skill development is best fostered within a culture that encourages and nurtures change.

Technological Culture of Change

Establishing a culture of change is critical to the success of technology integration within any school. Michael Fullan (2013a) described the theory of change knowledge as successful implementation of something new across an organization. In order to move people towards a new direction, organizational leadership must be highly motivational, feedback rich, and collaborative in a large-scale setting. Within any process of change, the vision and subsequent plan for change must meet eight specific design criteria described in Table 2.1.

Table 2.1

The Eight Criteria of Change Knowledge

Trait	Description
Focus	Vision is focused on both teacher and student outcomes for desired change.
Innovation	Focus on innovative practices that are student centered and extend learning beyond the classroom. These practices leverage technology as a tool for task completion.
Empathy	The focus on how others feel and react to the change process as a whole.
Capacity building	The skills, knowledge, and frame of mind of stakeholders relative to the meeting the change expectation.
Contagion	Leverage of social capital and group think to achieve the desired change.

(continued)

Table 2.1

The Eight Criteria of Change Knowledge (continued)

Trait	Description
Transparency	Non-judgmental collaboration to create and assess new things.
Elimination of non-essentials	Reduce items that distract from reaching the stated vision.
Leadership	Leaders empower others and build their capacity within the established criteria.

(Fullan, 2013b, p. 66)

An established culture of change is essential for the successful integration of technology in education. Simply providing devices without changing instructional methods will not produce the desired impact on student achievement (Ertmer & Ottenbreit-Leftwich, 2010; Inan & Lowther, 2010b; Sauers & McLeod, 2012). Technology is most impactful when the instructional methodology is focused on creating meaningful and relevant student experiences (Sheninger, 2014). When a thorough understanding of change knowledge is combined with a pedagogy focused on individual student learning and technology integrated throughout K-12, educators will be able to provide the necessary foundations and skills required for success in the global economy (Fullan, 2013b). The advancement of technology allows for the development of these 21st century skills including effective communication, local and global collaboration, individualized critical thinking, and creativity. When leveraged appropriately, the addition of inexpensive internet connected devices provides students a chance to readily master 21st century skills (Fullan, 2013b). Furthermore, the implementation of technology allows educators to personalize the learning experience for students.

It is the comprehensive understanding of both Fullan's technology integration with Dweck's self-theories that will assist a building leader in the successful and purposeful implementation of technology in the K-12 classroom. To be a successful technology leader, a principal must embrace the notion that skills and knowledge can increase incrementally with appropriate work by both teachers and students while constantly recognizing that the change process involved in this shift requires a focused vision and specific supports along the way (Dweck, 2000; Fullan, 2013b)

National Technology Education Plan

As the uses and types of educational technology have evolved, so has the definition itself. From the chalkboard and ink pen to SmartBoard and personal computer, the tools available to have advanced and will continue to evolve. In 1996, the United States Department of Education published *Getting America's Students Ready for the 21st Century,* which was the first National Educational Technology Plan which served as the framework for implementing technology in American schools. This early plan focused on securing access to both hardware and networking for both teachers and students throughout the country (Boss, 2011; Murray, 2016; United States Department of Education, 1996). The National Technology plan is updated every five years by the U.S. Department of Education. More recent versions were revised to include updated technologies and the expansion of the internet, but the primary goals included student access to hardware and network capabilities along with the integration of educational technology into the classroom (Paige, Hickok, & Patrick, 2004; Riley, Holleman, & Roberts, 2000).

The 2010 revision of the national technology plan, *Transforming American Education Learning Powered by Technology*, was released at the height of the No Child Left Behind accountability movement. This revision shifts the focus of the plan to leveraging technology to making data-driven decisions, transforming the instructional practice, and utilizing technology for professional growth (Atkins, Bennett, Brown, Chopra, & Dede, 2010; Boss, 2011).

The 2016 technology plan revision and subsequent 2017 update shifted the focus of the plan from a passive content supported integrative approach to an active student-centered approach. In this approach, the teacher acts as a facilitator of knowledge leveraging technology to meet students at their level while providing opportunities for growth. It is in this revision and update where the United States Department of Education saw value in and the need for strong leaders capable of creating a vision of the educational environment described in the plan (Murray, 2016; U.S. Dept of Education: Office of Educational Technology, 2017; U.S. Dept of Education, 2016). The most recent national technology plan makes the following recommendations of best practice to create a culture within a school based on innovation and change:

1. Establish clear strategic planning connections among all state, district, university, and school levels and how they relate to and are supported by technology to improve learning.
2. Set a vision for the use of technology to enable learning such that leaders bring all stakeholder groups to the table, including students, educators, families, technology professionals, community groups, cultural institutions, and other interested parties.

3. Develop funding models and plans for sustainable technology purchases and leverage openly licensed content while paying special attention to eliminating those resources and tasks that can be made obsolete by technology.
4. Develop clear communities of practice for education leaders at all levels that act as a hub for setting vision, understanding research, and sharing practices (U.S. Dept of Education: Office of Educational Technology, 2017)

The Impact of Technology on Student Learning

Technology integration is defined as the "use of computing devices such as desktop computers, laptops, handheld computers, software or Internet in K-12 schools for instructional purposes" (Hew & Brush, 2007, p. 225). This definition is broad in its scope as it focuses more on a learning environment incorporating computing devices in instructional practices and not specific hardware or software integration (Hew & Brush, 2007). This type of learning environment can range from a more traditional lab-based setting, to a classroom where students bring their own device (Sheninger, 2014), or to 1:1 computing programs in which every student and teacher have his own computing device (Corn, Tagsold, & Argueta, 2012).

According to John King, U.S. Secretary of Education, "One of the most important aspects of technology in education is the ability for technology to level the field of opportunity for students" (U.S. Dept of Education: Office of Educational Technology, 2017, p. 3). When the appropriate technology tool is utilized in a format designed to enhance student learning or support the teaching of difficult concepts, student outcomes are evident across all types of learners (Ertmer & Ottenbreit-Leftwich, 2010; Inan & Lowther, 2010a; Sauers & McLeod, 2012). Tamin et al. (2011) performed a second level meta-analysis of 40 years of research on the impact of technology on learning. This systemic review of the literature included studies published after 1985 that used student achievement as an outcome to measure the impact of technology-rich instruction. Twenty-five meta-analyses which touched over 1,000 primary studies found the implementation of educational technology has produced, on average, a 12 percentile point increase across all subjects examined (Tamin et al., 2011). Furthermore, this second level meta-analysis also showed that technology used in support of instruction has a significantly larger effect size (.42 vs. .31) than technology used for direct instructional purposes (Tamin et al., 2011). Hattie's (2008) meta-analysis of influences on instruction found that computer-assisted instruction has an effect size of .37 and is more effective when there are multiple opportunities for learning that the student is in control of.

Students in 1:1 learning programs have demonstrated increased academic achievement and reported the availability of the technology increased their motivation, fostered confidence in schoolwork, and facilitated increased interactions between teachers and peers (Mouza, 2008; Sauers & McLeod, 2012). The research also speaks to the impact of the type of instruction occurring as a result of the technology integration. Technology implemented as a support to the classroom teacher's instruction has a significantly higher impact on learning than technology used as a means of direct instruction as demonstrated by an effect size of 0.42 compared to 0.31 (Tamin et al., 2011). Furthermore, technology utilized as a support to learning in informal, non-traditional setting has an effect size of 0.70 compared to a 0.5 effect size of technology implemented in the traditional classroom or computer lab (Chauhan, 2017). When implemented with appropriate instructional strategies, technology has a positive effect on student overall learning, motivation, and engagement (Chauhan, 2017; Mouza, 2008; Sauers & Mcleod, 2012; Tamim et al., 2011). These technology-infused learning environments emphasize student agency in complex authentic learning experiences. This leads to a deeper understanding and engagement in the learning activities not seen in the industrialized classroom (McLeod & Shareski 2018).

The Misuse of Technology

In spite of an inspiring vision statement related to preparing students with 21st century skills, most schools are still fixed on the industrial revolutionary factory model of education that does not account for individual needs and interests (An & Reigeluth, 2011; Fullan, 2013b; Wagner, 2014). Compounded with the accountability era of high stakes testing that arose from the No Child Left Behind, the current state of schools has shown a decline in entrepreneurism and creativity in children as they receive more formal education (Zhao, 2012). This lack of entrepreneurial spirit and creativity is also seen in the utilization of technology in K-12 classrooms across the United States despite their lower costs and easier access. Research has found increased use of technology is primarily in the form of teacher-directed low-level "drill and kill" activities or content consumption, neither shown to increase student learning nor 21st century skill acquisition (Ertmer & Ottenbreit-Leftwich, 2010; Mueller & Oppenheimer, 2014; Sauers & McLeod, 2012). In this method, teacher pedagogy is focused on implicitly teaching how to use the technology application or device or using technology as substitution for tasks that are a low level of Bloom's taxonomy.

In his blog, Futurist Alan November stated, "As these emerging information and communication technologies continue to have a profound impact on society, one of the most important leadership skills will revolve around helping educators, families, and community to let go of existing structures" (November, 2012 para. 18). Many schools are spending money to increase the amount of internet- or technology-based devices available for students but are not investing the capital in professional learning for the teachers and administrators in charge of making the device implementation successful. This often leads to low level technology use focused on basic skill development (Henriksen, Mishra, & Fisser, 2016; Sadaf & Johnson, 2017). In order for successful integration of technology in the classroom the focus must be around changing from instruction focused on the use of a digital device toward a student-centered approach that is enhanced by a digital device (Hew & Brush, 2007; November, 2013). Devices in the classroom need to be centered around student creation of content, rather than the student consumption of content.

Leading 21st Century Schools

One major theme in educational technology literature is the development of 21st century skills. Tony Wagner (2014) identified seven survival skills: critical thinking and problem solving, collaboration across networks and leading by example, agility and adaptability, initiative and entrepreneurialism, effective oral and written communication, accessing and analyzing information, and curiosity and innovation as the keys to 21st century success. When implemented with fidelity and appropriate supports for teachers, technology has been shown to impact student mastery of these skills including communication and collaboration through multiple methods including social media platforms (Garland & Tadeja, 2013). The integration of technology into lesson planning increases student motivation and higher order cognitive thinking skills (Keengwe et al., 2012; Klieger, Ben-Hur, & Bar-Yossef, 2010; Sauers & McLeod, 2012). In a multisite case study of seven school districts across the United States, McKnight et al (2016) found that appropriate technology integration increases student engagement and deepens learning.

While a shift in pedagogy toward a learner-centered model coupled with technology as a tool can be a difficult change for both teachers and students (Krueger, 2018), the impact can be a dramatic increase in student learning and foster 21st century skill development in students (An & Reigeluth, 2011; Fullan, 2013b; McKnight et al., 2016). Many teachers do not feel prepared with the necessary tools, skills, and professional development to facilitate this change (Henriksen et al., 2016; Machado & Chung, 2015; Sadaf & Johnson, 2017). The role of the principal in facilitating this shift in pedagogy to a student-centered, technology-rich environment is critical (Greaves, Wilson, & Gielniak, 2017; Machado & Chung, 2015; Schrum & Galizio, 2011). This is accomplished through a strong vision and mission using transformative and distributed leadership skills (Afshari, Bakar, & Wong, 2012; Levin & Schrum, 2013; Pautz & Sadera, 2017)

As technology continues to advance, becomes cloud based, and less expensive, more schools and districts are shifting to 1:1 computing programs where each student is provided an individual computing device to use for learning (Garland & Tadeja, 2013; Keengwe et al., 2012; Sauers & McLeod, 2012). Successful implementation of 1:1 programs requires a shift in the way students are taught and technology is implemented. Teachers now need to collaborate with their students through the mode of technology and move beyond basic skills like word processing and internet searches (Keengwe et al., 2012; Pautz & Sadera, 2017).

The technological competency and leadership ability of a principal significantly affects the level of technological integration in the classroom and teachers' technology literacy (Anderson & Dexter, 2005; Greaves et al., 2017; Chang, 2012; Machado & Chung, 2015). The empowering of teachers builds collective teacher efficacy, which has an effect size of 1.57 on student achievement (Hattie, 2008). Educational leaders in the digital age must be cognizant of the broad influence they have on others and hone their ability to problem solve and facilitate technological issues as they rise as well as be proficient in modeling technology (Anderson & Dexter, 2000, 2005; Sugar & Holloman, 2009). This presents a strong need for principals who serve as change leaders in their buildings to guide the transition to the technology-enhanced student-centered classroom where the use of computer technology will enable learners to enhance problem-solving skills and conceptualize information on higher level of Bloom's taxonomy (Pautz & Sadera, 2017; Sauers & Mcleod, 2012; Sheppard & Brown, 2014). Essential to this shift is the leaders support of teachers throughout high quality professional learning focused on improving student instruction in the classroom (Mouza, 2002; Supovitz, Sirinides, & May, 2010).

The Role of the Principal as Technological Leader

The key to improved student learning facilitated by teachers leveraging technology is school leadership creating an environment of teacher efficacy (DuFour & Mattos, 2013; Hattie, 2008; Supovitz et al., 2010). Marzano, Waters, and McNulty (2005) published a meta-analysis of 35 years of educational leadership. The study found that “school leadership has a substantial effect on student achievement and provides guidance for experienced and aspiring administrators alike” (Marzano et al., 2005, p. 12). This study went on to identify 21 responsibilities of a school leader and correlate each of these responsibilities to its impact on student learning. Within the 21 responsibilities were change agent, ideals/beliefs, instruction and assessment, optimizer, outreach, and resources (Marzano et al., 2005). These specific responsibilities are needed to facilitate the integration of technology within a school.

Catano, Richard, and Stronge (2008) recognized the paradigm shift from the principal as manager to the principal as manager and educational leader and identified school climate, human resource administration, teacher evaluation, organizational management, communication and community relations, professionalism, and the principal’s role in student achievement. As digital change leaders, competency in these areas is essential to facilitate and create the climate of change necessary for successful technology integration in the school setting. Effective digital leaders embrace these eight areas as they continue to shift the culture of their building to a digital environment.

Krasnoff (2015) found that highly effective principals influence a variety of school outcomes including student achievement, ability to identify and articulate a school vision, effective allocation of resources, and development of organizational structures to support student learning. “Research and practice confirm that there is a little chance of creating and sustaining a high-quality learning environment without a skilled and committed instructional leader” (p. 7).

A common theme in research on the impact of the principal is that the principal is directly involved in effecting positive change throughout the building. The research also supported the shifting role of the principal from manager to the more complex role of instructional leader with an impact on student achievement. The role of instructional leader is made even more complex as it is intertwined with the changes needed to successfully integrate technology.

The Need for Standards in Technology Leadership

In 1998, the International Society for Technology in Education (ISTE) identified a need for universal technology standards to standardize the skills displayed by multiple stakeholders in education. The project, called the National Educational Technology Standards (NETS) was designed to create nationally recognized technology standards for students, teachers, and administrators. The first set of standards published by ISTE was the National Educational Technology Standards for Students (NETS-S) in 1998. These standards have since been updated in 2007 and 2016, respectively (ISTE, 2016). This was followed by the release of the National Educational Technology Standards for Teachers (NETS-T) in 2000. The teacher standards were updated in 2008 to represent a constructivist approach to pedagogy (Healey, 2015).

Technology Standards for Administrators (NETS-A, ISTE Standards-EL)

In 2001, national and international groups representing school administrators including the National Association of Elementary School Principals, the National Association of Secondary School Principals, the American Association of School Administrators, the National School Board Association, the North Central Regional Educational Laboratory, the International Society for Technology in Education, two state departments, two universities, and other interested parties came together to discuss the roles and necessary skills school administrators have in the integration of technology into the classroom (Schrum & Galizio, 2011). This newly formed group, the Collaborative for Technology Standards for School Administrators (TSSA), developed and posted National Educational Standards for Public School Administrators or NETS-A in the area of technology leadership (Lecklider, Britten, & Clausen, 2009; Richardson et al. 2012; Richardson, Flora, & Bathon, 2013). These standards were created as the next progression in standards with the understanding that if not properly supported by school leaders, teacher technology standards and student technology use will never be fully realized (Schrum & Galizio, 2011). The NETS-A were initially adopted or adapted by most states in some format, yet little research exists on the how these standards have been utilized to prepare future school leaders.

In 2009, the NETS-A standards were reviewed and subsequently updated to prepare students for the 21st century economy and demonstrate the beliefs that the use of technology needs to be integrated with the definition of good teaching and leadership as opposed to a component of good teaching (Ertmer & Ottenbreit-Leftwich, 2010; Schrum & Galizio, 2011). The standards were again updated in 2018 and renamed the ISTE Standards for Educational Leaders (ISTE Standards-EL).

Table 2.2

The NETS-A Standards in 2002, 2009, 2018 ISTE Standards for Educational Leaders

2002 NETS-A Standards	2009 NETS-A Standards	2018 ISTE Standards-EL
Leadership and vision	Visionary leadership	Equity and Citizenship Advocate
Learning and teaching	Digital age learning culture	Visionary Planner
Productivity and professional practice	Excellence in professional practice	Empowering Leader
Support, management, and operations	Systematic improvement	Systems Designer
Assessment and Evaluation	Digital citizenship	Connected learner
Social, Legal, and Ethical Issues		

(ISTE, 2002, 2009, 2018)

As described in Table 2.2, the updated standards reflect the ideals of systemic leadership and strategic planning (ISTE, 2009). In order to successfully integrate technology into the school environment, the school leader must understand the change process and how to lead successful change in an organization (Thomas & Knezek, 1991). Furthermore, upon close examination, the evolution of the standards parallel the progression of instructional leadership theory from the principal as the sole focus to a distributive model in which formal and informal leaders are empowered throughout the organization (Neumerski, 2012). Using the five domains created in the 2009 NETS-A standards, one can begin to develop the construct of technology leadership for the K-12 building principal.

Technology Leadership

Anderson and Dexter (2005) developed a technology leadership model that identified a reciprocal relationship between leadership components and technology arrangement in the school. They found that an increase in the technology infrastructure of a school required an increase in leadership related to the technology. The presence of hardware alone does not change the teaching and learning that is occurring in the daily classroom (Lecklider et al., 2009). It was found that an increase in leadership characteristics related to educational technology including technology committees, school budget, and staff development will result in an increase in the net use and infrastructure within the school (Anderson, 2006; Anderson & Dexter, 2005; Vanderlinde & van Braak, 2013). The increase in leadership components directly influenced the technology outcomes, which promote technology integration within the school (Anderson & Dexter, 2000, 2005). Grady (2011) described 10 essential tasks for the role of a building principal serving as technology leader in their building. According to Grady, the principal should:

1. Establish the vision and goals for technology in the school
2. Carry the technology banner in the school
3. Model the use of technology
4. Support the use of technology
5. Engage in professional learning which focuses on the integration of technology for student learning
6. Provide professional learning for staff that facilitate the integration of technology into student learning
7. Secure resources to support technology integration within the school
8. Be an advocate for technology use to support student learning
9. Be knowledgeable and promote the attainment of appropriate technology standards
10. Communicate the importance of the use of technology in enhancing the learning experience to stakeholders. (pp. 7–8)

In all the frameworks and models for leadership in technology, the physical hardware is seen as a device or tool to be used to improve student learning (Anderson & Dexter, 2005; Chang, 2012; Grady, 2011). These frameworks take into account that incorporating technology into schools requires a leader who is an agent of change who understands the technology is a tool for increased student learning (Anderson & Dexter, 2005; Fullan, 2013b). It is in this mindset that the standards for technology leadership were developed.

Effective technology integration in schools is a combination between teacher competency and effective technology leadership (Anderson & Dexter, 2005; Raman & Shariff, 2017). Strong leaders work to eliminate some of the perceived barriers to integration within the classroom including access, time, and professional development (Kopcha, 2012). Furthermore, leaders need to understand the implications of technology in the classroom and demonstrate how it can be effective in increasing both learning and teacher productivity. Teo (2011) found that teachers are more likely to utilize technology in their classroom when they perceive the use will have a positive impact on their craft. In examining the relationship between teaching practices and administrative technology leadership, Raman and Shariff (2017) found a significant relationship between teacher technology leadership and teacher computer literacy and use.

Thorough integration of technology in a school building is more effective when guided by an educational leader who can facilitate the change process (Afshari et al., 2008; Anderson & Dexter, 2005; Sheninger, 2014; Sheppard & Brown, 2014). ISTE identified a need to create a universal set of standards for all three groups – students, teachers, and administrators. As technology and its use and purpose have evolved within the classroom, the standards associated with individual groups continue to evolve to fit the needs of the students each group serves.

Equity and Citizenship Advocate

Today's leaders need to work to ensure equitable technological access for all. Sincar (2013) found lack of resources to be the largest challenge for principals. With the increased use of bring your own device policies or 1-1 initiatives, it is important that technological leaders account for access issues including Wifi connectivity away from the academic environment and accessibility for all students. In times of budgetary constraints, the principal needs to serve as an activist and promote access for all students (Garland, 2009).

The 2009 NETS-A and subsequent 2018 ISTE Standards-EL standards have evolved to incorporate major components of visionary and distributed leadership theory. Table 3 compares the NETS-A and ISTE Standards-EL to these modern leadership theories.

Table 2.3

The 2009 NETS-A Standards and 2018 ISTE Standards-EL Compared With Modern Leadership Theory

2009 NETS-A	ISTE Standards-EL	Modern Leadership Theory
Visionary leadership	Equity and Citizenship Advocate	Leaders develop a broadly shared mission, vision, and organizational goals accessible to all
Digital age learning culture	Visionary Planner	Communication of high expectations with an established culture to build capacity towards the mission and vision
Excellence in professional practice	Empowering Leader	Treats employees individually works to gain respect and trust.
Systematic improvement	Systems Designer	System of leadership practices established involving both formal and informal leaders
Digital citizenship	Connected learner	Develops productive relationships with multiple stakeholders to promote continuous improvement

(Bass, 1990; ISTE, 2009, 2018; Leithwood & McCullough, 2016)

The concept of visionary leadership in the area of technology leadership can be a challenge to school principals in a field that is constantly changing and evolving (Anderson & Dexter, 2005), yet having a vision in regards to educational technology is a critical component to the construct of technology leadership (Banoglu, 2011; Larson et al., 2010; Richardson et al., 2013). The development of a long-term technology plan complete with vision and goals is an essential component for the professional growth of faculty and staff (Chang, 2012). In a review of eight highly integrated schools, Levin and

Schrum (2015) found that the leader's vision was a significant factor in the success of the school.

In examining leaders' visions for their respective schools, Schrum and Levin (2009) found that most of their visions lacked a pure understanding of the role technology plays in the education and the incorporation of this into their vision. This vision needs to be more than simply new hardware in an educational setting. It must contain a plan that is learner centered and modeled with fidelity by the leader (Banoglu, 2011; Sheppard & Brown, 2014). The vision must be positive and focused on access for all (Kopcha, 2012). A sound technology vision must focus on the people using the technology (Overbay, Mollette, & Vasu, 2011). A critical component of this vision is the integration of infrastructure with the methodologies in which it will be utilized (Vanderlinde & van Braak, 2013). The inclusion of technology into a leader's vision for schooling will assist the leader in creating innovative learning environments for students in a new digital age (Richardson et al., 2013).

Visionary Planner

The second domain of the standards focuses on creating a digital learning culture. A digital age learning culture is created when principals who routinely integrate technology in administrative tasks and professional development directly increase the technology integration of classroom teachers (Hew & Brush, 2007; Chang, 2012). In a path analysis approach, Inan and Lowther (2010a) found that teacher readiness and overall support by administration had a significant impact on the integration of technology into their pedagogy. Effective technology leaders continue to stay current on the latest hardware and software and model how to integrate them into the learning environment (Banoglu, 2011; Cabellon & Brown, 2017).

In a digital age learning culture appropriate professional development and ongoing training for teachers using new technologies is paramount (Campbell, 2012). Changes in classroom technology use among teachers occur more frequently in an environment where teachers are free to be innovative with technology use (Ertmer & Ottenbreit-Leftwich, 2010).

Empowering Leader

The operationalization and alignment of technology goals, resources, and policies improve the role of technology in learning (Anderson & Dexter, 2005) and also are key components in the NETS-A domain excellence in professional practice. This domain also calls on administrators to model the use of effective communication and collaboration among stakeholders via digital age tools (ISTE, 2009). As new technology is integrated into the educational setting, leaders need to continue to learn and develop best practices in respect to effective pedagogy and continue to stay abreast of new technologies and their potential implications on the K-12 classroom (Garcia & Abrego, 2015; Pautz & Sadera, 2017).

Systems Designer

The major role of the principal as technology leader is to lead the implementation change process using technology (Afshari et al., 2008). Principals must work directly with teaching staff to collaborate for the successful integration of technology throughout the school. Leading this systematic change process throughout the school is the foundation of the fourth domain of the 2018 ISTE Standards-EL, Systems Designer. In this domain, principals need to provide the professional development critical to shifting adult behaviors from teacher directed to student centered (Davies, 2010; Sheppard & Brown, 2014). In looking for specific improvements, the technology needs to be aligned with the teacher's classroom practice, and appropriate professional development needs to be incorporated (Anthony, 2011).

Successful technology integration is achieved when leadership is distributed and teachers have opportunities to provide input for improvement (Anthony, 2011). Distributed leadership is a key component of any leadership that is to be sustainable (Hargreaves & Fink, 2006). Effective organizations are successful due to the development of multiple leaders in multiple areas of expertise (Fullan, 2013a). All technology leaders including district specialists, principals, teachers, and students need to share the role in successful integration and management of technology in schools (Davies, 2010). This type of culture fosters a growth mindset and school culture that embraces change and the challenges involved in incorporating technology for increased student learning (Schrum & Levin, 2016).

In fostering a climate around systemic improvement, principals need to create an environment where teachers feel supported and encouraged to take academic risks (Fullan, 2013a; Garcia & Abrego, 2015). Furthermore, a leader's understanding of the change process was found to be a critical attribute in the successful implementation of technology initiatives in schools (Afshari et al., 2012; Anderson & Dexter, 2005; Pautz & Sadera, 2017).

Connected Learner

The final domain of the standards is the modeling and understanding of the social, ethical, and legal issues related to creating a digital culture also known as digital citizenship. This domain focuses on the ideas of equitable access for all learners, safe, ethical, and responsible social use of digital tools, and the facilitation and involvement in global access of technologies. Anderson and Dexter (2005) found that schools with fewer mechanisms and policies in place were less likely to integrate technology into their educational culture. Additionally, Banoglu (2011) discovered that this was the area in which most principals considered themselves as adequate or above.

The need for more than just incorporating hardware into schools is essential. The understanding that students will need to prepared to interact with others in a civil manner online and understand legal and ethical responsibilities associated with a significantly increased online presence is paramount (Cabellon & Brown, 2017). Schools need to go beyond just ensuring students and parents sign an acceptable use policy and implicitly teach how to use technology correctly to students (Larson et al., 2010). When scrutinized, the ITSE Standards-EL support the construct of technology leadership as a process in which technology is incorporated as a learning tool and not a process of helping others use computers (Afshari et al., 2008).

Principals have a bearing on classroom instruction through their use of distributed leadership impacts peer influence (Supovitz et al., 2010). Principals need to place a priority on learning and continued professional development (Lecklider et al., 2009; Sheninger, 2014; Vanderlinde & van Braak, 2013). They need to take the role of lead learner and constantly model new ways of technology integration in their daily practice

(Cabellon & Brown, 2017). It is important that the focus of the learning within the organization is based on the integration and application to pedagogy and not just the hardware or software alone (Chang, 2012). The more teachers find a tool valuable to their pedagogy or instructional goal, the more likely they are to integrate it into their daily practice (Ertmer & Ottenbreit-Leftwich, 2010).

Change Leadership

The ISTE Standard for Educational Leaders focus on systemic improvement and creating a culture of change in which the principal continuously improves the implementation of technology into all facets of the organization. At their base, they focus on the establishment of systems that take advantage of the opportunities provided to them by digital innovation (Sheninger, 2014). The incorporation of technology in the educational setting involves establishing an environment based on constant change. The concept of technology leadership focuses on the application of technology to the organization to increase performance (Chang, 2012).

The idea of technology leadership and being a change agent were central throughout Davies' (2010) review of the available literature. Davies discovered that, at times, technology leadership resulted in a movement away from the teaching and learning as a central focus. Additionally, school technology implementation was found to be primarily teacher driven in the work of Sheppard and Brown (2014). The integration of technology into teaching and learning requires a pedagogical shift from teacher-directed approach to learner-centered approach. Davies (2010) also reported that principals disagreed over the definition of educational technology leadership and the construct in which it falls. She found the central idea in the literature reviewed was the concept of change. Strong technology leadership involves getting people to continuously change and adapt as technology improves and evolves.

Creating a Culture of Change

With technology continuously changing, principals need to be the change they wish to see in education (Sheninger, 2014). In establishing a culture of change, the focus must first be set on creating a positive culture of change, followed by the change itself (Fullan, 2013a). Education is a people business. Investing in the teachers, staff, and students is paramount to organizational success. Educational leaders establish an environment of change by displaying regular positive feedback for the adults implementing the desired change. These small, yet positive feedback loops create the motivation for the adults to move out of their comfort zone and continue to experiment with the unknown (Fullan, 2013a).

Effective digital leaders provide access to data and new pedagogy associated with technology use in the classroom (Lecklider et al., 2009; Sheninger, 2014). Creating a culture of innovation requires the leader to trust and support their employees unconditionally and support them throughout the inevitable setbacks that may occur in the journey (Demski, 2012; Sheninger, 2014). Furthermore, the principal as the lead learner needs to be proficient in the use of technology and model this use with their teachers (Afshari et al., 2008; Juraime, n.d.; Sheninger, 2014). It is in this establishment of organizational transparency that leads to creating the desired culture of change (Fullan, 2013b).

Twenty-first century education and leadership is no longer a skill that is done in isolation; creating a collaborative atmosphere is essential to the success of all (Demski, 2012). This collaboration results in increased competencies, ideas, and motivation for all (Fullan, 2013b). Principals that create environments where teachers work together with a common purpose significantly improve student learning and achievement (DuFour & DuFour, 2009). Digital leadership strategies include encouraging teachers and staff to establish professional learning networks (PLNs) through social media sites like Twitter, Pinterest, and Linkedin and also add to the collaborative and growth atmosphere in the school environment (Demski, 2012; Sheninger, 2014).

This establishment of a vision distributed throughout teacher leaders has shown to have a significant impact on student achievement. In a study of English language arts (ELA) and math learning, Supovitz et al. (2010) found that peer influence had a .21 effect size in ELA instruction and a .26 effect size in math. In addition, they found that principal leadership has a very strong association with peer influence represented by a .38 ELA and .30 math effect size. It is within this spirit of collaboration between principals and teacher leaders that leads to improved instruction utilizing technology (Mouza, 2002; Pautz & Sadera, 2017).

Factors Impacting Principal's Technology Leadership

Principals are being held to a continuously rising standard and proficiency expectation in the area of technology leadership (Yu & Prince, 2016). The concept of technology leadership is lacking among many principals (Juraime, n.d.). One of the major hurdles to implementing technology in the classroom is transitioning from managerial uses to pedagogical uses (Schachter, 2010). In a qualitative study of all the school districts in one Canadian province, Sheppard and Brown (2014) observed a lack of learner-centered instruction in many classrooms that contained large amounts of educational technology. The physical presence of more technology requires a leader with a stronger technology leadership skill set including the ability to find the time for high quality professional learning (Anderson & Dexter, 2005; Mouza, 2002; Pautz & Sadera, 2017; Supovitz et al., 2010). Accomplished technology-building leaders understand that though empowering and supporting others to move towards a common vision, teacher resistance to the change process and implementation of technology become lower barriers to successful integration of technology to meet the needs of all students (Juraime, n.d.; Pautz & Sadera, 2017; Sheppard & Brown, 2014; Sincar, 2013). The modern principal needs to be competent in driving the change process to ensure that all students have access to rich, high quality, individualized authentic instruction that are infused with technology throughout (McLeod & Shareski, 2018).

Summary

The review of literature demonstrates the need for strong technology leadership and its impact on student learning, productivity, and the development of critical 21st century skills. As technology becomes more affordable and abundant in K-12 schools, the need for principals with a strong foundation in technology leadership is critical for a high quality student experience (Anderson & Dexter, 2005).

As the leader of the school, the role of a high quality principal is to have an impact on the learning that takes place in the school (Marzano et al., 2005). This influence comes from establishing a mission and vision and providing the resources and support for all stakeholders to reach that vision. Accomplished 21st century principals are leaders, not managers, who empower teacher efficacy through increased teacher agency and collaboration. As these leaders guide their teachers to prepare students to be successful in the information economy, they understand the need for strong digital leadership skills.

Today's digital leaders have a deep understanding that the role of technology is to support a deeper, authentic understanding of the curriculum (McLeod & Shareski, 2018). They see technology as a way to connect to the world and embrace the opportunity to have an audience. Digital leaders are change agents who work to ensure access for all and deliver this change by empowering people to be the agents. The digital principal knows that this shift is hard, and appropriate time and differentiated professional learning must be provided for stakeholders to explore and innovate with the tools provided. Finally, true leaders are learners and are cautiously working to improve their craft through their professional learning networks (ISTE, 2018; Sheninger, 2014).

A gap in the literature is principals' perceived level of competency in each of the five domains of the 2009 NETS-A and 2018 ISTE Standards for Educational Leaders and their role in technological proficiency in their building. Richardson et al. (2012) found a significant lapse in necessary research to provide resources for technology leaders to make significant changes in teaching and learning. Furthermore, limited research is available on the impact of various demographic characteristics and the perceived level of competency in each of the five domains of the leadership standards.

Based on the reviewed literature, the purpose of this study was to examine the perceived level of competency for the 2018 ISTE Standards-EL for Ohio K-12 administrators. Given the advances in educational technology, technology leadership needs to move from the sole managerial responsibility of the district IT director to a distributed leadership approach between multiple school leaders, including the building principal (Kowch, 2013). This needs to occur from the leadership training programs at the institutional level and continue as embedded professional development throughout a leader's tenure to develop a proficiency in the ISTE Standards-EL (Yu & Prince, 2016). This study investigated the level of perceived ISTE Standards-EL competency of principals based on various demographic characteristics including age, gender, professional experience, level of school, school size, current technology plan, and school setting.

CHAPTER III

METHODS

This chapter describes the research design, questions, and hypotheses studied. Sampling methods and the instrument used are also discussed. Finally, data analysis methods and study limitations are presented. The purpose of this study was to investigate the competency of the 2018 International Society for Technology in Education (ISTE) Standards for Education Leaders (ISTE Standards-EL) of Ohio principals as measured by the 2018 Principal Technology Leadership Assessment (2018 PTLS) in five domain areas. Furthermore, this study investigated if a significant relationship exists between standards competency and various demographic variables including school setting (i.e., urban, rural, or suburban), level, gender, years of experience in the principalship, age, and endorsement in technology or a technology-related field. This study also sought to see if a relationship existed between competency on the ISTE Standards-EL compared to the level of use/implementation (LoU) of a recent technology initiative.

Research Questions

This study aimed to address three research questions:

1. What is the self-reported competency level of Ohio Principals in each of the five 2018 ISTE Standards Education Leader domains: Equity and citizenship advocate, visionary planner, empowering leader, systems designer, and connected learner measured by the 2018 Principal Technology Leadership Survey (ISTE, 2018)?
2. Are differences in technology leadership competency correlated to demographic characteristics: gender, years in the principalship, age, has the

participant earned a degree, license, certificate, or endorsement in technology or a technology-related field school level, school environment, poverty level, and school size?

3. Is there a significant relationship between the technology leadership competency of principals as defined by the ISTE Standards-EL based with the current level of technology implementation levels of use on a recent technology initiative (Hall et al., 2006)?

Research Design

This study was a quantitative descriptive research study aimed to gather Ohio principals' perceived level of leadership competency and analyze it utilizing statistics in search of any correlations between the variables (Trochim & Donnelly, 2008). This study utilized a nonexperimental quantitative design method of research (Trochim & Donnelly, 2008). It was characterized as a nonexperimental quantitative design because there was no control group, manipulated variable, or random assignment of subjects to test conditions (Jhangiani, Chiang, & Price, 2015; Trochim & Donnelly, 2008). The focus of the study was to examine the statistical relationships between the perceived level of proficiency in the ISTE Standards-EL standards and various demographic characteristics. In this case, nonexperimental research was appropriate because the associated research questions are broad and exploratory and not limited to specific causal phenomena (Jhangiani et al., 2015) The purpose of this study was to collect descriptive statistics to see if any relationships exist in the sample. The data collected described general trends for technology leadership among Ohio principals.

For quality control of descriptive survey research design, two issues need to be considered in the research design: 1) internal validity, and 2) external validity. Internal validity in nonexperimental quantitative studies refers to the strength of the overall of the study (Huitt & Humel, 1999). External validity refers to the ability of the findings in this study to be generalized to other populations (Trochim & Donnelly, 2008). In the following sections, detail discussions are provided to review the specific issues related to internal and external validity. Then, possible threats to both validities for this study were identified. Detail strategies were illustrated to alleviate those threats.

Internal Validity

The established purpose for this study was to describe if a relationship exists between the perceived mastery of 2018 ISTE Standards-EL when compared to a variety of demographic characteristics. To improve the internal validity the researcher accounted for study design, sample size, instrumentation validity, and data analysis method. This study was designed as a non-experimental study; the goal was to see if any significant relationship exists between Oho principals' self-reported competency levels of the 2018 ISTE Standards-EL and various demographic factors. Other methods to improve the internal validity include the use of an appropriate sample size that falls within Fowler's (1988) recommended guidelines for a 95% confidence rate. Finally, appropriate statistical analysis methods were utilized using SyStat 13 software to see if any significant relationship existed.

Ohio principals were asked to assess themselves in regard to their levels of implementation of technology leadership indicators using the 2018 PTLS. This instrument was developed with permission from the original PTLA designed in 2005.

Instrumentation validity of the 2018 PTLS was increased in multiple ways. The original 2005 PTLA was reviewed by 10 experts for validation purposes. This expert review strengthened the instrumentation validity of the instrument. To keep both the construct validity and face validity of the revised instrument, prior to the study the 2018 PTLS was reviewed by a member of CASTLE, the authors of the original PTLA and other education technology specialists. Expert review of the survey encouraged the addition of working definitions for terms including technology, digital citizenship, stakeholders, and online professional learning networks. Other internal validity challenges to the 2018 PTLS come in the area of scoring and response issues. These include leniency error, halo error, and recency error (McLeod, 2005; Trochim & Donnelly, 2008). All three of these errors are explained in detail in the instruction sheet of the PTLA to limit these errors and strengthen both the internal and face validity of the instrument. Leniency error refers to a participant providing a higher rating than they truly deserve because they either feel other participants are doing the same, they have relatively low standards, or do not feel like providing a poor assessment of their skills (McLeod, 2005). In the halo effect phenomenon, participants may respond to the questionnaire in a manner of how they hope they are acting instead of in a manner that is truly representative of their practice (McLeod, 2005). Finally, recency error refers to the participant basing responses on their most recent behavior instead of the past year in total.

The original PTLA showed high reliability with a measured Cronbach's Alpha (α) = 0.95 (McLeod, 2005). This means that the instrument is reliable as a whole and in smaller subsets (Trochim & Donnelly, 2008). The metrics of the original PTLA are not valid for the 2018 PTLS, but the format of the instrument and subsequent expert review increases the reliability of the 2018 PTLS (Trochim & Donnelly, 2008).

External Validity

When conducting a quantitative descriptive study, external validity and the ability to generalize the findings to a larger population is a concern (Trochim & Donnelly, 2008). Survey research of an appropriate sample size does allow the results to be generalizable to a larger population if that sample is a sound representative of the larger population (Kelley, Clark, Brown, & Sitzia, 2003; Trochim & Donnelly, 2008). The sample in this study was purposefully selected as being listed in the Ohio Educational Directory System as a principal in the state of Ohio. Fowler's (1988) recommendations for minimum sample size were followed to increase the external validity of the study. The research questions associated with the study were seeking to identify a relationship between principal demographic characteristics and their mastery of the ISTE Standards-EL (Coolican, 2017). External validity was weakened in this study as little attempt was made by the researcher to control any extraneous variables. The statistical relationship of the examined variables was examined qualifying the study as a correlational nonexperimental research design (Jhangiani et al., 2015).

Variables

The dependent variables in this study were the respondents' perceived levels of mastery in the five domains of the ISTE Standards-EL, which are:

1. Equity and Citizenship Advocate
2. Visionary Planner
3. Empowering Leader

4. Systems Designer
5. Connected learner (ISTE, 2018)

The independent variables studied include demographic and school factors in which principals had to self-report including age (20-29, 30-39, 40-49, 50-59, 60+), gender (male, female, other), years as an administrator (1-4, 4-5, 10-14, 15-19, 20-24, 25-29, 30-35, 35+), has the participant earned a degree, license, certificate, or endorsement in technology or a technology related field (yes, no), grade levels that attend the school (elementary, middle, high, K-8, K-12), school size as measured by average daily membership (1-249, 250-499, 500-749, 750-999, 1000 -1499, 1500-1999, 2000+) school environment (rural, suburban, urban), percentage of student eligible for free or reduced lunch (less than 25%, 26%-50%, 51%-75%, greater than 75%) and a description of the implementation level (Hall et al., 2006) of a recent technology initiative.

Research Hypotheses

Alternate Hypothesis (1): There are significant statistical differences between principals' demographic factors including gender, years in the principalship, age, school level, school environment, and school size on the self-reported competency level of Ohio Principals of Ohio Principals in each of the five 2018 ISTE Standards Education Leader domains.

Null Hypothesis (1): There is no significant difference of principals' demographic factors including gender, years in the principalship, age, school level, school environment, and school size on the self-reported competency level of Ohio Principals of Ohio Principals in each of the five 2018 ISTE Standards Education Leader domains.

Alternate Hypothesis (2): There is a significant statistical correlation between the LoU of a recent technology initiative and the self-reported competency level of Ohio Principals of Ohio Principals in each of the five 2018 ISTE Standards Education Leader domains.

Null Hypothesis (2): There is no significant statistical correlation between the LoU of a recent technology initiative and the self-reported competency level of Ohio Principals of Ohio Principals in each of the five 2018 ISTE Standards Education Leader domains.

Instrumentation and Procedures

The UCEA Center for the Advanced Study of Technology Leadership in Education (CASTLE) developed the Principals Technology Leadership Assessment (PTLA) based on the 2002 NETS-A standards (McLeod, 2005). The 2006 PLTA survey provides 35 statements related to the six domains of 2002 NETS-A standards with five levels of leadership involvement in each. Permission was gained from the author of the 2006 PTLA to modify the instrument into the 2018 instrument. The 2018 PTLS is organized by leadership standard. Each standard has at least one statement in which a participant answers that correlates to a specific indicator for that standard. Each of the statements in the PTLA is organized in an ordinal response format with choices being (1) *Not at all,* (2) *Minimally*, (3) *Somewhat,* (4) *Significantly*, and (5) *Fully* (McLeod, 2005; Trochim & Donnelly, 2008). Upon completing the survey, a participant is scored in each area with a response of somewhat set at a midline zero and range of +2 to -2. Individual indicator statements under the standard were averaged to find a standard score for each of the six original standards (Banoglu, 2011; McLeod, 2005).

The 2018 ISTE Standards-EL are further supported by 22 descriptive indicators. Collectively these standards and indicators describe what an accomplished technology educational leader knows and does. Given all the other demands of school principals, these standards represent the ideal, not minimum standard (McLeod, 2005). The 2018 PLTA provides an opportunity to define relative strengths and challenges for each of the five standards. Average scores in a standard area closer to 5 represent a relative area of strength for that leader. Average scores closer to 1 in a standard area represent a potential area of growth caused by limited knowledge or involvement.

Equity and Citizenship Advocate

Equity and citizenship advocate are defined as an educational leader's use of technology to increase equity, inclusion, and digital citizenship practices according to the ISTE Standards-EL. Five items were included in this subscale to measure equity and citizenship advocate competency of principals. For better clarity in questioning the indicator, "model digital citizenship by critically evaluating online resources, engaging in civil discourse online and using digital tools to contribute to positive social change" (ISTE, 2018) was divided into two distinct statements: (1) to what extent did you model digital citizenship by critically evaluating online resources? and (2) to what extent did you engage in civil discourse online and using digital tools to contribute to positive social change?

To assist in the internal validity of the instrument, working definitions of both technology and digital citizenship were provided for the participant. Technology was defined as computing devices used to improve instruction. This can include computers, tablets, cell phones, etc. inclusive of the related hardware and software associated with the device. Digital citizenship was defined as the knowledge, behaviors, and skills essential for appropriate and responsible technology use.

For the equity and citizenship advocate standard the total possible score is 25. An average score closer to 5 represents the participant indicated relative strengths or participation in the areas of providing access to skilled teachers who engage students in authentic way with technology. These leaders provide the access and opportunities to partake in the online environment in a safe and ethical setting (ISTE, 2018). Scoring closer to a 1 in this standard represents a potential lack of access to technology for all students, lack of appropriate skill in teachers, or lack of digital citizenship curriculum.

Visionary Planner

The 2018 ISTE Standards-EL define a visionary planner as a leader who "engages others in establishing a vision, strategic plan, and ongoing evaluation cycle for transforming learners with technology" (ISTE, 2018). Five items were included in this set to gage the school leader's competency in visioning and strategic planning. Each individual item of the five domains represented a competency indicator of the equity and citizen advocate standard of the ISTE Standards-EL. To increase internal validity in this standard, education stakeholder (stakeholder) was defined as anyone who has a role in the success and welfare of students. This includes but is not limited to administrators, teachers, support staff, parents, families, community members, local officials, etc.

For the visionary planner standard the total possible score is 25. Average scores closer to 5 indicate the educational leader indicated they practice distributive leadership and strategic planning specifically in the area of educational technology. Leaders with and an average score closer to 1 either lack the capacity for shared leadership and strategic planning or have yet to participate in the process.

Empowering Leader

The 2018 PTLS defines an empowering leader as one who "creates a culture where teachers and learners are empowered to use technology in innovative ways to enrich teaching and learning" (ISTE, 2018). Five items were included in this standard to measure a technology leader's relative competency. Each of the items directly correlated with an indicator of the empowering leader standard. A maximum score of 25 is possible in this standard, indicating a culture where teachers and students are empowered to build their capacity towards mastery of their respective set of ISTE standards. Average scores closer to 5 in this domain indicate the leader has worked to establish a culture of collaboration that supports the professional learning and development of leadership skills in others. Average scores closer to 1 in this area indicate a more traditional teaching and learning environment lacking the personalization increased technology can provide.

Systems Designer

The systems designer standard takes into account the teams and systems implemented throughout the building to support learning practices. The PLTA defines four indicators in this standard that focuses on establishing sustainable hardware, software, and security systems throughout the educational space. The highest score a participant could earn is 20 with an average closer to 5 which would be representative of a leader who is accomplished in developing sustainable teams and systems to support teaching and learning (ISTE, 2018). An average score closer to 1 would indicate areas of growth for the leader in selecting hardware, software, and security elements.

Connected Leader

The final standard assessed in the 2018 PTLS promotes the notion that effective technology leaders lead by example and are lifelong learners. Four supporting statements are listed for participants to answer. To increase the face validity of the instrument, the term professional learning network was specifically defined as the use of social media technologies to connect, collaborate, communicate, and create with colleagues worldwide. The connected learner standard has a maximum score of 20. An average score closer to 5 indicates a school leader that leverages technology and social media to establish a reflective digital professional learning environment. An average score near 1 indicates growth opportunities for the leader to leverage technology for best practices and continuous improvement.

The review of the individual items of the original 2005 PTLA survey found that each item added to the measurement of the technology leadership construct as described in the 2002 NETS-A standards. The PTLA was reviewed by 10 content experts in the field of education technology, which provides evidence for face validity for the instrument. This also strengthens the internal validity of the instrument as the expert review confirmed the alignment of the assessment items to the 2002 NETS-A standards (McLeod, 2005).

According to the instructions accompanying the 2018 PTLS, the survey should take approximately 10 minutes to complete. The survey along with accompanying directions and demographic questions was administered electronically to Ohio principals listed in the online Ohio Educational Database. In order to obtain a desired sample size, a link to the survey was emailed with two reminder emails to follow.

Page-Jones (2008) used the original PTLA to investigate the relationship between principals and technology use in Collier County, Florida. In 2011, Duncan used the instrument to survey Virginia public school administrators to determine their levels of mastery of the 2002 NETS-A standards (Duncan, 2011). Banoglu (2011) translated the survey into Turkish to complete his study relating principals' technology leadership competency with ability to coordinate technology within their institution.

In 2012 Burns-Metcalf correlated the PTLA the 2009 NETS-A standards as a part of her doctoral dissertation, *K-12 Principals' Perceptions of Their Technology Leadership Preparedness* (Burns-Metcalf, 2012). The new instrument utilized the same format by grouping questions based on the NETS-A subscales but used the identical rating scale. By using the updated 2009 PTLA, the original 2002 PTLA instrument psychometrics were no longer valid. To ensure content validity, the 2009 PTLA was piloted and revised based on feedback (Burns-Metcalf, 2012; Coolican, 2017; Trochim & Donnelly, 2008).

This study used the 2002 PTLA and Burns-Metcalf's 2009 variation as the basis for instrument development. Permission was acquired from the Center for Advanced Study of Technology Leadership in Education to modify the PTLA to reflect the current ISTE Standards-EL. The 2018 PTLS (see Appendix A) was organized in the similar fashion as both the 2002 and 2009 versions by grouping questions based on the standard indicators. Table 3.1 provides a crosswalk between the three instruments.

Table 3.1

Crosswalk Between 2002, 2009, and 2018 PTLS

2002 PTLA	2009 PTLA	2018 PTLS
I. Leadership and Vision	**I. Visionary Leadership**	**I. Equity and Citizenship Advocate**
1. To what extent did you participate in your district's or school's most recent technology planning process?	1. To what extent are you prepared to facilitate a change that maximizes learning goals using digital resources?	1. To what extent did you ensure all students have skilled teachers who actively use technology to meet student learning needs?
2. To what extent did you communicate information about your district's or school's technology planning and implementation efforts to your school's stakeholders?	2. To what extent are you prepared to engage in an ongoing process to develop, implement, and communicate technology-infused strategic plans?	2. To what extent did you ensure all students have access to the technology and connectivity necessary to participate in authentic and engaging learning opportunities?
3. To what extent did you promote participation of your school's stakeholders in the technology planning process of your school or district?	3. To what extent are you prepared to promote programs and funding to support implementation of technology-infused plans?	3. To what extent did you model digital citizenship by critically evaluating online resources?
4. To what extent did you compare and align your district or school technology plan with other plans, including district strategic plans, your school improvement plan, or other instructional plans?		4. To what extent did you engage in civil discourse online and using digital tools to contribute to positive social change?
5. To what extent did you advocate for inclusion of research-based technology practices in your school improvement plan?		5. To what extent did you cultivate responsible online behavior, including the safe, ethical and legal use of technology?
6. To what extent did you engage in activities to identify best practices in the use of technology (e.g. reviews of literature, attendance at relevant conferences, or meetings of professional organizations)?		

II. Learning & Teaching	II. Digital Age Learning Culture	II. Visionary Planner
1. To what extent did you provide or make available assistance to teachers to use technology for implementing and analyzing student assessment data?	1. To what extent are you prepared to ensure instructional innovation focused on continuous improvement of digital learning?	1. To what extent did you engage education stakeholders in developing and adopting a shared vision for using technology to improve student success?
2. To what extent did you provide or make available assistance to teachers for using student assessment data to modify instruction?	2. To what extent are you prepared to model and promote the frequent and effective use of technology for learning?	2. To what extent did you build on the shared vision by collaboratively creating a strategic plan that articulates how technology will be used to enhance learning?
3. To what extent did you disseminate or model best practices in learning and teaching with technology to faculty and staff?	3. To what extent are you prepared to provide learning environments with technology and learning resources to meet the diverse needs of all learners?	3. To what extent did you evaluate progress on the strategic plan and make course corrections for using technology to transform learning?
4. To what extent did you provide support (e.g., release time, budget allowance) to teachers or staff who were attempting to share information about technology practices, issues, and concerns?	4. To what extent are you prepared to ensure effective practice in the study of technology and its infusion across the curriculum?	4. To what extent did you communicate effectively with stakeholders to gather input on the plan, celebrate successes and engage in a continuous improvement cycle?
5. To what extent did you organize or conduct assessments of staff needs related to professional development on the use of technology?	5. To what extent are you prepared to promote and participate in learning communities that stimulate innovation, creativity, and digital collaboration?	5. To what extent did you share lessons learned, best practices, challenges and the impact of learning with technology with other education leaders?
6. To what extent did you facilitate or ensure the delivery of professional development on the use of technology to faculty and staff?		

III. Productivity & Professional Practice	III. Excellence in Professional Practice	III. Empowering Leader
1. To what extent did you participate in professional development activities meant to improve or expand your use of technology?	1. To what extent are you prepared to allocate time, resources, and access to ensure ongoing professional growth in technology fluency and integration?	1. To what extent did you empower educators to exercise professional agency, build teacher leadership skills and pursue personalized professional learning?
2. To what extent did you use technology to help complete your day-to-day tasks (e.g., developing budgets, communicating with others, gathering information)?	2. To what extent are you prepared to facilitate and participate in learning communities that stimulate and support faculty in the study and use of technology?	2. To what extent did you build the confidence and competency of educators to put the ISTE Standards for Students and Educators into practice?
3. To what extent did you use technology-based management systems to access staff/faculty personnel records?	3. To what extent are you prepared to promote and model effective communication and collaboration among stakeholders using digital-age tools?	3. To what extent did you inspire a culture of innovation and collaboration that allows the time and space to explore and experiment with digital tools?
4. To what extent did you use technology-based management systems to access student records?	4. To what extent are you prepared to stay up-to-date on educational research and emerging trends of effective use of technology and encourage new technologies for potential to improve student learning?	4. To what extent did you support educators in using technology to advance learning that meets the diverse learning, cultural, and social-emotional needs of individual students?
5. To what extent did you encourage and use technology (e.g., e-mail, blogs, videoconferences) as a means of communicating with education stakeholders, including peers, experts, students, parents/guardians, and the community?		5. To what extent did you develop learning assessments that provide a personalized, actionable view of student progress in real time?

1. To what extent did you support faculty and staff in connecting to and using district- and building-level technology systems for management and operations (e.g., student information system, electronic grade book, curriculum management system)?	1. To what extent are you prepared to lead purposeful change to reach learning goals through the use of technology and media-rich resources?	1. To what extent did you lead teams to collaboratively establish robust infrastructure and systems needed to implement the strategic plan?
2. To what extent did you allocate campus discretionary funds to help meet the school's technology needs?	2. To what extent are you prepared to collaborate to establish metrics, collect and analyze data, and share findings and results to improve staff performance and student learning?	2. To what extent did you ensure that resources for supporting the effective use of technology for learning are sufficient and scalable to meet future demand?
3. To what extent did you pursue supplemental funding to help meet the technology needs of your school?	3. To what extent are you prepared to recruit highly competent personnel who use technology to advance academic and operation goals?	3. To what extent did you protect privacy and security by ensuring that students and staff observe effective privacy and data management policies?
4. To what extent did you ensure that hardware and software replacement/ upgrades were incorporated into school technology plans?	4. To what extent are you prepared to establish and leverage strategic partnerships to support systemic improvement?	4. To what extent did you establish partnerships that support the strategic vision, achieve learning priorities, and improve operations.
5. To what extent did you advocate at the district level for adequate, timely, and high-quality technology support services?	5. To what extent are you prepared to establish and maintain a robust infrastructure for technology to support management, operations, teaching, and learning?	
6. To what extent did you investigate how satisfied faculty and staff were with the technology support services provided by your district/school?		
V. Assessment & Evaluation		
1. To what extent did you promote or model technology-based systems to collect student assessment data?		

2. To what extent did you promote the evaluation of instructional practices, including technology-based practices, to assess their effectiveness?		
3. To what extent did you assess and evaluate technology-based administrative and operations systems for modification and upgrade?		
4. To what extent did you evaluate the effectiveness of professional development offerings in your school to meet the needs of teachers and their use of technology?		
5. To what extent did you include the effective use of technology as a criterion for assessing the performance of faculty?		

VI. Social, Legal & Ethical Issues	**V. Digital Citizenship**	**V. Connected Learner**
1. To what extent did you work to ensure equity of technology access and use in your school?	1. To what extent are you prepared to ensure access to appropriate digital tools and resources to meet the needs of all learners?	1. To what extent did you set goals to remain current on emerging technologies for learning, innovations in pedagogy and advancements in the learning sciences?
2. To what extent did you implement policies or programs meant to raise awareness of technology-related social, ethical, and legal issues for staff and students?	2. To what extent are you prepared to promote, model, and establish policies for safe, legal, and ethical use of digital information and technology?	2. To what extent did you participate regularly in online professional learning networks to collaboratively learn with and mentor other professionals?
3. To what extent were you involved in enforcing policies related to copyright and intellectual property?	3. To what extent are you prepared to promote and model responsible social interactions related to the use of technology and information?	3. To what extent did you use technology to regularly engage in reflective practices that support personal and professional growth?
4. To what extent were you involved in addressing issues	4. To what extent are you prepared to model and	4. To what extent did you develop the skills needed to

related to privacy and online safety?	facilitate the development of a shared cultural understanding and involvement of global issues through communication and collaboration tools?	lead and navigate change, advance systems and promote a mindset of continuous improvement for how technology can improve learning?
5. To what extent did you support the use of technology to help meet the needs of special education students?		
6. To what extent did you support the use of technology to assist in the delivery of individualized education programs for all students?		
7. To what extent did you disseminate information about health concerns related to technology and computer usage in classrooms and offices?		

(Burns-Metcalf, 2012; McLeod, 2005)

The updated instrument was sent to CASTLE for expert review and piloted with Ohio school administrators and technology leaders outside the sample population to establish content validity (Trochim & Donnelly, 2008). In addition to the 2018 PTLS, sample demographic questions were asked of the survey participants (See Appendix B). The additional demographic questions were not evaluated for use with the PTLA instrument.

Sample and Sampling Method

The purpose of this study was to see if a significant relationship exists between perceived competency levels of the 2018 ISTE Standards-EL and various demographic factors of Ohio principals. In order to allow for generalizability of the results, an appropriate sample needed to be used (Trochim & Donnelly, 2008). An appropriate sample size was critical to the internal validity to the study as it better represented the population as a whole and reduced the inherent sample error (Trochim & Donnelly, 2008; Salkind, 2013). Additionally, a higher response rate to the survey provided greater external validity to the sample as it was more inclusive of the demographic variables associated with the study (Trochim & Donnelly, 2008). At a minimum the design of the study selected a large enough sample size to meet Fowler's (1988) 95% confidence range based on an expected 35% response rate (Anseel, Lievens, & Schollaert, 2010).

Nonprobability, convenience sampling (Trochim & Donnelly, 2008) was used to survey Ohio K-12 public school principals. This study sample was considered a convenience sample because the survey was sent to emails of public school principals identified in the Ohio Educational Directory System (OEDS) database. The study's sample was those principals who elected to complete the 2018 PTLS and associated demographic questionnaire. Although convenience based in the response rate, the sampling method of this study was also purposive as it targeted principals specifically (Trochim & Donnelly, 2008). Both sampling methods were appropriate for this study as they are ways to quickly measure the results of the targeted group. In utilizing this sampling method, external validity was weakened as the results may not be representative of the total population (Trochim & Donnelly, 2008).

According to the OEDS database, there are approximately 2,976 Ohio public school principals. Fowler's (1988) sample size recommendations were followed to increase validity. A sample size of a minimum of 300 participants would yield a 5% error rate, given the fact that each item on PTLA has five choices or 20/80 variability to select from (Fowler, 1988, p. 42). Sample participants were sent an email with an introduction to the study, statement of risks associated with participation, and link to the

2018 PTLS at https://www.surveymonkey.com/r/2018PTLA. The link remained active for three weeks after the initial invitation was sent. Two additional reminder emails were sent 7 and 14 days from the initial survey invitation.

The advantages of using an online survey include easy access to the sample, and both time and cost savings (Wright, 2006). Glover and Bush (2005) found that online surveys were effective for gathering opinions and process, content, and philosophical issues. Disadvantages to online research include possible threats to validity due to instrumentation clarity, the candor of the participant responding, or working definitions of terms used. Additionally, the online format naturally favors those respondents who have some comfort with technology to begin with.

In a meta-analysis of response rates among organizational science works, Anseel et al. (2010) found a mean response rate of 35% with a standard deviation of 17.5% for surveys issued to those in executive or managerial roles. When this was applied to the population of 2,976 listed K-12 principals in OEDS database, the expected sample size was between 521 and 1,562 participants.

The online demographic questions and 2018 PTLS survey were accessed through an embedded SurveyMonkey link contained in the invitation to participate sent to Ohio public school district building principals as identified in the Ohio Educational System (OEDS) Database adding up to 2,796 possible participants. The invitation was sent to the identified OEDS email from the researcher's YSU email address. One weakness in this method is the sample is only as accurate as the principal information stored in the OEDS database. School districts are required to annually submit principal names and emails for state report card information, so it can be assumed the information was current up through the last school year (2017-2018).

Perspective participants were sent an email that had an embedded survey tab that took participants straight to the online, confidential SurveyMonkey survey that began with a consent form. The survey did not collect any individual or personal information. The survey was open for three weeks. Throughout the open period, the researcher sent two additional reminder emails to increase response rate. The reminder emails were sent at the start of the second week, with a follow-up email for willing participants to complete the survey at the beginning of the third week.

Data Collection and Privacy Practices

Data collection methods were approved by the Youngstown State Institutional Review Board. The collection methods established were within the guidelines and policies of the Institutional Review Board. Perspective participants were emailed a letter of introduction with the link to the survey. The total survey took about 15 minutes to complete. The first page of the survey was an informed consent page which included a link to the Survey Monkey privacy policy as well as providing appropriate, informed consent. All responses were kept confidential and at no time was identifying information used in the report findings. The survey data were made secure by enabling SSL encryption and anonymous by disabling IP address tracking.

Data Analysis

Participants in the study completed the web-based 2018 PTLS survey. Respondents self-reported answers corresponding to the five different categories of the 2018 ISTE Standards-EL. Respondents were asked to rate their level of engagement regarding each statement: (1) *Not at all*, (2) *Minimally*, (3) *Somewhat*, (4) *Significantly*, (5) *Fully*. Additional demographic and student technology access questions were asked to identify any significant correlations between standards mastery and demographic factors related to research questions #2 and #3.

Using the SyStat 13 statistical software, data from the PTLA and demographic questions were organized and analyzed for descriptive purposes. Mean, median, mode, standard deviation, skewness, and kurtosis were calculated for all questions. General descriptive statistics were computed for each of the five domains of the 2018 PTLS as well as to provide some base information on how Ohio principals who participated in the study self-report regarded their technology leadership abilities.

The self-reported mean scores on each of the five domains of the 2018 ISTE Standards-EL were compared to the demographic and level of technology implementation identified. The data were then examined using a factor analysis of variance to determine if any significant relationships existed between perceived levels of competence on the 2018 ISTE Standards-EL and demographic characteristics and student technology access (Salkind, 2013).

Limitations

This study was limited in the actual sample by only drawing from Ohio principals and therefore, has the potential not to be representative of all principals. In addition, the use of a convenient sample methodology and online delivery might not produce a representative sample of all subgroups. This could present a challenge to the external validity that will be mitigated using an appropriate sample size. Results from this study may not be appropriate and representative of administrators throughout all states and other countries. This design of this study is such that other researchers could replicate it in other states, which in turn, strengthens the external validity of the study.

The internal validity of concern for this study includes the face validity (Trochim & Donnelly, 2008) of the 2018 PTLS, specifically in the areas of leniency error, halo error, and recency error (Principals Technology Leadership Assessment, 2006). The instructions page of the 2018 PTLS specifically describe leniency error, halo error, and recency error to the participant along with suggestions for trying to reduce the errors in taking the instrument. Survey participant answers cannot be fully controlled and therefore this presents a challenge to the face validity of the PTLA and the internal validity of the study.

Chapter Summary

This study examined the perceived level of mastery of the 2018 ISTE Standards-EL of principals in Ohio schools. It then sought to see if any relationship exists between the self-reporting of the standards and various demographic characteristics or levels of implementation of a recent technology initiative. This study did not provide a prescriptive treatment of search for a cause of the level of mastery. It was solely looking for any relationship that may exist between the established variables. Benefits of this study include a contribution to the general knowledge base related to the 2018 ISTE Standards-EL. The results of this study can also assist in the leadership preparation programs of Ohio principals.

CHAPTER IV

RESULTS

The purpose of this quantitative, non-experimental study was to investigate the competency of the 2018 International Society for Technology in Education (ISTE) Standards for Education Leaders (ISTE Standards-EL) of Ohio principals as measured by the 2018 Principal Technology Leadership Assessment (2018 PTLS) in five domain areas: Equity and Citizenship Advocate, Visionary Planner, Empowering Leader, Systems Designer, and Connected Learner. Furthermore, this study investigated the relationship between standards competency and various demographic variables including school setting (i.e., urban, rural, or suburban), level, gender, years of experience in the principalship, age, and endorsement in technology or a technology related field. This study also looked at the relationship between competency on the ISTE Standards-EL compared to the level of implementation of a recent technology initiative. This study provided descriptive data that can be used in future studies regarding principal technology leadership. This chapter presents findings related to the 2018 PTLS and the demographic data collected. In addition, findings are presented as related to the research questions:

1. What is the self-reported competency level of Ohio Principals in each of the five 2018 ISTE Standards Education Leader domains: Equity and citizenship advocate, visionary planner, empowering leader, systems designer, connected learner, measured by the 2018 Principal Technology Leadership Survey (ISTE, 2018)?

2. Are differences in technology leadership competency correlated to demographic characteristics: gender, years in the principalship, age, has the participant earned a degree, license, certificate, or endorsement in technology or a technology related field school level, school environment, poverty level, and school size?
3. Is there a significant relationship between the technology leadership competency of principals as defined by the ISTE Standards-EL based with the current level of technology implementation levels of use on a recent technology initiative (Hall et al. 2006)?

Data were collected in accordance with the conditions set forth by the Youngstown State University's Internal Review Board. An online survey with related demographic questions was sent via email to the 2,796 Ohio principal email addresses identified in the Ohio Educational System (OEDS) database. Data were collected utilizing the secure, online platform SurveyMonkey and analyzed using SyStat 13 software. In addition, an inferential statistical test, ANOVA, was run to determine if there was a statistically significant difference between the technology leadership competencies of building principals and the demographic data collected.

Participant Response

The targeted population for the study was Ohio head principals listed in the OEDS database. Nonprobability, convenience sampling was used to select the participants in the study. A voluntary survey was sent electronically to identified principals along with three follow-up emails regarding the study. The online demographic questions and PTLA survey were accessed through an embedded Survey

Monkey link contained in the invitation to participate sent to Ohio public school district building principals from the researcher's YSU email address. The invitation had an embedded survey tab that took participants straight to an online, confidential Survey Monkey survey that began with a consent form. After giving permission, participants completed the 2018 PTLS and demographic questions. The survey remained open for three weeks. Throughout the open period, two additional reminder emails were sent. The initial email collected 23% of the participants' responses. The highest participant response day was immediately after the first reminder email was sent collecting 35% of the participants' responses.

Of the 2,796 emails sent to OEDS identified principals, 127 were returned as undeliverable due to an incorrect or inaccurate email address. Seven additional emails were returned by the district as being filtered out as potential SPAM mail. Email content is increasingly identified as SPAM by a variety of methods, the majority of which do not notify the sender (Fan & Yan, 2010). This leaves the final count of viable surveys at 2,662. Of the 2,662 surveys that were sent, 128 were completed for a response rate of 4.8%. Participants do not complete surveys for a variety of reasons including outright refusal, lack of topical interest, forgetfulness, and others (Fan & Yan, 2010). The concern regarding non-response in survey research is the impact on the generalizability of the study (Trochim & Donnelly, 2008).

There are two distinct types of non-response in survey research, item non-response and total non-response. This study had a total non-response rate of 95.2% where invited participants failed to respond at all. Item non-response refers to the survey being opened but not completed in its entirety. In this study, 37 participants gave permission but failed to complete the 2018 PTLS. In total the usable for this study was 91 leading to a response rate of 3.4%. The predicted response rate was between 17.5% and 52.5%. The concerns of the low response rate are discussed in Chapter V.

Demographic data were collected using SurveyMonkey and exported as a csv file into SyStat 13. Basic statistics on each of the individual standards statements for the total population as well as the average participant score for each of the domains were calculated using the SyStat 13 statistical program. Finally, a Pearson correlation coefficient was calculated between each of the 2018 ISTE Standards-EL domains and identified independent variables in which principals had to self-report including age, gender, years as an administrator, has the participant earned a degree, license, certificate, or endorsement in technology or a technology related field, type of school, school size as measured by average daily membership, school environment, percentage of student eligible for free or reduced lunch, and a description of the implementation level (Hall et al., 2006) of a recent technology initiative.

Demographic Data

Table 4.1 shows the demographic breakdown of the participants and their respective schools. Of the participating principals, 48.89% were between the ages of 40-49. Males represented 43.96% of respondents, and females represented 52.7% of respondents. Over 50% of the participants have between 5 and 14 years of administrative experience. Over 14% of the participants have earned a technology degree or endorsement in addition to their principal credential. Above 56% of the principals identified the school they lead as being in a suburban setting. Finally, 74.72% of the participating schools served contained less than 50% of students on free and reduced lunch.

Table 4.1

Demographic Data of Participants

Characteristic	Percent	Number
Age	n = 90	
20-29	1.11%	1
30-39	17.78%	16
40-49	48.89%	44
50-59	25.56%	23
60 +	6.67%	6
Gender	n = 91	
Male	43.96%	40
Female	52.75%	48
Prefer not to answer	3.30%	3
Years as an administrator	n = 91	
1-4	19.78%	18
5-9	25.27%	23
10-14	27.47%	25
15-19	14.29%	13
20-24	9.89%	9
Greater than 25	3.30%	3
Technology degree, license, or endorsement	n = 90	
Yes	14.44%	13
No	85.56%	77
School Type	n = 89	
Elementary School	42.70%	38
Middle School	17.98%	16
High School	29.21%	26

K-8	5.62%	5
K-12	4.49%	4
School Size	n = 90	
1-249	6.67%	6
250-499	42.22%	38
500-749	18.89%	17
750-999	12.22%	11
1000-1499	6.67%	6
1500 -1999	10.00%	9
2000 +	3.33%	3
School Setting	n = 91	
Urban	23.08%	21
Suburban	56.04%	51
Rural	20.88%	19
Poverty level	n = 91	
Less than 25% (low poverty)	26.37%	24
26%-50% (mid-low poverty)	48.35%	44
51%-75% (mid-high poverty)	7.69%	7
Greater than 75% (high poverty)	17.58%	16

Research Question 1: What is the self-reported competency level of Ohio principals in each of the five 2018 ISTE Standards Education Leader domains: Equity and citizenship advocate, visionary planner, empowering leader, systems designer, connected learner, measured by the 2018 Principal Technology Leadership Survey (ISTE, 2018)?

In looking at the mean reported score of Ohio principals in the 2018 ISTE-EL Standards, the mean for all reported standards by participants was above 2.5 on a scale of 1-5. Furthermore, all but two standards, I.4 to what extent did you engage in civil discourse online and using digital tools to contribute to positive social change?, and III.2 to what extend did you build the confidence and competency of educators to put the ISTE Standard for Students and Educators into practice?, showed a mean score of standard implementation of greater than 3. When a confidence level of 95% was applied to the data, two additional standards, II.1 to what extent do you engage education stakeholders in developing and adopting a shared vision for using technology to improve student success? and III.5 To what extent did you develop learning assessments that provide a personalized, actionable view of student progress in real time? were found to be not significant. Participants self-reported the strongest leadership in the standard of providing students access to technology and connectivity with a 4.12 mean, 95% CI [3.94, 4.30], and positive kurtosis of 1.27. Additional self-reported strengths with means over 4 (significantly participating) are in the area of digital citizenship M = 4.02, 95% CI [3.86, 4.19] and protection of privacy M = 4.40, 95% CI [3.86, 4.23]. It is of note that all three of these areas focus on the areas of accessing technology in a safe environment. The strongest domain by average scores as self-reported by Ohio principals is in the area of Equity and Citizenship with a category mean of 3.63, 95% CI [3.50, 3.76]. In terms of the standard needing the most growth was found to be I.4: To what extent did you engage in civil discourse online and using digital tools to contribute to positive social change? M = 2.77, 95% CI [2.55, 2.99]. The standard in which respondents showed the greatest amount of variation in the mastery was standard III.5. To what extent did you develop learning assessments that provide a personalized, actionable view of student progress in real time? M = 3.19, 95% CI [2.95, 3.43], SD = 1.15.

Table 4.2

Descriptive Statistics for 2018 PTLS Domain Means

2018 PTLA Statement	*M*	*SD*	*Kurt*
I. Equity and Citizenship	3.628	0.634	2.143
II. Visionary Planner	3.292	0.806	-0.172
III. Empowering Leader	3.538	0.752	0.738
IV. Systems Designer	3.547	0.7	-0.422
V. Connected Learner	3.422	0.813	-0.076

Note. M = mean, *SD* = Standard Deviation *Kurt* = kurtosis

Table 4.3

Descriptive Statistics for 2018 PTLS Survey Items

2018 PTLA Statement	*M*	*SD*	*Kurt*
I. Equity and Citizenship			
1. To what extent did you ensure all students have skilled teachers who actively use technology to meet student learning needs?	3.725	0.857	1.075
2. To what extent did you ensure all students have access to the technology and connectivity necessary to participate in authentic and engaging learning opportunities?	4.121	0.854	1.265
3. To what extent did you model digital citizenship by critically evaluating online resources?	3.489	0.963	-0.28
4. To what extent did you engage in civil discourse online and using digital tools to contribute to positive social change?	2.767	1.05	-0.561
5. To what extent did you cultivate responsible online behavior, including the safe, ethical and legal use of technology?	4.022	0.789	0.895
II. Visionary Planner			
1. To what extent did you engage education stakeholders in developing and adopting a shared vision for using technology to improve student success?	3.154	0.999	-0.514
2. To what extent did you build on the shared vision by collaboratively creating a strategic plan that articulates how technology will be used to enhance learning?	3.333	1.091	-0.409
3. To what extent did you evaluate progress on the strategic plan and make course corrections for using technology to transform learning?	3.242	0.923	0.018

2018 PTLA Statement	*M*	*SD*	*Kurt*
4. To what extent did you communicate effectively with stakeholders to gather input on the plan, celebrate successes and engage in a continuous improvement cycle?	3.341	1.002	-0.568
5. To what extent did you share lessons learned, best practices, challenges and the impact of learning with technology with other education leaders?	3.396	1.031	-0.315
III. Empowering Leader			
1. To what extent did you empower educators to exercise professional agency, build teacher leadership skills and pursue personalized professional learning?	3.956	0.842	1.303
2. To what extent did you build the confidence and competency of educators to put the ISTE Standards for Students and Educators into practice?	2.967	1.005	-0.252
3. To what extent did you inspire a culture of innovation and collaboration that allows the time and space to explore and experiment with digital tools?	3.689	0.932	-0.211
4. To what extent did you support educators in using technology to advance learning that meets the diverse learning, cultural, and social-emotional needs of individual students?	3.89	0.836	1.091
5. To what extent did you develop learning assessments that provide a personalized, actionable view of student progress in real time?	3.189	1.150	-0.653
IV. Systems Designer			
1. To what extent did you lead teams to collaboratively establish robust infrastructure and systems needed to implement the strategic plan?	3.198	0.945	0.006
2. To what extent did you ensure that resources for supporting the effective use of technology for learning are sufficient and scalable to meet future demand?	3.593	0.906	0.301
3. To what extent did you protect privacy and security by ensuring that students and staff observe effective privacy and data management policies?	4.044	0.886	-0.203
4. To what extent did you establish partnerships that support the strategic vision, achieve learning priorities, and improve operations.	3.356	1.009	-0.208
V. Connected Learner			
1. To what extent did you set goals to remain current on emerging technologies for learning, innovations in pedagogy and advancements in the learning sciences?	3.418	1.023	-0.224
2. To what extent did you participate regularly in online professional learning networks to collaboratively learn with and mentor other professionals?	3.088	1.061	-0.632

2018 PTLA Statement	*M*	*SD*	*Kurt*
3. To what extent did you use technology to regularly engage in reflective practices that support personal and professional growth?	3.736	0.953	-0.36
4. To what extent did you develop the skills needed to lead and navigate change, advance systems and promote a mindset of continuous improvement for how technology can improve learning?	3.456	0.85	-0.078

Note. M = mean, *SD* = Standard Deviation *Kurt* = kurtosis

Research Question 2: Are differences in technology leadership competency correlated to demographic characteristics: gender, years in the principalship, age, has the participant earned a degree, license, certificate, or endorsement in technology or a technology related field school level, school environment, poverty level, and school size?

Table 4.4 displays the averages of the self-reported scores in each of the domains of the 2018 ISTE Standards-EL separated by identified gender. Scores for male and female participants showed no significant variance in any one of the five domains. Results indicate that a principal's sex does not have an impact on their technology leadership abilities.

Table 4.4

Self-Reported Mean Leadership Score Compared by Gender

	Equity and Citizenship	Visionary Planner	Empowering Leader	Systems Designer	Connected Learner
			Female		
n	48	48	48	48	48
M	3.657	3.203	3.533	3.573	3.406
SD	0.573	0.737	0.672	0.652	0.780
			Male		
n	40	40	40	40	40
M	3.620	3.385	3.570	3.538	3.485
SD	0.719	0.899	0.865	0.779	0.870
			Pearson Correlation Coefficient		
R	-0.02	-0.08	-0.06	-0.02	-0.11

Note: n = number of cases, *M* = mean, *SD* = standard deviation $p < .05$

Table 4.5 and Figure 4.1 display the averages of the self-reported scores in each of the domains of the 2018 ISTE Standards-EL separated by age. One observation from the data is in categories with more than one participant, as participants get older, scores in the domains visionary planner and connected learner decrease on average. The Pearson correlation coefficient was calculated for all domains and a weak negative relationship was found between the administrator age and the visionary planner domain (- 0.23, n = 90) and connected learner (-0.23 n = 90 $p < .05$). The other three domains of the 20018 ISTE Standards-EL equity and citizenship (-0.07 n = 90, $p < .05$), empowering leader (-0.12 n = 90, $p < .05$), and systems designer (-0.03 n = 90, $p < .05$) showed no statistically significant relationships.

Table 4.5

Self-Reported Mean Leadership Score Compared by Principal Age

	Equity and Citizenship	Visionary Planner	Empowering Leader	Systems Designer	Connected Learner
			20-29		
N	1	1	1	1	1
M	2.600	3.400	3.600	2.500	3.500
			30-39		
n	16	16	16	16	16
M	3.837	3.537	3.703	3.750	3.844
SD	0.642	0.648	0.613	0.665	0.700
			40-49		
n	44	44	44	44	44
M	3.600	3.318	3.518	3.466	3.398
SD	0.534	0.785	0.704	0.673	0.746
			50-59		
n	23	23	23	23	23
M	3.650	3.296	3.589	3.674	3.301
SD	0.613	0.863	0.840	0.755	0.894
			60 +		
n	6	6	6	6	6
M	3.400	2.458	3.133	3.292	3.083
SD	1.207	0.888	1.150	0.732	1.080

	Equity and Citizenship	Visionary Planner	Empowering Leader	Systems Designer	Connected Learner
	Pearson Correlation Coefficient				
R	-0.07	-0.23	-0.115	-0.03	-0.23

Note: n = number of cases, *M* = mean, *SD* = standard deviation $p < .05$

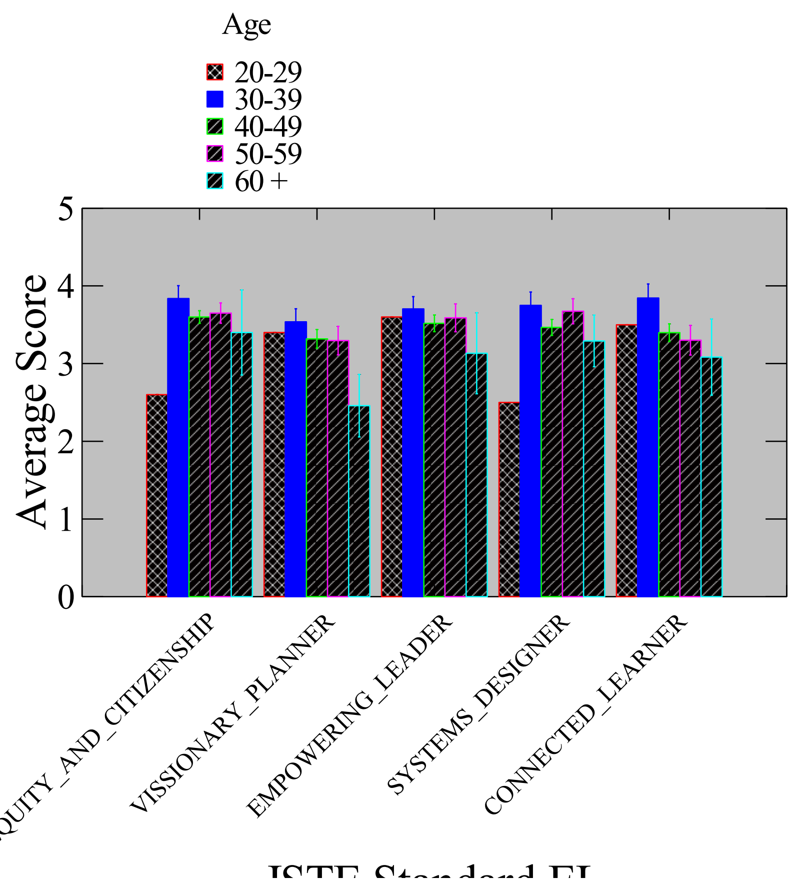

Figure 4.1. Self-reported average score in each of the 208 ISTE Standards-EL domains by reported age.

When administrative experience is compared to self-reported competency on the ISTE Standards-EL, a gap in average scores in each of the five domains is present when administrators with more than 25 years of experience are compared to other groups. When more closely examined, the sample size of three combined with the standard deviation in each domain for 25 plus year administrators of over one makes this finding moot. Pearson correlation coefficients calculated between years of administrative experience and each domain showed no significant relationship ($p < .05$) between any two variables. Table 4.6 provides more specifics related to these data.

Table 4.6

Self-Reported Mean Leadership Score Compared by Years as an Administrator

	Equity and Citizenship	Visionary Planner	Empowering Leader	Systems Designer	Connected Learner
			1-4 Years		
n	18	18	18	18	18
M	3.478	3.200	3.414	3.319	3.347
SD	0.655	0.776	0.815	0.831	0.692
			5-9 Years		
n	23	23	23	23	23
M	3.670	3.296	3.626	3.598	3.565
SD	0.608	0.809	0.686	0.629	0.755
			10-14 Years		
n	25	25	25	25	25
M	3.804	3.432	3.568	3.650	3.577
SD	0.523	0.787	0.652	0.692	0.907
			15-19 Years		
n	13	13	13	13	13
M	3.462	3.092	3.415	3.500	3.115
SD	0.506	0.651	0.624	0.559	0.712
			20-25 Years		
n	9	9	9	9	9
M	3.806	3.528	3.794	3.667	3.444
SD	0.515	0.905	0.825	0.625	0.737
			Greater Than 25 Years		
n	3	3	3	3	3
M	2.933	2.800	3.133	3.500	2.750
SD	1.677	1.562	1.890	1.392	1.561
			Pearson Correlation Coefficient		
R	**- 0.01**	**0.00**	**0.02**	**0.10**	**- 0.10**

Note: *n* = number of cases, *M* = mean, *SD* = standard deviation **$p < .05$**

When compared to mastery of the ISTE Standards-EL domains, the possession of a technology teaching license, endorsement, or degree made no discernable difference in the observed sample as listed in Table 4.7.

Table 4.7

Self-Reported Mean Leadership Score Compared by Earning a Technology License

	Equity and Citizenship	Visionary Planner	Empowering Leader	Systems Designer	Connected Learner
			Has a Technology License or Endorsement		
n	13	13	13	13	13
M	3.677	3.215	3.631	3.481	3.462
SD	0.557	0.680	0.770	0.710	0.721
			Never had a Technology License or Endorsement		
n	77	77	77	77	77
M	3.618	3.301	3.519	3.555	3.408
SD	0.652	0.832	0.757	0.707	0.834
			Pearson Correlation Coefficient		
R	**-0.03**	**0.04**	**-0.05**	**0.04**	**-0.02**

Note: n = number of cases, *M* = mean, *SD* = standard deviation ***p* < .05**

In addition to demographic questions about the principal as a whole, questions were asked about the school the principal leads. These data were analyzed by the mean score the principal reported in each of the domains for the 2018 ISTE Standards-EL and descriptive statistics were analyzed for these was well. The ANOVA test was used as well in an attempt to find group differences between any of the school demographic variables and ISTE domains. No causation was found for any of the demographic variables related to self-reported domain competency.

Table 4.8 and Figure 4.2 display the results by school type, Elementary, Middle, High School, K-8 and K-12. For data purposes, elementary schools were identified as a school that contained the grades K, 1, 2, and 3 and did not have students in grades 7 or 8. Middle schools were identified as schools that contained some band configuration of students in grades 5-8 including 5-6 buildings, 6-8 buildings, 7-8 buildings, etc. High schools were identified as schools who educate students in grades 10-12 at a minimum. K-8 and K-12 identifications were used if students grades K-8 or K-12 respectively attended the school. In examining the school data, principals in K-12 building scored the highest in each of the domains; however, they also had the smallest sample size. Middle school principals self-identified empowering leader as their strongest domain M = 3.82 95% CI [3.38, 4.25]. Both elementary and high school principals showed strength in the equity and citizenship domain M = 3.65, 95% CI [3.48, 3.82] (elementary schools) and M = 3.54, 95% CI = [3.21, 3.87] respectively.

Table 4.8

Self-Reported Mean Leadership Score Compared by School Level

	Equity and Citizenship	Visionary Planner	Empowering Leader	Systems Designer	Connected Learner
			Elementary School		
n	38	38	38	38	38
M	3.651	3.253	3.489	3.513	3.388
SD	0.517	0.718	0.627	0.673	0.702
			Middle School		
n	16	16	16	16	16
M	3.737	3.472	3.816	3.734	3.578
SD	0.605	0.923	0.812	0.588	0.934
			K-8 Building		
n	5	5	5	5	5
M	3.600	3.040	3.640	3.800	3.250
SD	0.812	0.984	0.921	0.818	0.468
			High School		
n	26	26	26	26	26
M	3.538	3.215	3.390	3.365	3.413
SD	0.825	0.898	0.885	0.801	0.972
			K-12 Building		
n	4	4	4	4	4
M	3.800	3.650	3.950	4.063	3.729
SD	0.163	0.342	0.379	0.427	0.747

Note: n = number of cases, *M* = mean, *SD* = standard deviation

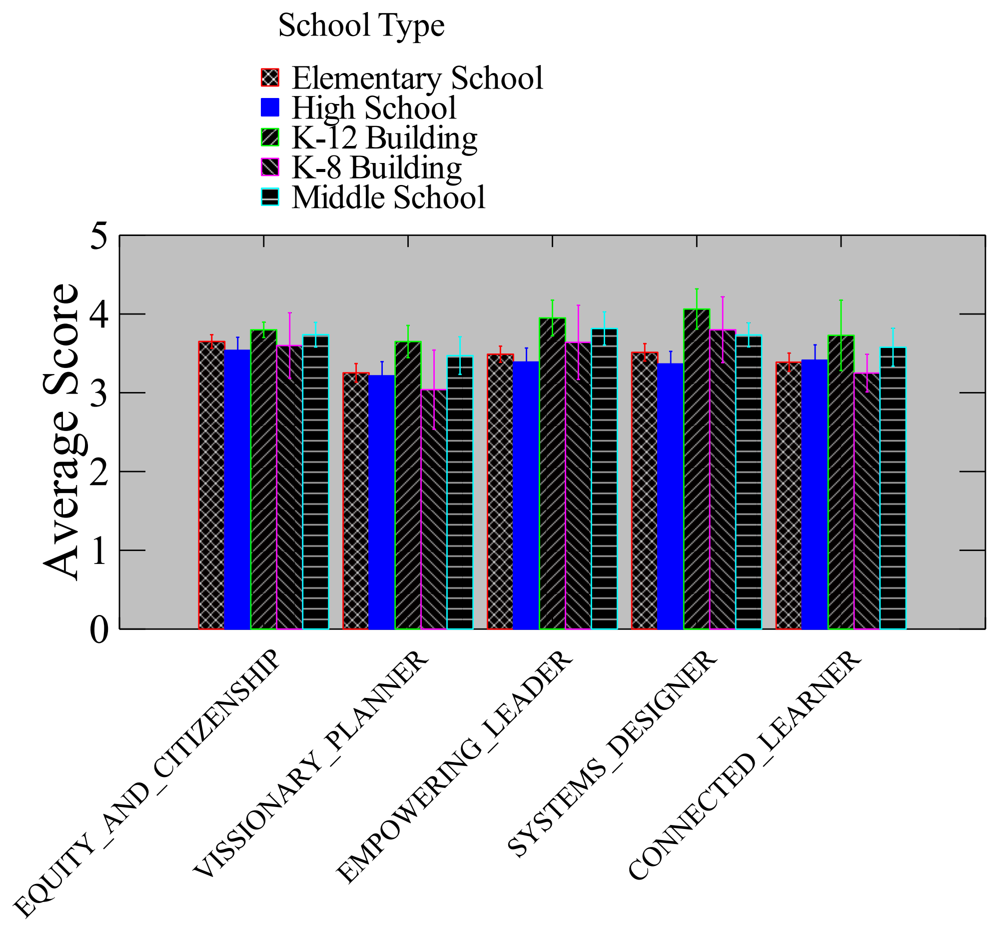

Figure 4.2. Self-reported average score, in each of the 208 ISTE Standards-EL domains by school type.

Table 4.9 and Figure 4.3 list the mean reported ISTE-EL domain scores when compared by identified school environment (rural, suburban, and urban). It is of note, but not statistically significant that principals of rural schools self-reported higher averages on the ISTE-EL domains than their colleagues in either suburban or urban environments.

Table 4.9

Self-Reported Mean Leadership Score Compared by School Environment

	Equity and Citizenship	Visionary Planner	Empowering Leader	Systems Designer	Connected Learner
			Suburban		
n	51	51	51	51	51
M	3.624	3.314	3.479	3.466	3.446
SD	0.703	0.829	0.820	0.725	0.861
			Urban		
n	21	21	21	21	21
M	3.569	3.102	3.502	3.607	3.202
SD	0.570	0.846	0.757	0.752	0.753
			Rural		
n	19	19	19	19	19
M	3.705	3.442	3.737	3.697	3.601
SD	0.514	0.688	0.521	0.563	0.724

Note: n = number of cases, *M* = mean, *SD* = standard deviation

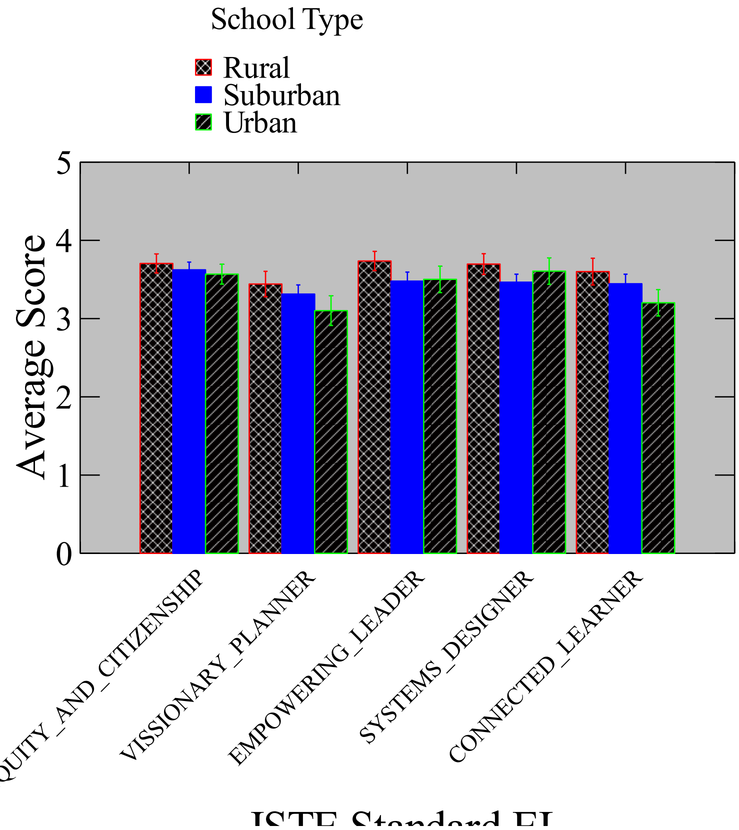

Figure 4.3. Self-reported average score, with standard error, in each of the 208 ISTE Standards-EL domains by school type.

When school size measured by average daily attendance is compared to average self-reported domain average on the ISTE-EL domains, a slight trend is noticed that as school size increases up to 1,499 students, leadership skills increase. Large schools over 1,500 students show the principal's average domain score for each of the ISTE-EL domains. When calculated for a Pearson correlation coefficient, all domains showed no statistically significant relationship compared to school size.

Table 4.10

Self-Reported Mean Leadership Score Compared by School Size

	Equity and Citizenship	Visionary Planner	Empowering Leader	Systems Designer	Connected Learner
			1-249		
n	6	6	6	6	6
M	3.367	2.500	3.033	3.208	3.083
SD	0.638	0.892	0.753	0.749	0.563
			250-499		
n	38	38	38	38	38
M	3.578	3.316	3.589	3.579	3.336
SD	0.645	0.802	0.723	0.668	0.795
			500-749		
n	17	17	17	17	17
M	3.718	3.118	3.482	3.500	3.500
SD	0.553	0.633	0.765	0.673	0.848
			750-999		
n	11	11	11	11	11
M	3.873	3.632	3.768	3.841	3.652
SD	0.553	0.663	0.581	0.516	0.833
			1000-1499		
n	6	6	6	6	6
M	4.000	3.800	3.892	3.917	3.917
SD	0.358	0.727	0.656	0.585	0.719
			1500-1999		
n	9	9	9	9	9
M	3.222	3.067	3.267	3.083	3.139
SD	0.604	0.748	0.872	0.673	0.741
			2000 +		
n	3	3	3	3	3
M	4.067	3.733	3.600	3.750	3.917
SD	1.137	1.419	1.400	1.561	1.465
			Pearson Correlation Coefficient		
r	**0.07**	**0.16**	**0.04**	**0.00**	**0.12**

Note: *n* = number of cases, *M* = mean, *SD* = standard deviation ***p* < .05**

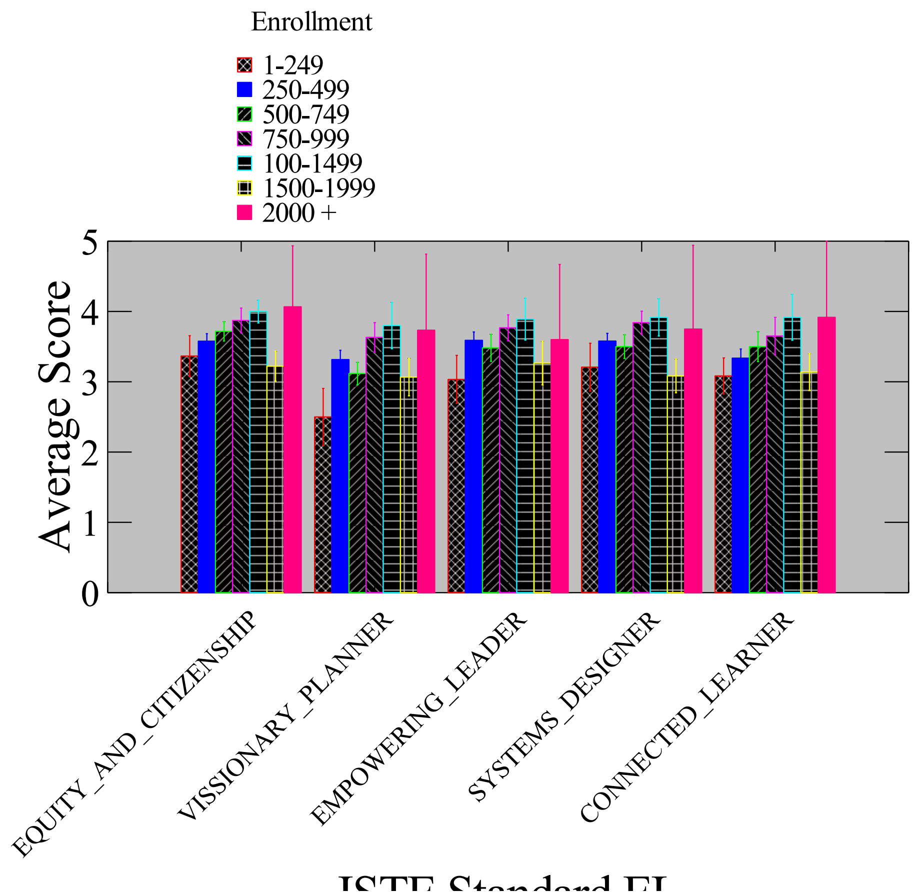

Figure 4.4. Self-reported average score, with standard error, in each of the 208 ISTE Standards-EL domains by enrollment.

The last of the school demographics investigated was school poverty level. School poverty level is determined by the percentage of students in the school who qualify for federal free and reduced lunch programs. When calculated for significant correlation, a negative trend emerged between all of the domains except Systems Designer and poverty level, yet no statistically significant correlation was found with all Pearson correlation coefficients being less than -.02.

Table 4.11

Self-Reported Mean Leadership Score Compared by School Poverty Level

	Equity and Citizenship	Visionary Planner	Empowering Leader	Systems Designer	Connected Learner
			Low poverty (less than 25%)		
n	24	24	24	24	24
M	3.825	3.492	3.675	3.708	3.531
SD	0.597	0.857	0.729	0.674	0.712
			Mid-low poverty (26%-50%)		
n	44	44	44	44	44
M	3.586	3.318	3.533	3.432	3.515
SD	0.555	0.646	0.662	0.659	0.780
			Mid-high poverty (51%-75%)		
n	7	7	7	7	7
M	3.000	2.486	2.800	3.107	2.429
SD	0.917	0.965	1.083	0.690	0.910
			High poverty (greater than 75%)		
n	16	16	16	16	16
M	3.722	3.272	3.672	3.813	3.438
SD	0.619	0.911	0.740	0.750	0.777
			Pearson Correlation Coefficient		
r	**-0.11**	**-0.15**	**-0.06**	**0.02**	**-0.12**

Note: n = number of cases, *M* = mean, *SD* = standard deviation $\boldsymbol{p < .05}$

Research Question 3: Is there a significant relationship between the technology leadership competency of principals as defined by the ISTE Standards-EL based with the current level of technology implementation levels of use on a recent technology initiative (Hall et al. 2006)?

Levels of use (LoU) is an approach to any school-based innovation which investigates the extent of implementation of any process or procedure (Hall et al., 2006). LoU focuses on the behavior of the implementation of the innovation and not the quality of the innovation or the attitudes and beliefs about the innovation by those implementing it (Hall et al., 2006). The eight levels of use in order from least to most are: nonuse, orientation, preparation, mechanical use, routine, refinement, integration, and renewal.

Figure 4.5 compares the level of use statement on the participant survey with the corresponding level description as described by Hall et al. (2006).

Nineteen participants identified the last technology initiative as in the refinement (IV.B) level of use. This corresponds with the statement, "Teachers/adults are routinely implementing new technology with students." Sixty-four (71%) of the principals described their teachers as at or above the refinement stage (IV.B) when reflecting on the most recent building technology initiative in their school. Table 4.12 displays the numbers, mean scores, and standard deviation for self-reported principal leadership on each of the domains of the levels of ISTE-EL standards compared by the identified LoU for a recent technology initiative in their building. Figure 4.5 displays this information graphically.

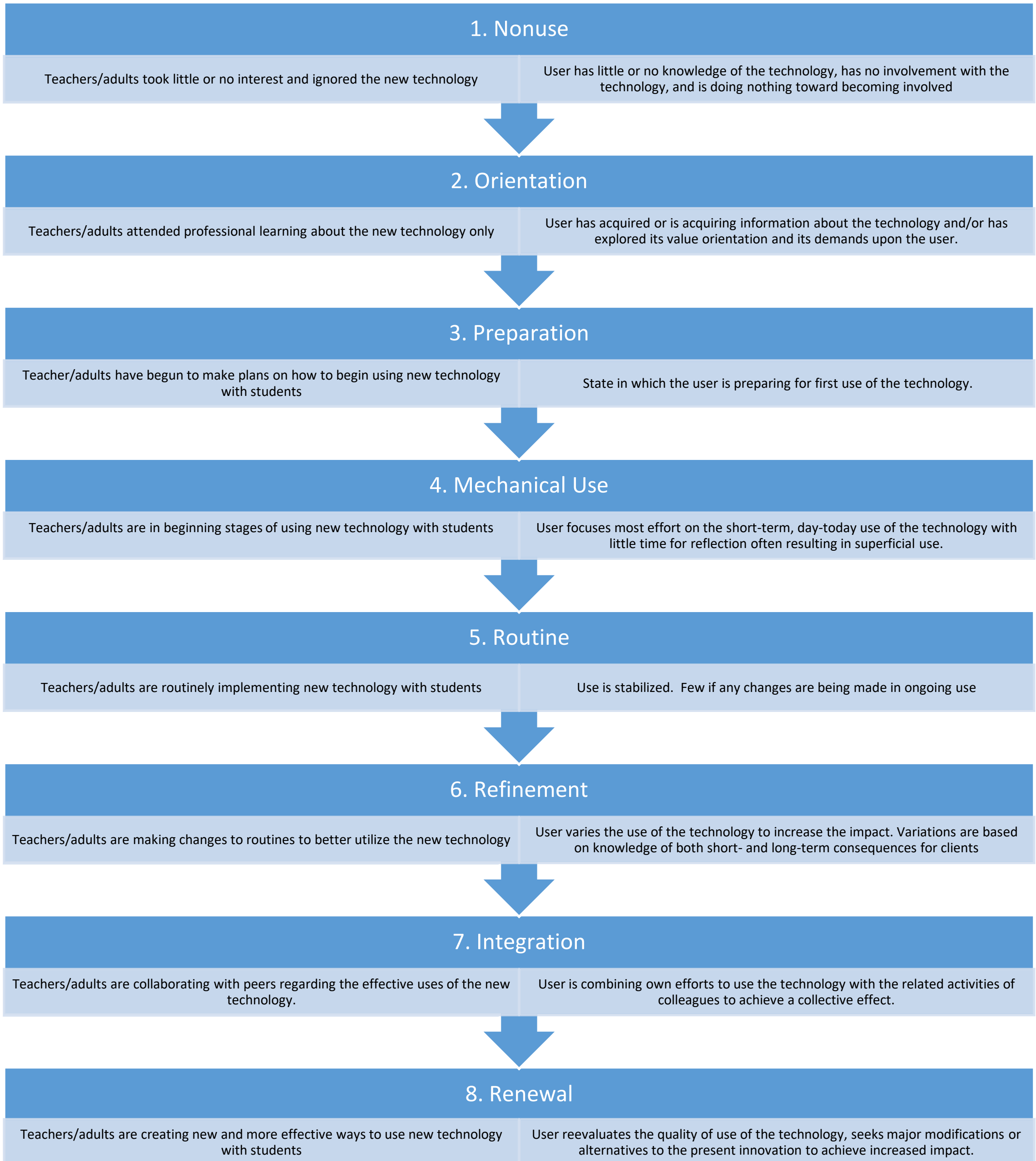

Figure 4.5. Levels of implementation with question from participant survey on left side and level descriptor on right side (Hall et at. 2006)

When the LoU of participants was compared with each of the five domains using the Pearson correlation coefficient, weak to moderate correlations were found (Table 4.12, Figure 4.6). The domain of Equity and Citizenship was found to moderately correlate with a value of 0.44. All other domains showed a weak relationship. The null hypothesis can be rejected in relationship to the domain Equity and Citizenship as the power for a sample size of 90 at .95 confidence is .993.

Table 4.12

Pearson Correlation Coefficient Values for Levels of Implementation by Leadership Standard

Standard	Correlation Size
Equity and Citizenship	0.44
Visionary Planner	0.32
Empowering Leader	0.36
Systems Designer	0.33
Connected Learner	0.23

Note: n = 90 p < .05

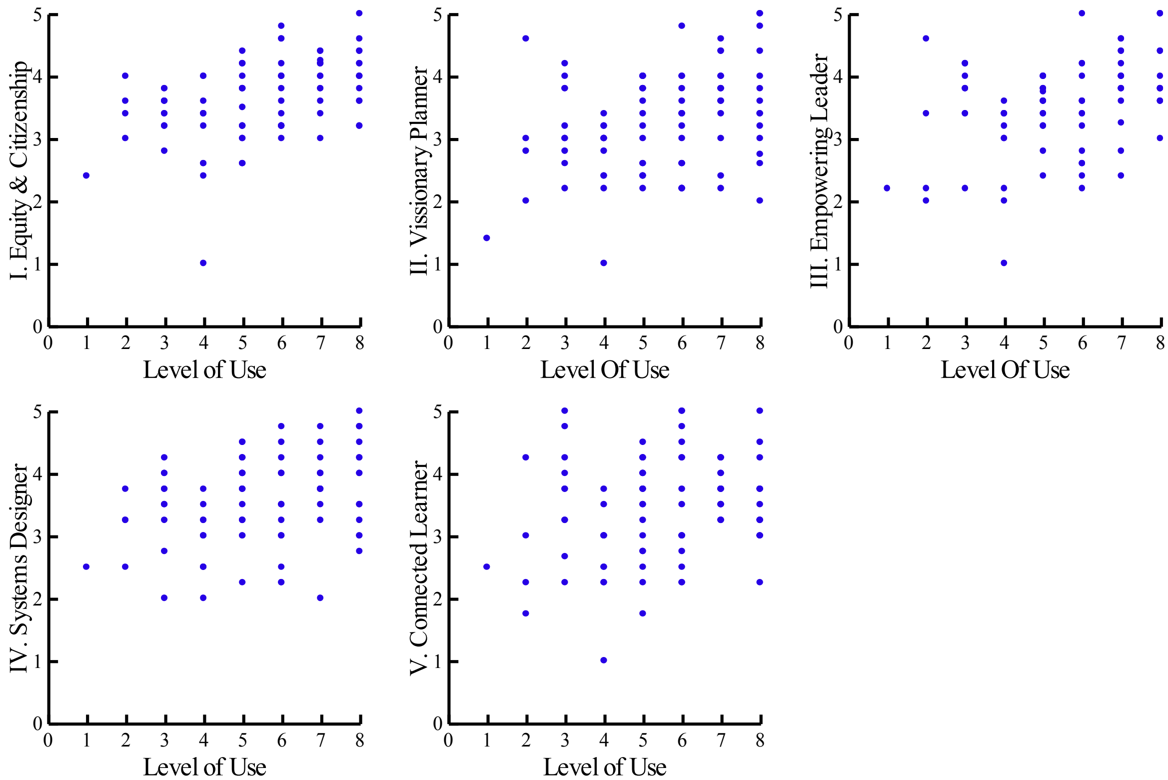

Figure 4.6. Scatterplot of LoU by 2018 ISTE Standards-EL Domain

Summary

This chapter presented the results from the 2018 PTLA descriptive survey. Ohio principals identified in the OEDS database were the population for the study. The 2018 PTLA data from the sample were used to determine if any relationship exists between the self-reporting of the standards and various demographic characteristics or student access to technology.

This study sought to answer three research questions. The first research question explored the descriptive statistics for Ohio principals' self-reported technology leadership as measured by the 2018 PTLA. Mean, standard deviation, and kurtosis were listed for the sample for each of the associated statements. Descriptive statistics were also calculated for the mean values for the each of the statements in the five domains of the ISTE Standards-EL.

The second and third research questions sought to seek a relationship between the domains of the ISTE Standards-EL and different factors. The second question explored principal demographic information. The results found no significant correlation between principal or site demographics and technology leadership ability. The final research question investigated a correlation between LoU of a recent building technology initiative and self-reported mastery of the domains of the ISTE Standards-EL. Pearson correlation coefficient were calculated when appropriate. Weak correlations were found when age is compared to the visionary planner and connected learner domains. A moderate correlation was found between the LoU of a recent technology initiative and the Equity and Citizenship domain. The other four domains showed a week correlation when compared to LoU of a recent technology initiative.

CHAPTER V

SUMMARY OF THE STUDY

A principal's technology leadership ability directly impacts the level of technological integration in the classroom and teachers' technology use (Anderson & Dexter, 2005; Chang, 2012; Greaves et al., 2017; Machado & Chung, 2015). Principals, who serve as change leaders in their buildings, guide the transition of technology integration to use digital tools that enable learners to enhance problem-solving skills and conceptualize information at higher levels of cognition (Pautz & Sadera, 2017; Sauers & McLeod, 2012; Sheppard & Brown, 2014). It is the building leader's responsibility to assist teachers and staff into transitioning to this new environment and to ultimately support teaching and learning processes (November, 2012). The International Society for Technology in Education (ISTE) developed leadership standards to serve as benchmarks to technology integration for schools. The 2018 International Society for Technology in Education Standards for Educational Leaders (208 ISTE Standards-EL) provides guidelines for educational leaders to support technology-rich learning environments in this reimagined, innovative, learning environment (International Society for Technology in Education, 2018).

The purpose of this study was to examine the level of competency of the 2018 ISTE Standards-EL of Ohio building principals. This study also sought to investigate differences in self-reported technology leadership competency when correlated to various demographic characteristics of building principals and schools. Finally, this study compared the self-reported level of proficiency of the 2018 ISTE Standards-EL compared to the current level of use (LoU) of the most recent technology initiative (Hall et al., 2006). Descriptive statistics were presented as well as the Pearson correlation coefficients in areas in which a statistically significant correlation existed. This chapter discusses the findings of the study, the limitations to the study, the significance of the study, and implications for future research.

Summary of Findings

Principal Demographics

Study participants represented a cross-section of Ohio principals. Of the participating principals, 30.0% were between the ages of 40-49 with 5-14 years of administrative experience. This means that most principals were in the midrange of their careers. The majority of the educators most likely began their careers as teachers when beginning forms of digital technology were being introduced as learning tools. In the classroom, these leaders were most likely experimenting with ways to utilize new digital technologies for student learning. Educational technology integration was a part of their daily instruction and not new tools or skills they needed to learn. As these leaders moved from teaching to a leadership role, they continued to gather new experiences attending and running professional learning opportunities on new technologies. Claro, Nussbaum, Lopez, and Contardo (2017) found that principals with the highest levels of technology integration in the schools they led had direct experience implementing the technology as teachers.

Over 14% of the participants have earned a technology degree or endorsement in addition to their principal credential. As leaders with technology degrees and expertise, this study has intrinsic meaning, one with a personalized connection for them, making this group more likely to complete the survey (Saleh & Bista, 2017). As principals who have worked to gain a technology endorsement or degree, these leaders have significant coursework and training in using a variety of technology for student learning. This formal training would lead them to a higher starting proficiency on the 2018 ISTE Standards-EL than their counterparts.

School Demographics

Demographic information was also collected about school typography. Above 52% of the principals identified the school they lead as being in a suburban setting with less than 50% of students on free and reduced lunch. This is slightly higher than state of Ohio school typology information which indicates that 46% of Ohio students attend suburban districts with less than 50% poverty (Ohio Department of Education, 2015). Elementary principals who led buildings of less than 750 students comprised 41.6% of the study population. Wood and Howley (2012) found that Ohio students in affluent suburban schools demonstrated more sophisticated technology use than their peers in higher poverty, rural, or urban areas. Of the 26 responding high school principals, 69.2% led buildings with more than 750 students. High school principals made up 29.2% of the study. This appears to be representative of the population surveyed as there are more elementary schools in Ohio, and these schools tend to be smaller in size. According to the Ohio Department of Education Report Card (2018), elementary schools make up 44.5% of the school buildings in Ohio; middle and high school participants made up 18.0% and 29.2%, respectively. Statewide, 18.4% of Ohio schools would be categorized as high schools and 22.8% would be categorized as middle schools in this study (Ohio Department of Education, 2018). Principals of K-8 schools made up 5.62% of this study, compared to 7.36% in Ohio. Less than one percent of Ohio schools are categorized as K-

12 (Ohio Department of Education, 2018), yet 4.49% (n = 4) of study participants identified as K-12 leaders. The study sample of building leaders was abnormally small which does not provide the heterogeneity needed for generalizability or avoiding type I and type II conclusion validity errors. The small sample size also has a low power for statistical analysis to detect significant differences.

Research Question 1: What is the self-reported competency level of Ohio principals in each of the five 2018 ISTE Standards Education Leader domains: Equity and citizenship advocate, visionary planner, empowering leader, systems designer, connected learner, measured by the 2018 Principal Technology Leadership Survey (International Society for Technology in Education, 2018)?

Participants were asked to complete the 2018 Principals Technology Leadership Assessment (2018 PTLA) which provides an opportunity to define relative strengths and challenges for each of the five 2018 ISTE Standards-EL domains. Each of the statements in the PTLA is organized in an ordinal response format with choices being (1) *Not at all,* (2) *Minimally,* (3) *Somewhat,* (4) *Significantly,* and (5) *Fully* (McLeod, 2005; Trochim & Donnelly, 2008). Average scores in a domain area closer to five represent an area of strength for that leader. Average scores closer to one in a domain represent limited knowledge or involvement in that domain and a potential area of growth. An average score of 3 represents the leader is, at minimum, proficient in the area. Descriptive statistics were calculated for participant responses for each of the 22 descriptive indicators as well as the mean scores in each of the domains of the 2018 ISTE Standards-EL: Equity and Citizenship, Visionary Planner, Empowering Leader, Systems Designer and Connected Leader (International Society for Technology in Education, 2018).

Results from this study showed that participants, on average, scored above a 3 in each of the five domains of the 2018 ISTE Standards-EL. The self-reported high competency was the Equity and Citizenship domain (M = 3.63). The domain with the lowest self-reported competency was Visionary Planner (3.29). These results indicate that for all domains, Ohio principals are somewhat aware of the competencies deemed essential for technology leadership (International Society for Technology in Education, 2018). This result is important as it shows that study participants are, at a minimum, somewhat implementing the necessary skills to establish a future-ready learning environment for students in their schools. These leaders are demonstrating the appropriate mindset and establishing a culture of change within their buildings to support appropriate digital learning.

Results also showed that Ohio principals showed the greatest amount of variance in domain of Connected Learner, SD = 0.81. When the connected learner domain statements are analyzed, they focus on the personal, professional growth of the leader and not the interactions with students and teachers. The large standard deviation points to the notion that professional growth for Ohio principals is varied in value compared to the other domains of the 2018 ISTE Standards-EL. In analyzing the demographic subgroups, principal age seemed to impact the connected learner standard deviation. Principals who were 30-39 years old had a mean score of 3.84, while those in the 60 + age group identified a mean score of 3.08. Principals in their 30s are most likely to be digital natives and used to connecting with others through social media and other digital platforms. Principals above 60 years old are digital immigrants and have a need to learn the basics of how these social media platforms work prior to the advanced use for personal growth.

I. Equity and Citizenship

The domain of equity and citizenship describes a principal's leadership in leveraging technology to promote access to all in a safe environment (International Society for Technology in Education, 2018). Study participants had a mean score of 3.63 (SD = 0.63), 95% CI [3.50, 3.76]. This domain was the greatest area of strength for study participants. Within this domain, participants showed their greatest strengths to be in the areas of providing access to technology M = 4.12 and cultivating safe online use M = 4.02. These relative strengths of these two standards are consistent with Anderson and Dexter's (2005) finding that as technology access increases so does the technology leadership in a school. The relative strengths in these areas can also be attributed to a culture of federal and state compliance. As information technology has increased, laws and regulations surrounding safe and ethical use for students has as well. Modern principals have to manage cyberbullying and other technology-related discipline issues. Furthermore, through the Every Student Succeeds Act (ESSA), federal Title I funds were diverted to be used to provide access to technology in schools. The amount of federal Title I funds awarded is directly related to the percentage of poverty in the school. This is a way to force equity of access to all students (Office of Ed. Tech, 2016; U.S. Department of Education, 2016). The self-reported high level of proficiency for these two statements within the Equity and Citizenship domain relates to technology leadership at the compliance level.

Findings also show that Ohio principals' greatest area to grow within the domain of Equity and Citizenship is in the area of engaging in online civil discourse and using tools to contribute to positive social change (International Society for Technology in Education, 2018) M = 2.77 (SD 1.05) 95% CI [2.55, 2.99]. It is of note that this statement also showed the greatest amount of variance within the domain. Whereas the source of the variation cannot be identified, partly due to the small sample size, it is of note that this statement is an expression of a high LoU of any technology initiative. By engaging in civil discourse and promoting change, users are reimagining the use of the device to achieve a broader impact. Furthermore, proficiency in this domain represents principals who are modeling important traits of modern leadership theory through their technology leadership. Modern educational leaders understand the value in empowering stakeholders for organizational change (Anderson, 2017; Bass, 1990; Leithwood & McCullough, 2016). Self-reported higher scores in this area represent a school environment in which the principal promotes the use of technology to provide student voice and choice in an interconnected world (Fullan, 2013b; November, 2013; Sheninger, 2014; Wagner, 2014).

II. Visionary Planner

The leadership domain of Visionary Planner showed the most area for growth in study participants M = 3.29 (0.81) 95% CI [3.12, 3.46]. This domain focuses on the leadership characteristics of visioning and strategic planning (International Society for Technology in Education, 2018). In a traditional K-12 environment, those directly involved with the vision and strategic plan of the district are in central office administrative roles and not of the principalship.

In analysis of the five statements supporting this domain, principals' biggest area of growth was in the need to engage education stakeholders to develop a shared vision of technology to improve student success M = 3.15 (1.0) 95% CI [2.95, 3.36]. Principal self-reported competencies within this domain increased as the role shifted from creating a vision (II.1) to building the vision (II.2), communicating the vision (II.4), and sharing best practices (II.5). At the building level, principals may have a limited role in creating the district vision, but they are the ones in the leadership role charged with implementing that vision and sharing best practices with colleagues regarding the processes of implementation.

III. Empowering Leader

In the Empowering Leader domain, technology leaders create a culture of distributed leadership and encourage innovation in teaching and learning (International Society for Technology in Education, 2018). Study participants self-reported a domain mean of 3.54 (.081) 95% CI [3.38, 3.70]. In ordinal ranking this domain showed both the third highest mean and variance of the five domains. A mean score of above 3.5 on this domain indicates that Ohio principals feel they somewhat to significantly empower others to use technology to enhance learning.

Analysis of the five statements within this domain shows a range of mean responses from 2.97 – 3.96. Principals reported the greatest competency in building teacher leadership skills and pursuing personalized professional learning M = 3.96 (.84) 95% CI [3.78, 4.13]. Principals understand that choice in learning is a significant motivator and empowering others to lead gains respect and trust (Leithwood & McCullough, 2016; Pink, 2011). The lowest self-reported mean score was in the area of putting ISTE Standards for Students and Educators in place M = 2.97 (1.01) 95% CI [2.76, 3.18]. In 2017 the state of Ohio introduced new learning standards for technology. These learning standards were drafted from the ISTE standards for students and other sources (Ohio Department of Education, 2019). In respect to the 2018 PTLA, reference to the ISTE standards and the Ohio Technology Standards could have resulted in lower self-reported scores by Ohio principals on this statement.

The Ohio Department of Education released updated standards for principals in 2018. These are the benchmarks by which a principal is to be evaluated. Within the revised Ohio principal standards, a reference to technology is specifically mentioned one time with relationship to equity and access. The remainder of the standards fail to explicitly address technology leadership and use, yet many of the concepts behind the principal standards are in line with the 2018 ISTE-EL including visionary leader, equity, and strategic planning (Ohio Department of Education, 2018b).

IV. Systems Designer

The domain of Systems Designer had the second highest self-reported mean score with the second lowest standard deviation M = 3.55 (0.70) 95% CI [3.40, 3.69]. This domain captures the technology leader's ability to support continuous improvement in the use of technology to support learning (International Society for Technology in Education, 2018). The mean score on this domain indicates that participating Ohio principals have established a system of leadership that develops experts in different areas of expertise and provides them with opportunities for input (Fullan, 2013a. Hargreaves & Fink, 2006).

The Systems Designer domain was supported by four statements on the 2018 PTLA. Both the statement which had the highest reported mean and lowest reported mean in this domain are typically functions of district level leadership and building level leadership. Ohio principals self-reported that, on average, they significantly have practices to ensure students and staff observe effective privacy and data management policies M = 4.04 (0.89) 95% CI [3.86, 4.23]. In Ohio schools, student and staff privacy, along with data management policies are covered in district's technology acceptable use policy. The signature on this standardized district form works to establish a starting point towards this privacy management. Ohio principals reported the largest area for growth within the systems designer domain with regards to collaboratively designing infrastructure and systems to implement the strategic plan M = 3.20 (.095) 95% CI [3.38, 3.70]. The implementation of infrastructure is one that is typically reserved for the district technology director or chief technology officer (Anderson, 2006). Traditional principal technology leadership roles involve utilizing the established infrastructure to improve teacher efficacy and student learning. It is the goal of this strand of the Systems Designer domain to make the building level leader a part of the planning to better meet the needs of all students in a connected world.

V. Connected Learner

The fifth domain of the 2018 ISTE Standards-EL focuses on the leader's professional development of themselves and others. This domain had the second lowest self-reported mean, with the highest standard deviation M = 3.42 (.81) 95% CI [3.25, 3.59]. An average score of 3.4 indicates that Ohio principals somewhat work to improve the professional learning with regards to educational technology. Effective technology leaders embrace the role of lead learner within their environment and model these practices for students and staff to observe (Cabellon & Brown, 2017; Lecklider et al., 2009; Sheninger, 2014; Vanderlinde & van Braak, 2013).

Of the four statements on the 2018 PTLA which made up the Connected Learner domain, principals self-reported the highest mean in self-improvement through reflective practices M = 3.73 (0.95) 95% CI [2.87, 3.31]. Reflection is a key competency for leadership in a complex work environment (Roberts, 2008). In analysis of the Connected Learner domain, the statement which Ohio principals need the most growth in centers around the establishment of online professional learning networks (PLN) to collaboratively learn and grow M = 3.09 (1.06) 95% CI [2.7,3.31]. It is the establishment of PLN that allows leaders to take control of their own development and grow making professional learning meaningful, relevant, and convenient (Sheninger, 2014). The principalship is a demanding position and the addition of technology self-improvement to an already full plate of duties of responsibilities is a challenge (Larson et al., 2010; Lavinge, Shakman, Zweig, & Geller, 2016).

Research Question 2: Are differences in technology leadership competency correlated to demographic characteristics: gender, years in the principalship, age, has the participant earned a degree, license, certificate, or endorsement in technology or a technology related field school level, school environment, poverty level, and school size?

The analysis of the data related this question involved both the use of descriptive and inferential statistics. Inferential statistics are used to predict the relationship between two variables (Salkind, 2014). This research question compared the dependent variable, the mean score in each of the domains of the 2018 ISTE Standards-EL, the independent demographic variables related to the study participant (gender, years in the principalship, age, and has the participant earned a degree, license, certificate, or endorsement in technology or a technology related field), and demographic information about the school the participant leads (school level, school environment, poverty level, and school size).

Principal gender showed no significant relationship with mastery of the 2018 ISTE Standards-EL. In a study of principals in Virginia, Duncan (2011) found no significant relationship between gender in any of the domains of the 2002 National Standards for Public School Administrators (2002 NETS-A). Both these results differ from Banoglu's (2011) study of Turkish principals in which female administrators showed more effective technology leadership in the leadership and vision domain of the 2002 NETS-A.

In studying participant age, a weak, negative, correlation was discovered between principal age and the visionary planner (- 0.23, n = 90) and connected learner (-0.23 n = 90) domains. This is consistent with the work of Prensky (2001) and his concept of digital natives and digital immigrants. As principals' age increase, the stronger connection they may have to being a digital immigrant. This would make the skills needed to plan for a digital vision and digital connectedness for personal growth more foreign and difficult for them.

Principal experience did not show a statistically significant correlation in regards to mastery in any of the five domains of the ISTE Standards-EL. On average, public school principals in the United States have 7.2 years of experience (Hill, Ottem, & DeRoche, 2016). Over 52% of the sample size reported to have 5-14 years of administrative experience, making the sample size more homogeneous with regards to administrative experience. It is of note that a weak negative correlation was found between age and two ISTE Standards-EL domains (visionary planner and connected learner). This was not the case with principal experience, however, as principals gain more experience, they also get older. This is a potential Type II conclusion validity error which a more heterogeneous sample could eliminate (Trochim & Donnelly, 2008).

With the exception of the weak negative correlation related to age and the visionary planner and connected learner domains, inferential statistics on all other domains related to the principal and school demographic variable showed no statistically significant relationship. This indicates the null hypothesis, there is no significant difference of principals' demographic factors including gender, years in the principalship, age, school level, school environment, poverty level, and school size on the self-reported competency level of Ohio Principals of Ohio Principals in each of the five 2018 ISTE Standards Education Leader domains, cannot be rejected.

Research Question 3: Is there a significant relationship between the technology leadership competency of principals as defined by the ISTE Standards-EL based with the current level of technology implementation levels of use on a recent technology initiative (Hall et al. 2006)?

Inferential statistics, specifically a Pearson correlation coefficient, was used to determine if a correlation existed between a principal's building level of use of a recent technology initiative and mean score for each of the domains of the 2019 ISTE Standards-EL. A statistically significant correlation was found between each of the domains and the principal's LoU of a recent technology initiative. The highest relationship discovered was the domain of Equity and Citizenship ($r = 0.44$, $n = 90$). Leaders who show higher levels of competence in this domain provide students with skilled teachers who actively use technology to meet learning needs. Additionally, these leaders look to provide technology access for all in a safe environment (International Society for Technology in Education, 2018). Providing skilled adults to teach appropriate skills to students who have access to technology likely facilitates the ability of a new technology to have a successful implementation.

The domain of Empowering Leader had a statistically significant weak correlation (r = 0.36, n = 90) to a principal's levels of use. Principals who are strong in this domain self-identified as those who inspire a culture of innovation for all stakeholders that strives to personalize the learning and assessment experience for all students (International Society for Technology in Education, 2018). A learning environment led by an empowering leader encourages the refinement, integration, and renewal of technology initiatives to meet the individual needs of learners (Hall et al., 2006).

LoU implementation compared to the self-reported scores in the Systems Designer domain showed a weak (R = 0.33, n= 90) statistically significant correlation. Results of this study found that a weak relationship exists between a principal's ability to provide continuous improvement towards technology initiatives and the level in which a new technology innovation is embraced and used throughout the school (Hall et al., 2006; ISTE, 2018). A principal's self-reported score in the Visionary Planner domain has a weak (R = 0.32, n = 90) correlation with the associated level of implementation of a recent building of district technology initiative. Building leaders who can establish and share a technology vision with stakeholders significantly impact on the level of implementation of a new innovation in their building. The vision and direction of where the innovation is heading is important to increase the LoU of an innovation.

The final domain, connected learner, had the lowest significant weak ($p = 0.23$, n = 90) correlation with the level of implementation of a technology initiative. The connected learner domain statements focus on the principal's ability to improve his/her own professional competencies and do not directly relate to student instruction.

In relationship to the null hypothesis, there are no significant statistical differences between the LoU of a recent technology initiative and the self-reported competency level of Ohio Principals in each of the five 2018 ISTE Standards Education Leader domains.

Discussion

To be a successful technology leader, a principal must embrace the notion that skills and knowledge can increase incrementally with appropriate work while constantly recognizing that the change process involved in this shift requires a focused vision and specific supports along the way (Dweck, 2000; Fullan, 2013b). The 2018 ISTE Standards-EL provides leaders with a framework of the base competencies needed to be a successful technology leader. In order to develop future-ready schools, building principals need to have established a level of proficiency across all five domains of these standards. This study focused on gathering foundational knowledge on Ohio principals with regards to their self-reported competencies within the domains of the 2018 ISTE Standards-EL. It also looked at relationships between personal and school demographics and self-reported standard competencies. Finally, this study examined the LoU of a recent technology initiative and looked to establish a correlation with self-reported domain proficiency.

Results from the research study showed that the Ohio principals, on average, self-report to be somewhat implementing each domain of the 2018 ISTE Standards-EL. These results indicate that Ohio principals display relatively equal proficiency in all domains of the technology leadership standards. This established proficiency is promising because research indicates that strong technology leadership has an impact on student learning and acquisition of future-ready skills for students (Afshari et al., 2008; Schrum & Levin, 2016).

Transformational Leadership

Transformational Leadership is characterized by a leadership style that enables and encourages change in both systems and individuals (Anderson, 2017). Transformational principals have an incremental mindset as they focus their efforts on changing attitudes and beliefs within the school they lead (Dweck, 2000). The nature of technology is a changing one which is evolving at a feverish pace. The understanding of the nature of change and how stakeholders react and adjust to constant change is critical for success in any technology-related endeavor. Furthermore, transformational leaders who understand the nature of change theory (Fullan, 2013b) understand how to create the appropriate environment in which the technology innovation is being reimagined to support individualized student learning. High levels of use for a technology innovation in schools foster an environment of future-ready learners. To achieve this high LoU, the building leader needs to be competent in the five domains of the 2018 ISTE Standards-El, display a transformational leadership style, and understand change theory to establish a culture of change. Figure 5.1 shows the graphical relationship between transformational leadership and knowledge of theory and its impact on principal competency in the 2018 ISTE Standards-EL and ultimately on creating future ready learners.

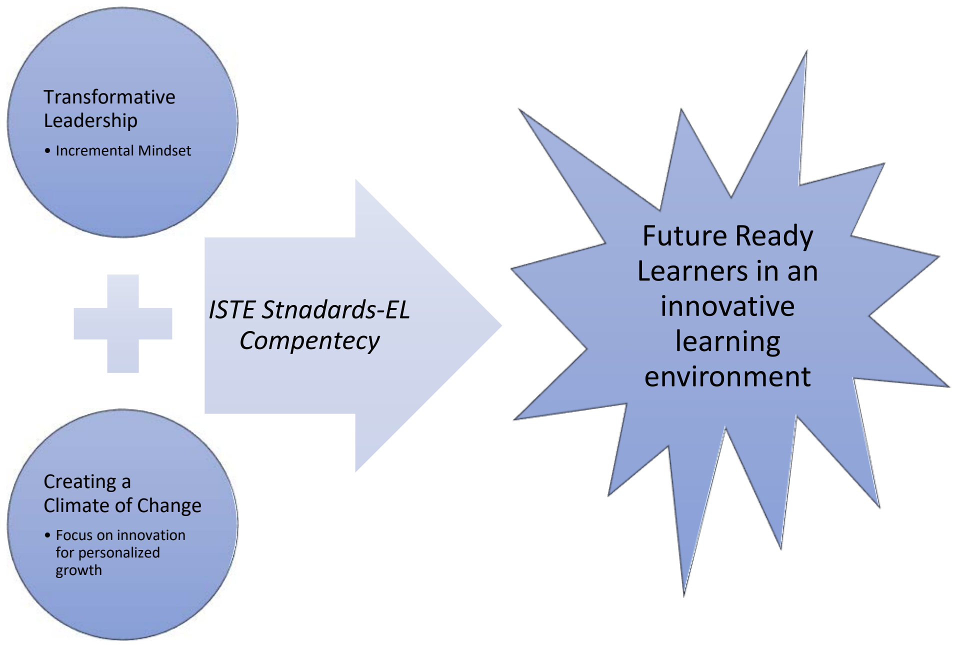

Figure 5.1: The impact transformational leadership and change theory have in developing the 2018 ISTE Standards-EL competency relating in an innovative learning environment.

Focus, Funding, and Resources

Educational technology expenditures have risen nearly 300% for districts over the past 30 years (Gosmire & Grady, 2007) with assistance from federal and state funding sources. It is during this technology boom in which this study's participants began their education careers as classroom teachers. As these participants transitioned into the principalship, they experienced firsthand the impact it had on both student learning and in their personal lives as teachers and leaders. In addition to the increase in the volume of technology use in schools, the way it has been implemented has evolved as well. Technology use has progressed from the use of a standalone device or program to using digital tools as a way to communicate and innovate learning (Fullan, 2013b). Most study participants were in the educational setting as either teachers or administrators during this transition.

School demographics including size, type (urban, rural, or suburban), or poverty level did not show a statistically significant correlation to the mastery of the 2018 ISTE Standards-EL domain. Recent federal and state policy have seen technology as the "great equalizer" and moved to fund technology and access to technology in rural and high poverty schools. Educational technology and the resources to purchase and implement technology in all K-12 schools as a means to increase equity and access have been a focus of many recent federal programs (United States Office of Educational Technology, 2019). In 2013, the Ohio Department of Education introduced the Straight A Fund, a competitive grant for all Ohio schools encouraging innovation and greater student resources, which was utilized by many school districts to purchase student devices and other technology. Throughout the three rounds of the grant, over $240 million were distributed to Ohio schools for innovative, efficient ideas (Ohio Department of Education, 2019b). This influx in technology from both the federal and state governments has forced leaders to grow their technology leadership skills and create an environment with technology integrated throughout the curriculum preparing learners to be truly future-ready (Fullan, 2013b; November, 2013).

Similar to the conversion of the NETS-A standards to the 2018 ISTE Standards – EL focused on device use to innovation, the initial federal and state monies were utilized to purchase devices for access and low level use. As the devices count in schools increased and the technology became more accessible to all, the shift in spending, teaching, and learning went from basic level use to high level reimagining and innovating. This shift is consistent with Hattie's (2008) meta-analysis of influences on instruction found that computer-assisted instruction has an effect size of .37 and is more effective when the student has some control of the learning. This shift to an innovative approach in which personalized learning strategies are utilized to assist all students in reaching their full potential is paramount in a future-ready school (Dossin, 2019).

The results from this research also showed that principal personal and school demographic factors do not significantly correlate to self-reported domain mastery. With the exception of principal age which only showed a weak correlation ($p = -0.23$, n = 90) in two of the five domains (visionary planner and connected learner), no discernable difference was observable between in self-reported standard competencies.

Technology Levels of Use

Levels of use is a tool which examines more than the rudimentary use/nonuse or presence/absence of an innovation in a setting. In applying LoU to the school setting in regard to a recent technology initiative, the researcher was better able to gauge the implementation of the technology over a simple do students have access to devices (Hall et al., 2006). By asking leaders to relate how the teachers have implemented the technology in the building, the researcher is better able to evaluate the effectiveness of the technology leadership in the school (Hall et al., 2006).

Results from this study indicated a statistically significant correlation between the level of use of a recent technology initiative and the principal's self-reported proficiency in each of the five domains of the 2018 ISTE Standards-EL. This is in support of prior research that technology leadership has an impact on both teacher implementation and student achievement (Anderson & Dexter, 2005; Catano et al.,2008). Furthermore, buildings which are higher in the LoU continuum are displaying signs of teacher efficacy where teachers are taking responsibility in reimaging the technology innovation to fit the needs of their students. It is in this type of learning environment that student learning flourishes (DuFour & Mattos, 2013; Hattie, 2008; Hall et al., 2006; Supovitz et al., 2010).

Limitations

Sampling

Nonprobability, convenience sampling (Trochim & Donnelly, 2008) was used to survey Ohio K-12 public school principals. This study sample was considered a convenience sample because the survey was sent to public school principals using email addresses identified in the Ohio Educational Directory System (OEDS) database. The study's sample was those principals who elected to complete the 2018 PTLS and associated demographic questionnaire. The sampling method of this study was both purposive as it targeted principals specifically and convenient (Trochim & Donnelly, 2008). Both sampling methods were appropriate for this study as they are ways to quickly measure the results of the targeted group. In utilizing this sampling method, external validity was weakened as the results may not be representative of the total population (Trochim & Donnelly, 2008). The expected response rate for online surveys by people serving in a managerial role was 35% (Anseel et al., 2010). This actual response rate for this study was tenfold less than the expected rate at 3.4% completed surveys. One reason for the low response rate may have been the use of the online delivery format. On average, public school building principals report spending 59 hours a week completing their required duties. The addition of the extra task of completing an online survey, even one that was 15 minutes in duration, puts an additional strain on the daily routine of the principal (Lavinge et al., 2016). It is of note that the greatest percentage of responses (34%) for Ohio principals came on a day when the majority of Ohio schools had an unexpected calamity day. As the survey was sent to participants from the researchers YSU email address with an embedded SurveyMonkey link, many of the 2,662 emails sent to prospective participants may have been identified as SPAM and not released for ease of subject participation (Fan & Yan, 2010).

This study's low response rate is a threat to the external validity of the study. Due to the significantly lower than projected response rate, the results from the study may not be generalizable and representative of Ohio principal's technology competencies (Trochim & Donnelly, 2008). Given the notion that the study was conducted in an online setting and the invitation email may have been identified as SPAM by some filters, a certain level of basic technology competency in finding and removing SPAM email was needed for some principals to participate. Principals having to search for the survey in their SPAM folder takes both time and competency. This limits the true heterogeneity of the sample size as those not interested in the study topic or lacking the skills to retrieve email from SPAM did not participate. Furthermore, these basic skills to retrieve the survey from SPAM indicate a potential interest in either the survey topic or a potential familiarity with the researcher. Although warned against, these two scenarios increase the potential for both leniency error and halo error.

Threats to Conclusion Validity

In order to allow for generalizability of the results, an appropriate sample needs to be used (Trochim & Donnelly, 2008). A sample size of 91 participants does not meet Fowler's (1988) 95% confidence range and therefore the internal validity of this study is in question. An appropriate sample size was critical to the internal validity of the study as it would have better represented the population as a whole and reduced the inherent sample error (Trochim & Donnelly, 2008; Salkind, 2013).

The small sample size also poses a threat to the conclusion validity of the study. This sample did not meet the expected 300 for a 95% confidence internal, thus increasing the chances of type I or type II conclusion errors. A type I error is finding a relationship in the data when a relationship does not exist. Given a small sample, it is also likely that type II error may occur where no relationship is found, when one truly exists (Trochin & Donnelly, 2008). With the small sample, the results could provide more statistical noise and not allow a signal to surface and be found (Trochin & Donnelly, 2008).

Finally, the small sample size truly impacted some of the demographic subgroup sizes in the resulting data set. Small subgroups limit the types of statistical analysis that can be reliably calculated throughout the study, increasing the possibility of Type I and Type II errors. The smaller the sample subgroup size, the less likely it is to represent the general qualifications of the population it was taken from, thus weakening the conclusion validity. Demographic areas where more than three subgroup categories existed for participants to choose resulted in subgroup sample sizes of less than 10 representatives. This included the categories: age, years as an administrator, school type, school size, and poverty level.

Significance of Study

This study attempted to address the gap in existing literature between the level of competency of the 2018 ISTE Standards-EL in Ohio building principals. The 2018 ISTE Standards-EL have divided the concept of technology leadership into five domains, but research on both the mastery of the domains and the connection between leadership competencies and available student technology is lacking (Richardson et al., 2012). This study also sought to investigate if the differences in self-reported technology leadership aptitude correlated to a principal's demographic characteristics or the current level of technology implementation in the school building. The research findings provided information on the self-reported competency level of Ohio principals in each of the five 2018 ISTE Standards-EL domains.

The 2018 ISTE Standards-EL provides a nationally recognized set of criteria for school administrators. Effective principals have a direct impact on student achievement, and part of the 21st century building leader's responsibilities is successful technology integration by both staff and students. Results from this study demonstrated that Ohio administrators have a proficient understanding and mastery of the established 2018 ISTE Standards-EL and that as principals increase their competencies within the domains, the level of teacher efficacy and high LoU occurs within the school. This is significant because it supports the research literature that principals with strong technology leadership skills have a significant impact on student learning (Anderson & Dexter, 2005; Chang, 2012; Greaves et al., 2017; Machado & Chung, 2015).

Results from this study also add to the limited body of research on technology leader preparation using the 2018 ISTE Standards-EL. Results from this study indicate that Ohio principals have the lowest self-reported mean in domain of visionary leadership. As school districts plan for technology infrastructure, professional learning in this area prior to the onset of the strategic plan would benefit all stakeholders. The results from this study can also be utilized by Ohio administrator licensure programs to provide relevant coursework focused on principal preparation, especially in the domain of visionary leadership.

Additionally, the results from this study could serve useful to building principals currently in practice and principal preparatory programs. Results from this study showed an area to grow in for building leaders is in the connected leader domain, specifically, establishing an online professional learning network. With the rapid change of educational technology and the varying individual skills and aptitudes digital immigrants and digital native leaders bring to their schools, an online learning network provides an opportunity for immediate, personalized learning (Sheninger, 2014). As technology evolves and changes, new challenges are presented in how to best utilize the new innovation to improve student learning. A leader's PLN can provide an opportunity for the leader to dialogue with both colleagues and content area experts to grow in areas of need immediately. School districts and graduate principal preparatory programs would be assisting the development of leaders by modeling and encouraging of principal to establish and participate in a PLN. The personal growth that occurs because of a leader's PLN will improve his/her leadership skills in all the other ISTE Standards -EL domains, as the selected learning is personalized, appropriate, and relevant.

Results from this study can add to the relevant research regarding the impact school leaders can have in creating future ready learners. Leaders who show strong competency in the 2018 ISTE Standards-EL have a transformative leadership style combined with a deep understanding of establishing a culture of change. This combination creates the future ready learners need to be successful in a global economy.

Future Research

This study sought to document the self-reported competencies of the 2018 ISTE Standards-EL for Ohio principals. This study was designed with the consideration of future research to follow, as both the 2018 ISTE Standards-EL were recently revised, and the concept of technology leadership is sparse within the literature.

The sample size and response rate collected are areas for concern to the internal, external, and conclusion validity. Future research may attempt to replicate this study in an effort to reduce the validity concerns with this study. If the study were replicated, it would be important to try to ensure a higher response rate and larger sample size to increase the likelihood that the sample is representative of the population and results are generalizable. Suggestions for improvement to the study design include delivering the online survey to principals in a group or professional learning community such as an association meeting, or county or state principal meeting instead of sending multiple emails to principals. This face-to-face contact, with dedicated time on the agenda would assist in the survey announcement not being identified as SPAM or ignored. Saleh and Bista (2017) found that a personal connection to the researcher or work being completed tends to result in a higher level of response rate for online surveys.

Dweck's (2000) theories of mindset combined with creating a culture of change (Fullan, 2013a; Fullan, 2013b) served as the theoretical framework behind this study for leaders gaining increased proficiency in the 2018 ISTE Standards-EL. Transformational leadership is the style in which the elements of change theory are utilized to facilitate new outcomes (Anderson, 2017). High proficiency in the 2018 ISTE Standards-EL requires a leader who can set a vision and empower those around them to work collaboratively to reach the vision. Fully implemented, the 2018 ISTE Standards-EL makes innovation with educational technology the norm. Encouraging innovation and change is a staple of a strong transformational leader. Future research may attempt to identify a significant relationship between principal transformational leadership aptitudes and competencies on the 2018 ISTE Standards-EL.

This study sought to identify and describe any phenomena within the technology leadership of building leaders. Principals have been shown to impact student achievement. Future research searching for a relationship between a principal's technology leadership and student achievement in a variety of methods would be of benefit. As the scholarship related to technology leadership continues to grow, the body of work would benefit from research investigating specific technology leadership styles related to student achievement.

The 2018 ISTE Standards-EL were purposely developed after a set of student and teacher technology standards. A competent technology leader is one who creates and fosters teacher efficacy though advanced levels of implementation of a new technology innovation. Future research would benefit from studying the relationship between the education leader, teacher, and student standards under the LoU lens of innovation.

Conclusion

This study used descriptive statistics to determine building level leaders' perceptions of their technology competency as related to 2018 ISTE Standards-EL. The quantitative study surveyed principals throughout Ohio. The first research question explored the descriptive statistics for Ohio principals' self-reported technology leadership as measured by the 2018 PTLA. Results indicate that Ohio principals self-report to be somewhat equally proficient in all domains of the technology leadership standards.

The second and third research questions sought to seek a relationship between the domains of the ISTE Standards-EL compared to demographic factors and adult behaviors. The second question explored principal and building demographic information. The results found no significant difference of principals' demographic factors including gender, years in the principalship, age, school level, school environment, poverty level, and school size on the self-reported competency level of Ohio Principals of Ohio Principals in each of the five 2018 ISTE Standards-EL domains. Ohio principals self-report to proficient in all areas of the 2018 ISTE Standards-EL. This finding shows that the recent focus put on educational technology and innovation through federal and state grants and initiatives is impacting the leadership of building principals.

The final research question investigated a correlation between LoU of a recent building technology initiative and self-reported mastery of the domains of the ISTE Standards-EL. A moderate correlation was found between the LoU of a recent technology initiative and the Equity and Citizenship domain. The other four domains showed a weak correlation when compared to LoU of a recent technology initiative. This finding parallels prior research in supporting the positive impact of technology leadership on student learning (Anderson & Dexter, 2005; Chang, 2012; Greaves et al., 2017; Machado & Chung, 2015)

The purpose of this study was to examine the level of mastery of the 2018 ISTE Standards-EL in Ohio building principals. Results from this study are intended to inform educational decision makers on the importance of providing appropriate professional learning in the areas of technology leadership for building level leaders. Today's digital leaders are change agents who have a deep understanding of the impact technology can have on teacher efficacy and student achievement.

REFERENCES

Afshari, M., Bakar, K. A., & Wong, S. L. (2012). Factors affecting the transformational leadership role of principals in implementing ICT in schools. *TOJET: The Turkish*. Retrieved from http://search.proquest.com/openview/3c671ef3870ce227ac4c61aa51b6b473/1?pq-origsite=gscholar&cbl=1576361

Afshari, M., Bakar, K. A., Wong, S. L., Samah, B. A., & Fooi, F. S. (2008). School leadership and information communication technology. *TOJET: The Turkish Online Journal of Educational Technology*, *7*(4). Retrieved from http://search.proquest.com/openview/fe7243378e5d77d4b458276d027337af/1?pq-origsite=gscholar

An, Y.-J., & Reigeluth, C. (2011). Creating technology-enhanced, learner-centered classrooms. *Journal of Digital Learning in Teacher Education*, *28*(2), 54–62.

Anderson, L. S. (2006). Enter the tech director. *T H E Journal*, *33*(7), 43–44.

Anderson, M. (2017) Transformational leadership in education: A review of existing literature. *International Social Science Review, 93*(1), 4.

Anderson, R. E., & Dexter, S. L. (2000). School technology leadership: Incidence and impact. Retrieved from http://escholarship.org/uc/item/76s142fc.pdf

Anderson, R. E., & Dexter, S. (2005). School technology leadership: An empirical investigation of prevalence and effect. *Educational Administration Quarterly: EAQ*, *41*(1), 49–82.

Anseel, F., Lievens, F., & Schollaert, E. (2010). Response rates in organizational science, 1995–2008: A meta-analytic review and guidelines for survey researchers. *Journal of Business*. Retrieved from https://link.springer.com/article/10.1007/s10869-010-9157-6

Anthony, A. B. (2011). Activity theory as a framework for investigating district-classroom system interactions and their influences on technology integration. *Journal of Research on Technology in Education*, *44*(4), 335–356.

Atkins, D. E., Bennett, J., Brown, J. S., Chopra, A., & Dede, C. (2010). Transforming American education: Learning powered by technology. *Learning*.

Banoglu, K. (2011). School principals' technology leadership competency and technology coordinatorship. *Educational Sciences-Theory & Practice*, *11*(1), 208–213.

Bass, B. M. (1990). From transactional to transformational leadership: Learning to share the vision. *Organizational Dynamics*, *18*(3), 19–31.

Boss, S. (2011). Technology integration: A short history. */www. Edutopia. Org/technologyintegration-History*. Retrieved from http://www.technology4teacher.com/uploads/2/8/3/0/2830612/technology_integration.docx

Burns-Metcalf, W. (2012). *K-12 principals' perceptions of their technology leadership preparedness*. Georgia Southern University. Retrieved from http://digitalcommons.georgiasouthern.edu/etd/400/

Cabellon, E. T., & Brown, P. G. (2017). Remixing leadership practices with emerging technologies: Remixing leadership practices with emerging technologies. *New Directions for Student Leadership*, *2017*(153), 9–20.

Campbell, B. (2012). Pathways to prosperity technology leadership and innovation for the new economy at school district 129. *Quarterly Review of Distance Education*, *13*(4), 219–224.

Catano, N., Richard, H., & Stronge, J. (2008). Qualities of effective principals. *Alexandria, VA: Association for Supervision and Curriculum Development*.

Chang, I.-H. (2012). The effect of principals' technological leadership on teachers' technological literacy and teaching effectiveness in Taiwanese elementary schools. *Educational Technology & Society*, *15*(2), 328–340.

Chauhan, S. (2017). A meta-analysis of the impact of technology on learning effectiveness of elementary students. *Computers & Education*, *105*, 14–30.

Claro, M., Nussbaum, M., López, X., & Contardo, V. (2017). Differences in views of school principals and teachers regarding technology integration. *Educational Technology & Society, 20*(3), 42–53.

Coolican, H. (2017). *Research methods and statistics in psychology*. Psychology Press.

Corn, J., Tagsold, J. T., & Argueta, R. (2012). Students with special needs and 1:1 computing: a teacher's perspective. *Journal of Research in Special Educational Needs*, *12*(4), 217–223.

Davies, P. M. (2010). On school educational technology leadership. *Management in Education)*, *24*(2), 55–61.

Demski, J. (2012). The seven habits of highly effective tech-leading principals: unwrapping the key attributes that transform principals into effective technology leaders in their schools and in their districts. *The Journal*, *39*(5), 48.

Dossin, L. (2019) Future ready frameworks - Future ready schools. Retrieved from https://futureready.org/about-the-effort/framework/Anderson, L. S. (2006). Enter the Tech Director. *T H E Journal*, 33(7), 43–44.

DuFour, R., & DuFour, R. (2009). *Revisiting professional learning communities at Workâ,,¢: New insights for improving schools*. Solution Tree Press.

DuFour, R., & Mattos, M. (2013). How do principals really improve schools? *Educational Leadership: Journal of the Department of Supervision and Curriculum Development, NEA,* 70(7), 34–39.

Duncan, J. A. (2011). *An assessment of principals' technology leadership: A statewide survey*. Virginia Commonwealth University. Retrieved from http://scholarscompass.vcu.edu/cgi/viewcontent.cgi?article=3620&context=etd

Dweck, C. S. (2000). *Self-theories: Their role in motivation, personality, and development*. Psychology Press.

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

Fan, W., & Yan, Z. (2010). Factors affecting response rates of the web survey: A systematic review. *Computers in Human Behavior, 26*(2), 132-139. doi:10.1016/J.CHB.2009.10.015

Fowler, F. J. (1988). *Survey research methods*. Los Angeles, CA: SAGE.

Fullan, M. (2013a). Introduction. In M. Grogan (Ed.), *The Jossey-Bass reader on educational leadership* (pp. 207–220). John Wiley & Sons.

Fullan, M. (2013b). *Stratosphere: Integrating technology, pedagogy, and change knowledge*. Pearson Canada.

Garcia, A., & Abrego, J. (2015). Elementary principal's technology leadership dispositions. *Global Journal of Human-Social Science Research*, *14*(9). Retrieved from https://socialscienceresearch.org/index.php/GJHSS/article/view/1313

Garland, V. E. (2009). Emerging technology trends and ethical practices for the school principal. *Journal of Educational Technology Systems*, *38*(1), 39–50.

Garland, V. E., & Tadeja, C. (2013). *Educational leadership and technology: Preparing school administrators for a digital age*. Routledge.

Glover, D., & Bush, T. (2005). The online or e-survey: A research approach for the ICT age. *International Journal of Research and Method in Education*, *28*(2), 125–146.

Gosmire, D., & Grady, M. (2007). A bumpy road: Principal as technology leader. Retrieved from https://digitalcommons.unl.edu/cehsedadfacpub/4/

Grady, M. L. (2011). *Leading the technology-powered school*. SAGE.

Greaves, T. W., Wilson, L., & Gielniak, M. (2017). *Leadership brief*. Project RED.

Hall, G. E., Dirksen, D. J., & George, A. A. (2006) *Measuring implementation in schools: Levels of use.* SEDL.

Hargreaves, A., & Fink, D. (2006). *Sustainable leadership*. Wiley.

Hattie, J. (2008). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement.* Routledge.

Healey, D. (2015). Review of a constructivist approach to the national educational technology standards for teachers. *Language Learning & Technology*, *19*(1), 54–58.

Henriksen, D., Mishra, P., & Fisser, P. (2016). Infusing creativity and technology in 21st century education: A systemic view for change. *Educational Technology & Society*, *19*(3), 27–37.

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

Hill, J., Ottem, R., & DeRoche, J. (2016). *Trends in public and private school principal demographics and qualifications: 1987–88 to 2011–12.* (No. 2016-189). Retrieved from https://nces.ed.gov/pubs2016/2016189.pdf

Huitt, W. H., & Humel, D. K. (1999). Internal and external validity: General issues. Retrieved September 29, 2018, from http://www.edpsycinteractive.org/topics/intro/valdgn.html

Inan, F. A., & Lowther, D. L. (2010a). Factors affecting technology integration in K-12 classrooms: a path model. *Educational Technology Research and Development: ETR & D*, *58*(2), 137–154.

Inan, F. A., & Lowther, D. L. (2010b). Laptops in the K-12 classrooms: Exploring factors impacting instructional use. *Computers & Education*, *55*(3), 937–944.

International Society for Technology in Education. (2002). ISTE National educational technology standards (NETS) and performance indicators for administrators. Retrieved from www.iste.org/docs/pdfs/nets-for-administrators-2002_en.pdf?sfvrsn:=2

International Society for Technology in Education. (2009). Standards for Administrators. Retrieved from http://www.iste.org/standards/iste-standards/standards-for-administrators

International Society for Technology in Education (ISTE). (2016). Redefining learning in a technology-driven world: A report to support adoption of the ISTE Standards for students. Retrieved from https://www.iste.org/docs/Standards-Resources/iste-standards_students-2016_research-validity-report_final.pdf?sfvrsn=0.0680021527232122

International Society for Technology in Education. (2018). ISTE Standards for education leaders. Retrieved from https://www.iste.org/standards/for-education-leaders.

Jhangiani, R. S., Chiang, I. A., & Price, P. C. (2015). Overview of nonexperimental research. In *Research methods in psychology-(2nd Canadian edition)*. BC Campus.

Juraime, F. (n.d.). *Technology leadership: Principal's roles and challenge*. National University of Malaysia, Selangor. Retrieved from http://s3.amazonaws.com/academia.edu.documents/35867843/Technology.docx?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1495396504&Signature=7ztD12ycamqmdkiyDQw8wiFlpRw%3D&response-content-disposition=attachment%3B%20filename%3DTechnology_Leadership_Principal_s_Roles.docx

Keengwe, J., Schnellert, G., & Mills, C. (2012). Laptop initiative: Impact on instructional technology integration and student learning. *Educ Inf Technol*, *17*, 137.

Kelley, K., Clark, B., Brown, V., & Sitzia, J. (2003). Good practice in the conduct and reporting of survey research. *International Journal for Quality in Health Care: Journal of the International Society for Quality in Health Care* / ISQua, 15(3), 261–266.

Klieger, A., Ben-Hur, Y., & Bar-Yossef, N. (2010). Integrating laptop computers into classroom: Attitudes, needs, and professional development of science teachers—A case study. *Journal of Science Education and Technology*, *19*(2), 187–198.

Kopcha, T. J. (2012). Teachers' perceptions of the barriers to technology integration and practices with technology under situated professional development. *Computers & Education*, *59*(4), 1109–1121.

Kowch, E. G. (2013). Whither thee, educational technology? Suggesting a critical expansion of our epistemology for emerging leaders. *TechTrends*, *57*(5), 25–34.

Krasnoff, B. (2015). Leadership qualities of effective principals. *Education Northwest*. Retrieved from http://nwcc.educationnorthwest.org/sites/default/files/research-brief-leadership-qualities-effective-principals.pdf

Krueger, N. (2018). Owning their learning: How student-centered learning is delivering on its promises. *Empowered Learner*, *1*(3), 26–32.

Larson, L., Miller, T., & Ribble, M. (2010). 5 considerations for digital age leaders: What principals and district administrators need to know about tech integration today. *Learning & Leading with Technology*, *37*(4), 12–15.

Lavigne, H. J., Shakman, K., Zweig, J., & Greller, S. L. (2016). Principals' time, tasks, and professional development: An analysis of schools and staffing survey data. REL 2017-201. Regional Educational Laboratory Northeast & Islands. Retrieved from https://eric.ed.gov/?id=ED569168

Lawriter - ORC. (n.d.). Retrieved from http://codes.ohio.gov/orc/3319

Lecklider, D., Britten, J. S., & Clausen, J. M. (2009). Principals priority for technology as an indicator of observed use in schools. *AASA Journal of Scholarship and Practice*, *5*(4), 27–33.

Leithwood, K., & McCullough, C. (2016). Leading high-performing school districts. *Education Canada*, *1*, 24–29.

Levin, B. B., & Schrum, L. (2015). *Leading technology-rich schools: Award-winning models for success*. Teachers College Press.

Machado, L. J., & Chung, C.-J. (2015). Integrating technology: The principals' role and effect. *International Education Studies*, *8*(5), 43.

Marzano, R. J., Waters, T., & McNulty, B. A. (2005). *School leadership that works: From research to results*. ASCD.

McKnight, K., O'Malley, K., Ruzic, R., Horsley, M. K., Franey, J. J., & Bassett, K. (2016). Teaching in a digital age: How educators use technology to improve student learning. *Journal of Research on Technology in Education*, *48*(3), 194–211.

McLeod, S. (2005). *Principals technology leadership assessment [Survey instrument and directions]*. Center for the Advanced Study of Technology Leadership in Education. Retrieved from http://schooltechleadership.org/research/projects/ptla/

McLeod, S., & Shareski, D. (2018). *Different schools for a different world*. Solution Tree Press, a division of Solution Tree.

Mouza, C. (2002). Learning to teach with new technology: Implications for professional development. *Journal of Research on Computing in Education, 35*(2), 272–289.

Mouza, C. (2008). Learning with laptops: Implementation and outcomes in an urban, underprivileged school. *Journal of Research on Technology in Education*, *40*(4), 447–472.

Mueller, P. A., & Oppenheimer, D. M. (2014). The pen is mightier than the keyboard: Advantages of longhand over laptop note taking. *Psychological Science*, *25*(6), 1159–1168.

Murray, T. (2016, April 22). The new national education technology plan: What's in it for me? Retrieved from https://futureready.org/netp/

Neumerski, C. M. (2012). Rethinking instructional leadership, a review: What do we know about principal, teacher, and coach instructional leadership, and where should we go from here? *Educational Administration Quarterly: EAQ*, *49*(2), 310–347.

November, A. (2012). Beyond technology: The end of the job and the beginning of digital work. Retrieved from http://novemberlearning.com/educational-resources-for-educators/teaching-and-learning-articles/beyond-technology-the-end-of-the-job-and-the-beginning-of-digital-work/

November, A. (2013, February 10). Why schools must move beyond one-to-one computing. Retrieved from http://novemberlearning.com/educational-resources-for-educators/teaching-and-learning-articles/why-schools-must-move-beyond-one-to-one-computing/

Office of Ed Tech. (2016, April 18). Building robust infrastructure as a tool for equity. Retrieved March 21, 2019, from https://medium.com/@OfficeofEdTech/building-robust-infrastructure-as-a-tool-for-equity-7170a3cd8fda

Ohio Department of Education. (2015). 2013 School district typology overview. Retrieved from http://education.ohio.gov/Topics/Data/Frequently-Requested-Data/Typology-of-Ohio-School-Districts

Ohio Department of Education. (2018a). Report card resources. Retrieved from http://education.ohio.gov/Topics/Data/Report-Card-Resources

Ohio Department of Education (2018b). 2018 Ohio standards for principals. Retrieved from: http://education.ohio.gov/Media/Ed-Connection/July-23-2018/Revised-Ohio-Standards-for-Principals-now-posted

Ohio Department of Education. (2019a). Ohio's learning standards for technology. Retrieved from http://education.ohio.gov/Topics/Learning-in-Ohio/Technology/Ohios-Learning-Standards-for-Technology

Ohio Department of Education. (2019b). Straight A fund. Retrieved from http://education.ohio.gov/Topics/Straight-A-Fund

Overbay, A., Mollette, M., & Vasu, E. S. (2011). A technology plan. *Educational Leadership: Journal of the Department of Supervision and Curriculum Development, NEA*, *68*(5), 56–59.

Page-Jones, A. B. (2008). *Leadership behavior and technology activities: The relationship between principals and technology use in schools.* University of Central Florida, Orlando. Retrieved from http://etd.fcla.edu/CF/CFE0002162/Page-Jones_Alexandra_B_200804_EdD.pdf

Paige, R., Hickok, E., & Patrick, S. (2004). Toward a new golden age in American education: How the internet, the law, and today's students are revolutionizing expectations. *Washington, DC: U.S. Department of Education*.

Pautz, S., & Sadera, W. A. (2017). Leadership practice in a one-to-one computing initiative: Principals' experiences in a technology driven, second-order change. *Computers in the Schools*, *34*(1/2), 45–59.

Pink, D. H. (2011). *Drive: The surprising truth about what motivates us*. Penguin.

Prensky, M. (2001). Digital Natives, Digital Immigrants Part 1. On the Horizon, 9(5), 1–6.

Raman, A., & Shariff, S. B. (2017). Relationship between technology leadership, ict facility, competency, commitments and teachers practices on implementations with effective teacher's management tasks in schools. *Scholedge International Journal of Multidisciplinary & Allied Studies ISSN 2394-336X*, *4*(9), 88–96.

Richardson, J. W., Bathon, J., Flora, K. L., & Lewis, W. D. (2012). NETS*A Scholarship: A review of published literature. *Journal of Research on Technology in Education (International Society for Technology in Education)*, *45*(2), 131–151.

Richardson, J. W., Flora, K., & Bathon, J. (2013). Fostering a school technology vision in school leader. *Educational Leadership: Journal of the Department of Supervision and Curriculum Development, NEA*. Retrieved from http://eric.ed.gov/?id=EJ1012953

Riley, R. W., Holleman, F., & Roberts, L. G. (2000). E-learning: Putting a world-class education at the fingertips of all children. *The National Educational Technology Plan, US*.

Roberts, C. (2008). Developing future leaders: The role of reflection in the classroom. *Journal of Leadership Education, 7*(1), 116–130.

Sadaf, A., & Johnson, B. L. (2017). Teachers' beliefs about integrating digital literacy into classroom practice: An investigation based on the theory of planned behavior. *Journal of Digital Learning in Teacher Education*, *33*(4), 129–137.

Saleh, A., & Bista, K. (2017). Examining factors impacting online survey response rates in educational research: Perceptions of graduate students. *Journal of MultiDisciplinary Evaluation, 13*(29), 63–74.

Salkind, N. J. (2013). *Statistics for people who (think they) hate statistics*. SAGE.

Sauers, N. J., & McLeod, S. (2012). What does the research say about school one-to-one computing initiatives. *Center for the Advanced Study of Technology Leadership in Education, University of Kentucky*.

Schachter, R. (2010). A call for technology leadership. *District Administration*, *46*(10), 41–45.

Schrum, L., & Galizio, L. M. (2011). Educational leadership and technology integration: An investigation into preparation, experiences, and roles. *Of School Leadership*. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=10526846&AN=66567483&h=iJwy0F5j18OsTxqxF8Tr3p%2Bu48khbT9mAjbu9r5rFW02GDOQj7c8yDDJ9IPy6%2FZ32FXbYp3DBkvOapKxLo9UsA%3D%3D&crl=c

Schrum, L., & Levin, B. B. (2009). *Leading 21st-century schools: Harnessing technology for engagement and achievement*. Corwin Press.

Schrum, L., & Levin, B. B. (2016). Educational technologies and twenty-first century leadership for learning. *International Journal of Leadership in Education*, *19*(1), 17–39.

Sheninger, E. C. (2014). *Digital leadership: Changing paradigms for changing times*. Thousand Oaks, Calif: Corwin.

Sheppard, B., & Brown, J. (2014). Leadership for a new vision of public school classrooms: Technology-smart and learner-centered. *Journal of Educational Administration and History*, *52*(1), 84–96.

Sincar, M. (2013). Challenges school principals facing in the context of technology leadership. *Educational Sciences: Theory & Practice*, *13*(2), 1273–1284.

Sugar, W., & Holloman, H. (2009). Technology leaders wanted: Acknowledging the leadership role of a technology coordinator. *TechTrends: Linking Research & Practice to Improve Learning*, *53*(6), 66–75.

Supovitz, J., Sirinides, P., & May, H. (2010). How principals and peers influence teaching and learning. *Educational Administration Quarterly: EAQ, 46*(1), 31–56.

Sykora, C. (2009). Building ed tech leadership. *Learning & Leading with Technology*, *48*.

Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research*, *81*(1), 4–28.

Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers & Education*, *57*(4), 2432–2440.

Thomas, L. G., & Knezek, D. (1991). Providing technology leadership for restructured schools. *Journal of Research on Computing in Education*, *24*(2), 265.

Trochim, W. M. K., & Donnelly, J. P. (2008). *Research methods knowledge base*. Atomic Dog Pub.

United States Department of Education (1996). *Getting America's students ready for the 21st century: Meeting the technology literacy challenge:* A report to the Nation on Technology and Education.

United States Department of Education. (2016). *Future ready learning: Reimagining the role of technology in education*. CreateSpace Independent Publishing Platform.

United States Department of Education. (2016). Office of Elementary and Secondary Education, Non-Regulatory Guidance: Student Support and Academic Achievement Grants, Washington, D.C.

United States Department of Education: Office of Educational Technology. (2017). *Reimagining the role of technology in education: 2017 National Education Technology Plan Update*.

United States Office of Educational Technology. (2019). *Funding digital learning*. Retrieved from https://tech.ed.gov/funding/

Vanderlinde, R., & van Braak, J. (2013). Technology planning in schools: An integrated research-based model. *British Journal of Educational Technology: Journal of the Council for Educational Technology*, *44*(1), E14–E17.

Wagner, T. (2014). *The global achievement gap: Why even our best schools don't teach the new survival skills our children need and what we can do about it*. Basic Books.

Wood, L., & Howley, A. (2012). Dividing at an early age: the hidden digital divide in Ohio elementary schools. *Learning, Media & Technology, 37*(1), 20–39. https://doi.org/10.1080/17439884.2011.567991

Wright, K. B. (2006). Researching internet-based populations: Advantages and Disadvantages of Online Survey Research, Online Questionnaire Authoring Software Packages, and Web Survey Services. *Journal of Computer-Mediated Communication: JCMC*, *10*(3), 00–00.

Yu, C., & Prince, D. L. (2016). Aspiring school administrators' perceived ability to meet technology standards and technological needs for professional development. *Journal of Research on Technology in Education*, *48*(4), 239–257.

Zhao, Y. (2012). *World class learners: Educating creative and entrepreneurial students*. Corwin Press.

APPENDICES

APPENDIX A

IRB APPROVAL

YOUNGSTOWN STATE UNIVERSITY

One University Plaza, Youngstown, Ohio 44555
Office of Research
330.941.2377

December 18, 2018

Dr. Jane Beese, Principal Investigator
Mr. Christopher Rateno, Co-investigator
Department of Counseling, School Psychology & Educational Leadership
UNIVERSITY

RE: HSRC PROTOCOL NUMBER: 090-2019
TITLE: System Error: Ohio Principals' Perceptions on their Technology Literacy

Dear Dr. Beese and Mr. Rateno:

The Institutional Review Board has reviewed the abovementioned protocol and determined that it is exempt from full committee review based on a DHHS Category 2 exemption.

Any changes in your research activity should be promptly reported to the Institutional Review Board and may not be initiated without IRB approval except where necessary to eliminate hazard to human subjects. Any unanticipated problems involving risks to subjects should also be promptly reported to the IRB.

The IRB would like to extend its best wishes to you in the conduct of this study.

Sincerely,

Dr. Greg Dillon
Interim Associate Vice President for Research
Authorized Institutional Official

GD:cc

c: Dr. Jake Protivnak, Chair
Department of Counseling, School Psychology & Educational Leadership

APPENDIX B

2018 PRINCIPALS TECHNOLOGY LEADERSHIP SURVEY

CONSENT FORM

1. Online Survey Consent Form

You are being invited to take part in a research study titledOhio Principals' Perceptions on their Technology Literacy. This study is being done by doctoral student, Christopher Rateno, from Youngstown State University. The purpose of this study is to explore principals' self-assessed competencies of their technology leadership in relationship to the 2018 ISTE Standards for Education Leaders.

The survey should take about 10 minutes to complete. We believe this study has no known risks; however, as with any online activity the risks related to confidentiality are always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by using the secure, password protected website of SurveyMonkey. The online survey will not collect personal information, such as emails or computer IP addresses. Your answers will be sent to and stored on a password protected link. No one, including the researcher will know if you participated in the study.

Your participation in this study is completely voluntary and you can withdraw at any time. The online survey link will be open for three weeks.

If you have questions about this project or have a problem with the survey, you may contact the researcher, Christopher Rateno at XXXXXX or the Doctoral Chair, Dr. Jane Beese at 330-941-X. If you have questions about your rights as a research participant, please contact the Office of Research Services at YSUIRB@ysu.edu or 330-941-2377.

Thank you for your participation!

Please complete the electronic consent below:

* **ELECTRONIC CONSENT:** By clicking "I agree" below you are an adult who is at least 18 years old, have read and understood this consent form and voluntarily agree to participate in this study.

I AGREE

I DO NOT AGREE

APPENDIX C

2018 PRINCIPALS TECHNOLOGY LEADERSHIP SURVEY

SUPPLEMENTAL INSTRUCTIONS

2018 Principal's Technology Leadership Survey Instructions

The purpose of this survey is to provide public school administrators with detailed and comparative information about their technology leadership. Survey items are based on the International Society for Technology in Education's (ISTE) Standards for Education Leaders. Your participation in this survey is completely voluntary and you may opt out at any time.

The individual items in the survey ask you about the extent to which you have engaged in certain behaviors that relate to pre-K-12 school technology leadership. Answer as many of the questions as possible. If a specific question is not applicable, leave it blank. For example, if a question asks about technology planning activities in your district, and your district has not engaged in any such activities, leave the item blank.

As you answer the questions, think of your actual behavior over the course of the last school year. Do not take into account planned or intended behavior. As you select the appropriate response to each question, it may be helpful to keep in mind the performance of other principals that you know. Please note that the accuracy and usefulness of this assessment is largely dependent upon your candor. If done with care, the results can provide valuable information to extend or improve public school administrator leadership skills.

The 2018 ISTE Standards for Education Leaders are new. Benefits to your participation in the study include an introduction to the skills needed by digital leaders to prepare students for success in a global economy. Additionally results from this survey will be made available to Ohio Educational Service Centers and Universities to help establish identified professional learning needs for Ohio Principals in the area of technology leadership.

When assessing behaviors and performance, individuals have a tendency to make several types of errors. You should familiarize yourself with the following errors:

Leniency Error: This occurs when an individual gives himself an assessment higher than he deserves. This could occur for several reasons: the individual has 116 relatively low performance standards for himself; the individual assumes that other individuals also inflate their ratings; or, for social or political reasons, the individual judges that it would be better not to give a poor assessment.

Halo Error: This occurs when an individual assesses herself based on a general impression of her performance or behavior, and the general impression is allowed to unduly influence all the assessments given. An example of halo error would be an individual who rates herself highly on every single assessment item. It is rare that individuals perform at exactly the same level on every dimension of leadership. It is more likely that an individual performs better in some areas than on others.

Recency Error: This occurs when an individual bases an assessment on his most recent behavior, as opposed to his entire behavior over some fixed period of time (e.g., the last year). This assessment should be based on your behavior over the entire year.

2018 ISTE Standards for Education Leaders

Equity and Citizenship Advocate	Leaders use technology to increase equity, inclusion, and digital citizenship practices.
Visionary Planner	Leaders engage others in establishing a vision, strategic plan and ongoing evaluation cycle for transforming learning with technology.
Empowering Leader	Leaders create a culture where teachers and learners are empowered to use technology in innovative ways to enrich teaching and learning.
Systems Designer	Leaders build teams and systems to implement, sustain and continually improve the use of technology to support learning.
Connected Learner	Leaders model and promote continuous professional learning for themselves and others.

(ISTE, 2018) https://www.iste.org/standards/for-education-leaders

APPENDIX D

2018 PRINCIPALS TECHNOLOGY LEADERSHIP SURVEY

2. INSTRUCTIONS

Survey items are based on the International Society for Technology in Education's (ISTE) 2018 Standards for Educational Leaders. Your participation in this survey is completely voluntary and you may opt out at any time. Detailed Survey Instructions and a description of the 2018 ISTE Standards for Educational Leaders can be found here.

This survey is not an evaluation of the work you do as a principal but an attempt to get a baseline of understanding of the self-reported proficiency of Ohio principals in regards to the new 2018 ISTE Standards for Education Leaders. Please respond as honestly as possible.

For this survey, technology is defined as computing devices used to improve instruction. This can include computers, tablets, cell phones, etc. inclusive of the related hardware and software associated with the device.

Select the level which best describes your behavior over the course of the last school year.

	Fully	Significantly	Somewhat	Minimally	Not at all
To what extent did you ensure all students have skilled teachers who actively use technology to meet student learning needs?					
To what extent did you ensure all students have access to the technology and connectivity (e.g. internet access) necessary to participate in authentic and engaging learning opportunities?					
To what extent did you model digital citizenship (defined as knowledge, behaviors, and skills essential for appropriate and responsible technology use.) by critically evaluating online resources?					
To what extent did you engage in civil discourse online and using digital tools to contribute to positive social change?					
To what extent did you cultivate responsible online behavior, including the safe, ethical and legal use of technology?					
To what extent did you engage education stakeholders (anyone who has a role in the success and welfare of students including but not limited to: administrators, teachers, support staff, families, community members, local officials, etc.) in developing and adopting a shared vision for using technology to improve student success?					
To what extent did you build on the shared vision by collaboratively creating a strategic plan that articulates how technology will be used to enhance learning?					
To what extent did you evaluate progress on a strategic plan and make course corrections for using technology to transform learning?					
To what extent did you communicate effectively with stakeholders to gather input on a strategic plan, celebrate successes and engage in a continuous improvement cycle?					

	Fully	Significantly	Somewhat	Minimally	Not at all
To what extent did you share lessons learned, best practices, challenges and the impact of learning with technology with other education leaders?	○	○	○	○	○
To what extent did you empower educators to exercise professional agency, build teacher leadership skills and pursue personalized professional learning?	○	○	○	○	○
To what extent did you build the confidence and competency of educators to put the ISTE Standards for Students and Educators into practice?	○	○	○	○	○
To what extent did you inspire a culture of innovation and collaboration that allows the time and space to explore and experiment with digital tools?	○	○	○	○	○
To what extent did you support educators in using technology to advance learning that meets the diverse learning, cultural, and social-emotional needs of individual students?	○	○	○	○	○
To what extent did you develop learning assessments that provide a personalized, actionable view of student progress in real time?	○	○	○	○	○
To what extent did you lead teams to collaboratively establish robust infrastructure and systems needed to implement the strategic plan?	○	○	○	○	○
To what extent did you ensure that resources for supporting the effective use of technology for learning are sufficient and scalable to meet future demand?	○	○	○	○	○
To what extent did you protect privacy and security by ensuring that students and staff observe effective privacy and data management policies?	○	○	○	○	○
To what extent did you establish partnerships that support the strategic vision, achieve learning priorities, and improve operations.	○	○	○	○	○
To what extent did you set goals to remain current on emerging technologies for learning, innovations in pedagogy and advancements in the learning sciences?	○	○	○	○	○
To what extent did you participate regularly in online professional learning networks (defined as the use of social media technologies to connect, collaborate, communicate, and create with colleagues worldwide) to collaboratively learn with and mentor other professionals?	○	○	○	○	○
To what extent did you use technology to regularly engage in reflective practices that support personal and professional growth?	○	○	○	○	○
To what extent did you develop the skills needed to lead and navigate change, advance systems and promote a mindset of continuous improvement for how technology can improve learning?	○	○	○	○	○

This survey was adapted with permission from:

McLeod, S. (2005). *Principals technology leadership assessment [Survey instrument and directions]*. Center for the Advanced Study of Technology Leadership in Education.

18

2018 Principals Technology Leadership Survey

3. Demographic and School Information

What is your age?

◯ 20-29 ◯ 30-39 ◯ 40-49 ◯ 50-59 ◯ 60 +

What is your gender?

◯ Male ◯ Female ◯ Prefer not to answer

How many years have you been an administrator?

◯ 1-4 ◯ 5-9 ◯ 10-14 ◯ 15-19 ◯ 20-24 ◯ 25-29 ◯ 30-35 ◯ 35 +

Have you ever earned a degree, licence, certificate, or endorsement in technology or a technology related field.

◯ Yes ◯ No

Select all grades that attend your school

☐ pre K ☐ K ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7
☐ 8
☐ 9 ☐ 10 ☐ 11 ☐ 12

How many students on average attend your school?

◯ 1-249 ◯ 250-499 ◯ 500-749 ◯ 750-999 ◯ 1000-1499 ◯ 1500 -1999 ◯ 2000 +

What type of area is your school located in?

◯ Urban ◯ Suburban ◯ Rural

Which category best describes your school's percentage of students eligible for free or reduced-price lunch?

◯ Less than 25% (low poverty) ◯ 26%-50% (mid-low poverty) ◯ 51%-75% (mid-high poverty) ◯ Greater than 75% (high poverty)

19

Think a recent building or district technology initiative (hardware or software implementation). Which best describes the majority of the teacher/adult behaviors towards that technology three months into implementation ?

- ◯ Teachers/adults took little or no interest and ignored the new technology
- ◯ Teachers/adults attended professional learning about the new technology only
- ◯ Teacher/adults have begun to make plans on how to begin using new technology with students
- ◯ Teachers/adults are in beginning stages of using new technology with students
- ◯ Teachers/adults are routinely implementing new technology with students
- ◯ Teachers/adults are making changes to routines to better utilize the new technology
- ◯ Teachers/adults are collaborating with peers regarding the effective uses of the new technology.
- ◯ Teachers/adults are creating new and more effective ways to use new technology with students

APPENDIX E

ANNOUNCEMENT OF UPCOMING STUDY

Dear Principal:

In the next few days you will receive an invitation to participate in a study asking you to rate your digital leadership. This study is looking to establish a baseline for the self-reported competencies for Ohio Principals related to the 2018 International Society for Technology in Education Standards for Education Leaders.

As educational leaders, we are tasked with the mission of preparing young people to thrive and contribute in a constantly changing global and interconnected digital society. As school districts continue to purchase computing devices at a feverish pace, the question remains, "Are these devices being best utilized to impact student learning?" Research has shown the technological competency and leadership ability of a principal significantly affects the level of technological integration in the classroom and teachers' technology literacy (Anderson & Dexter, 2005; Greaves et al., 2017; Chang, 2012; Machado & Chung, 2015). One benefit of your participation in the study is an introduction to the skills needed by digital leaders to prepare students for success in a global economy.

I am respectfully asking that you devote approximately 10 minutes from your busy schedule to participate in the study and complete the online survey. Information from this study will be made available to Ohio Educational Service Centers and Universities to develop professional learning based on Ohio's principals identified needs in technology leadership.

Thank you in advance,

Chris Rateno
Educational Technology Advocate
Youngstown State University Doctoral Candidate

APPENDIX F

INVITATION EMAIL SENT TO PARTICIPANTS LISTED IN OEDS DATABASE

Dear Principal,

My name is Chris Rateno and I am a local administrator and a Youngstown State University doctoral student in the department of Counseling, School Psychology, and Educational Leadership. I have a true passion for the positive use of educational technology and embedding this technology into the 21st century classroom.

I am reaching out to you as school leader for your assistance in my doctoral dissertation research study titled Ohio Principals' Perceptions on their Technology Literacy. In my study, I am looking for relationships between Ohio Principals' level of competency on the 2018 International Society for Technology in Education's (ISTE) Education Leader Standards and Ohio Principals and the buildings they lead.

Your participation in this study will inform you of the new ISTE standards and the skills needed by digital leaders to prepare students for success in a global economy. Additionally the results of this study will be made available to Ohio Educational Service Centers and Universities to develop professional learning based on Ohio's principals identified needs in technology leadership.

I believe there is no risk associated with the study; however, with any online study the risks related to confidentiality can be an issue. Participant answers will be kept confidential in the SurveyMonkey password protected website. This online website will not collect the IP address or email of the participant and your participation is voluntary and anonymous.

If you choose to participate in this study, the online survey should take about 10 minutes to complete. The online survey link is [illegible] and will be open for three weeks.

If you have questions about this project or have a problem with the survey, you may contact the researcher, Chris Rateno at XXXXX or the Doctoral Chair, Dr. Jane Beese at XXXXX.

Thank you in advance for your assistance and time to complete the survey.

Yours in education,

Chris Rateno

APPENDIX G

REMINDER EMAIL TO BE SENT TO POTENTIAL PARTICIPANTS ONE WEEK AFTER THE INITIAL EMAIL IS SENT

Dear Principal,

This is a reminder your help is needed ...

My name is Chris Rateno and I am a local administrator and a Youngstown State University doctoral student in the department of Counseling, School Psychology, and Educational Leadership. I have a true passion for the positive use of educational technology and embedding this technology into the 21st century classroom.

I am reaching out to you as school leader for your assistance in my doctoral dissertation research study titled Ohio Principals' Perceptions on their Technology Literacy. In my study, I am looking for relationships between Ohio Principals' level of competency on the 2018 International Society for Technology in Education's (ISTE) Education Leader Standards and Ohio Principals and the buildings they lead.

Your participation in this study will inform you of the new ISTE standards and the skills needed by digital leaders to prepare students for success in a global economy. Additionally the results of this study will be made available to Ohio Educational Service Centers and Universities to develop professional learning based on Ohio's principals identified needs in technology leadership.

I believe there is no risk associated with the study; however, with any online study the risks related to confidentiality can be an issue. Participant answers will be kept confidential in the SurveyMonkey password protected website. This online website will not collect the IP address or email of the participant and your participation is voluntary and anonymous.

If you choose to participate in this study, the online survey should take about 10 minutes to complete. The online survey link is [redacted] and will be open for two more weeks.

If you have questions about this project or have a problem with the survey, you may contact the researcher, Chris Rateno at [redacted] or the Doctoral Chair, Dr. Jane Beese at [redacted].

Thank you in advance for your assistance and time to complete the survey.

Yours in education,

Chris Rateno

Reminder email to be sent to potential participants one week prior to the survey link closing.

Dear Principal,

Just a friendly reminder your help is needed – only week left.....

My name is Chris Rateno and I am a local administrator and a Youngstown State University doctoral student in the department of Counseling, School Psychology, and Educational Leadership. I have a true passion for the positive use of educational technology and embedding this technology into the 21st century classroom.

I am reaching out to you as school leader for your assistance in my doctoral dissertation research study titled Ohio Principals' Perceptions on their Technology Literacy. In my study, I am looking for relationships between Ohio Principals' level of competency on the 2018 International Society for Technology in Education's (ISTE) Education Leader Standards and Ohio Principals and the buildings they lead.

Your participation in this study will inform you of the new ISTE standards and the skills needed by digital leaders to prepare students for success in a global economy. Additionally the results of this study will be made available to Ohio Educational Service Centers and Universities to develop professional learning based on Ohio's principals identified needs in technology leadership.

I believe there is no risk associated with the study; however, with any online study the risks related to confidentiality can be an issue. Participant answers will be kept confidential in the SurveyMonkey password protected website. This online website will not collect the IP address or email of the participant and your participation is voluntary and anonymous.

If you choose to participate in this study, the online survey should take about 10 minutes to complete. The online survey link is https://www.surveymonkey.com/r/2018PTLS and will be open for one week.

If you have questions about this project or have a problem with the survey, you may contact the researcher, Chris Rateno at [redacted] or the Doctoral Chair, Dr. Jane Beese at [redacted].

Thank you in advance for your assistance and time to complete the survey.

Yours in education,

Chris Rateno