Measuring Principals’ Technology Leadership and Principals’ Behaviors:

A Quantitative Study

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Measuring Principals’ Technology Leadership and Principals’ Behaviors: A Quantitative Study

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Abstract

The purpose of this research study was to identify the current self-reported technology leadership behaviors of principals in one public-school division in Virginia. Additionally, this study identified the difference, if any, in the self-reported technology leadership behaviors of principals across principal and school demographics. For this study Technology leadership was defined as “leadership practices and behaviors that support effective teaching and learning with technology as characterized by the ISTE-EL standards” (Schoenbart, 2019, p. 9). This quantitative descriptive study examined the essential role of principals as leaders responsible for successfully implementing technology integration plans. The researcher collected data via the Education Leaders Technology Survey (ELTS), developed by Dr. Adam Schoenbart, which assessed the 2018 International Society for Technology Education Standards for Education Leaders (Schoenbart, 2019). Overall, the researcher used technology leadership scores and demographic data to describe principal technology leadership behaviors related to the following research questions: (1) To what extent do principals report exhibiting technology leadership behaviors? (2) What are the differences in reported principal technology leadership behaviors, if any, across the following demographic factors? (2a) principal demographic groups of gender identity, age, years of experience. (2b) school demographic groups of school type, size, community technology access, and socioeconomic status. The findings of the study suggested that principals (n = 23) are somewhat exhibiting technology leadership behavior and there is no difference in technology leadership behavior across principal or school demographic groups.
Based on the finding of this study several implications for practice and recommendations for future research developed.
Measuring Principals’ Technology Leadership and Principals’ Behaviors: A Quantitative Study

Shameka Nicole Gerald

General Audience Abstract

The 2020 COVID-19 pandemic has forced businesses, government organizations, churches and schools across the United States of America to close. In a matter of days, COVID-19 has dismantled traditional educational structures and school leaders at all levels have been forced into becoming technology leaders. Though schools are closed, the expectation of teaching and learning are still present and have transitioned to completely online environments. It is up to school leaders to guide school communities into virtual learning, but are principals prepared?

This study examined the current technology leadership of principals in one public-school division in Virginia. Additionally, this study examined if a difference existed in principal reported technology leadership across principal and school demographic groups. Technology leadership can be summarized as practices that support effective teaching and learning with technology. Principal technology leadership scores were calculated based on responses to the online Education Leaders Technology Survey developed by Dr. Adam Schoenbart in 2019. The Education Leaders Technology Survey measured self-reported principal technology leadership based on the 2018 International Society for Technology in Education Standards for Education Leaders (Schoenbart, 2019).

The results of this study indicated that principals report somewhat demonstrating technology leadership and report having a slightly higher opportunity to demonstrate technology leadership in their schools. Study findings also indicate that there are no differences in principal reported technology leadership across principal or school demographic groups. Based on the
findings, several recommendations for principals, division leaders and principal preparation programs were made along with recommendations for future research on this topic.
Dedication

I dedicate this dissertation work to my husband, Jimmie, my son Jace, my parents Karon and Ulysses, grandparents, and family. Without my family, I would not be here. Jimbo…I love you. Your unwavering support, love, sacrifice, and dedication to our family are the definition of partnership in marriage and made this a reality for our family. When I decided to start this journey, you never questioned how we would get through this but instead did what was necessary to ensure the completion of our dissertation without hesitation. I am truly blessed to have you as my partner on our journey through life. Jimbo & Meka forever #TeamGerald

Jace, “Bud-Bear”, you may not understand now but I know one day you will see that writing at my desk with you in my lap, reading quantitative statistics to you at night while you picked out the words you knew, and the joy my heart feels when you tell me you are proud of me for doing my homework are all special memories that I will cherish forever. Your constant desire to research, write, and help me work on my paper kept me motivated even though at times I wanted to quit. Now that our dissertation is complete, we can play Beyblades, Uno, and Mario every weekend. Bee, Bah, Boop. I love you bud.

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Chapter 1: Introduction

Research in the field of educational leadership has demonstrated that school leaders significantly contribute to student achievement and school improvement (Collins & Halverson, 2018; Day, Gu, & Sammons, 2016; Fink & Markholt, 2011; Khalifa, Gooden, & Davis, 2016; Leithwood, Harris, & Hopkins, 2008; Leithwood, Louis, Anderson, & Wahlstrom, 2009). As the nation changed, so have the competencies required of school leaders to transform instructional programs that can successfully meet the needs of a highly technological society (Gu & Johansson, 2013; Leithwood et al., 2009; McLeod, Bathon, & Richardson, 2011; National Policy Board for Educational Administration, 2015; Theoharis & Brooks, 2012; Zhong, 2017). As a result, the International Society of Technology Education (ISTE) released technology leadership standards for education leaders that provide clear indicators and guidance for school leaders on the behaviors necessary to implement systematic changes that include equitable technology outcomes for all students (International Society of Technology Education, 2108).

The purpose of this research study was to identify the current self-reported technology leadership behaviors of principals in one public-school division in Virginia. Additionally, this study identified the difference, if any, in the self-reported technology leadership behaviors of principals across principal and school demographics. Collins and Halverson (2018) noted that school leaders, “need to think about changing schools from within, and how learners can be linked to resources outside schools. Thinking more broadly about technologies can revive our ideas about equity and extend available resources to the non-elites in our society” (p.143). Equipping school divisions and principal preparation programs with up-to-date tools to assess technology leadership is essential to informing education policy and practice, and the selection of...
principals to lead successful technology integration initiatives (Graves, 2019; Schoenbart, 2019; Zhong, 2017).

**Overview of Study**

This study employed a non-experimental descriptive and comparative quantitative design in one public-school division in Virginia. The researcher measured principal technology leadership behaviors using the Education Leaders Technology Survey (ELTS), developed by Schoenbart (2019). The instrument measured principal technology leadership behaviors directly related to the 2018 ISTE Standard for Educational Leaders (ISTE-EL) and included scale score to measure self-reported technology leadership behaviors for each of the five standards. The 2018 ISTE-EL standards divide technology leadership into five standards: (a) equity and citizenship advocate, (b) visionary planner, (c) empowering leader, (d) systems designer, and (e) connected learner (ISTE, 2018). Research on effective school leadership and school improvement suggests that principals must be systematic change agents for successful implementation of technology integration in schools (Graves, 2019; Rateno, 2019; Sun & Leithwood, 2012). A number of researchers identified that limited research is available on principal technology leadership behaviors and the impact of leadership on technology integration initiatives (Graves, 2019; McLeod et al., 2011; Zhong, 2017). Even fewer studies have examined principal technology leadership behaviors associated with the most recent ISTE-EL 2018 standards (Graves, 2019; Schoenbart, 2019; Zhong, 2017).

Descriptive statistics were used to determine self-reported principal technology leadership behaviors related to the 2018 ISTE-EL standards as an overall score and scores for each of the five standards. Analysis of variance (ANOVA) was used to determine any
statistically significant differences in technology leadership behaviors across principal and school demographic groups.

**Historical Perspective**

The purpose of the Elementary and Secondary Education Act of 1965 (ESEA) was “to provide all children significant opportunity to receive a fair, equitable, and high-quality education, and to close educational achievement gaps” (sec. 1002). The establishment of the ESEA marked the federal government’s commitment to ensuring all students attending public schools receive a quality and equitable education (Collins & Halverson, 2018; Culp, Honey, & Mandinach, 2005; United States National Commission on Excellence in Education, 1983). Forty years later, the ESEA was reauthorized by President Obama as the No Child Left Behind Act of 2001 (Paige, Hickok, & Neuman, 2002). The reauthorization expanded federal involvement in student achievement and student success by incorporating required practices, monitoring activities, and technology education goals that support equitable student achievement (Paige, Hickok, & Neuman, 2002). The most recent reauthorization of ESEA was signed into law by President Obama in 2015 and renamed the Every Student Succeeds Act (ESSA). Though the impact of this reauthorization has yet to become completely realized, the focus remains on ensuring all students have the opportunity to reach their fullest potential through accountability measures that include standardized testing and standards of quality ratings based on student performance. The addition of technology integration into ESSA’s goals as a means to address issues of inequity in education outcomes for students resulted in additional guidance being provided on how to best use the funding resources provided as schools work to meet state and federal accountability measures (Office of Education Technology, 2017).
The evolution of the United States from an industrial to technological society has driven changes not only in the workforce, but also in education policy. In turn, federal and state education accountability agencies expect schools and school leaders to prepare students for entry into an ever-changing technological society (Collins & Halverson, 2018; Day et al., 2016; National Policy Board for Educational Administration, 2015; Sheninger, 2014). The United States Department of Education’s National Commission of Excellence Report (1983) concentrated on technology integration in schools through identifying technology’s impact on the world and the current education systems failure to prepare high school graduates to enter a technological world. In the same report, the researchers also identified that marginalized communities were more susceptible to not having access to technology and could become further disenfranchised if the system of education remains stagnant in its practices (Culp et al., 2005; United States National Commission on Excellence in Education, 1983). Thirty-four years later, the 2017 National Education Technology Plan (NETP) identified that the system of education has yet to successfully implement the recommendations identified in the 1983 report to meet the ever changing needs of a technological society and ensure that all students have access to an equitable education which includes technology integration (Culp et al., 2005; United States Department of Education, 2017).

Statement of the Problem

The world is rapidly changing and the formerly singular digital divide has transformed from an issue of access alone to an issue of how unequal access to technology coupled with different use in educational and social settings, has created digital divides and a new civil rights issue for millennials (Graves, 2019; Graves & Bowers, 2018; Montrieux et al., 2015, Ragnedda, 2017). Global connectivity and technology advancement have created a society where digital
skills are necessary for success in the workforce and lack of digital skill development further exacerbates issues of equity (Collins & Halverson, 2018; Graves, 2019; Muro, Liu, Whiton, & Kulkarni, 2017; Ragnedda & Ruiu, 2018). To prepare all students to reach their full capacity as learners, to develop well educated citizens, and to learn the skills necessary contribute to a global society, schools must ensure that all students engage in technology embedded learning opportunities that include application of 21st century skills (Berger & Frey, 2017; Sheninger, 2014; United States Department of Education Office of Educational Technology, 2014; United States Department of Education, 2017).

The school leader’s role in the facilitation of systematic change and implementation of initiatives in schools is critical in preparing students to meet the needs of the every-changing workforce (Alexander, Salmon, & Alexander, 2014; Fink & Markholt, 2011; Leithwood & Jantzi, 2006; Zhong, 2017). In order to move education forward to meet 21st century demands, principals must be able to implement, monitor, and evaluate plans that fully integrate technology in ways that develop students’ digital capital (United States Department of Education Office of Educational Technology et al., 2013). Researchers indicated that extensive research has been conducted on teachers’ technology behaviors and the impact on technology integration in schools, while limited research exists related to the impact of principal technology leadership behaviors on implementing technology integration in schools (Afshari, Bakar, Luan, & Siraj, 2012; Graves, 2019; McLeod et al., 2011; Schoenbart, 2019; Zhong, 2017). To integrate technology in ways that close the digital divides, principals must improve their understanding of the role and responsibilities of technology leaders (Graves, 2019; Schoenbart, 2019; Sheninger, 2014; United States Department of Education, 2017; Zhong, 2017). In this research study, the Education Leaders Technology Survey, developed by Schoenbart in 2019, was used to address
the problem of limited research that describes principal technology leadership behaviors using current technology leadership standards (Schoenbart, 2019).

**Significance of the Study**

Researchers identified public education as the primary resource to address issues of societal inequity in the United States (Alexander et al., 2014; Collins & Halverson, 2018; Kober, 2007; United States National Commission on Excellence in Education, 1983). As a result, principals are responsible for ensuring the intent of ESEA 1965 is realized by providing an equitable education, that includes access to educational technology, to all students. Principals must develop and implement technology integrations plans that address the growing digital divide in access and use of technology in schools while leading in a continuously evolving technological society (Collins & Halverson, 2018; May-Vollmar, 2017; McLeod et al., 2011; Richardson, McLeod, & Sauers, 2015). Identifying principal technology leadership behaviors can assist school divisions in creating schools that equip students with digital capital plays a “key role in personal fulfilment in terms of achieving academic and professional success” (Ragnedda, 2017, p. 79). Ragnedda (2017) defined *digital capital* as, “the set of expertise, experience, skills, knowledge, digital literacy, ICTs access, based on and which can be converted into other types of capitals (economic, social, cultural, personal and political)” (p. 76). This research study contributes to the body of research on principal technology leadership by addressing the gap in research through using current technology leadership standards to measure principal technology leadership behaviors.

**National perspective.** Federal education programs, policies, and initiatives have identified technology integration and the development of 21st century skills for students as a priority to move the nation forward (Culp et al., 2005; Digital Equity Act of 2019; Muro et al.,
The 2018 ISTE-EL standards provided a nationally recognized framework to support education leaders in preparing students to succeed post-secondary (ISTE, 2018). Despite the continuous evolution of national education technology policy, the creation of technology leadership standards, and research on the preparedness of students to thrive in a technological society, school divisions have made little progress toward recognizing the need for identifying and developing effective technology leaders to address equity issues (Graves, 2019; McLeod et al., 2011; Ritzhaupt, Liu, Dawson, & Barron, 2013; Schoenbart, 2019; Sheninger, 2014).

State and local perspective. The Virginia Department of Education’s 2018-2023 Education Technology Plan for Virginia (2017) provided local school divisions the autonomy to create and implement individual technology plans based on local priorities. The Education Technology Plan for Virginia stated, “there is also an inequality that can result from local control based on local priorities, and the educational institutions of Virginia have tried to address these in various ways, with more work needed in this area” (Virginia Department of Education, 2017, para. 2). Variations in school divisions’ focus on technology integration across Virginia further exacerbates the growing digital divide in access to and use of technology by students, and further reduces public education’s ability to protect against digital inequity (Alexander et al., 2014). Virginia’s current technology leadership goals and indicators provide little information on specific actions that principals must carry out in order to successfully implement plan goals. Virginia’s Technology Use Survey does not address specific technology leadership behaviors that aid in the successful implementation of technology integration initiatives, nor is it designed to assess current principal technology leadership behaviors (VDOE, 2017). This study is
significant at the state and local level because no studies measuring principal technology leadership behaviors using the ISTE-EL standards have been conducted in Virginia.

**Purpose of the Study**

The purpose of this research study was to identify the current self-reported technology leadership behaviors of principals in one public-school division in Virginia. Additionally, this study identified the difference, if any, in the self-reported technology leadership behaviors of principals across principal and school demographics. For the purposes of this study, technology leadership is defined as, principal leadership behaviors that support the effective integration of technology in schools and principal behaviors that are aligned with the 2018 ISTE-EL standards (Schoenbart, 2019). The researcher collected data using an online version of the ELTS, which assesses the 2018 ISTE-EL standards. Schoenbart (2019) identified that each of the ELTS items align to specific leadership behaviors indicated in the 2018 ISTE-EL standards. The 2018 ISTE-EL standards divide technology leadership into the following five standards: (a) equity and citizenship advocate, (b) visionary planner, (c) empowering leader, (d) systems designer, and (e) connected learner (ISTE, 2018). Overall, the researcher used self-reported technology leadership behaviors and demographic data to describe and compare principal technology leadership behaviors.

**Justification of the Study**

The literature on principal technology leadership behaviors is limited, with many studies focusing on the principals’ use of technology to complete administrative tasks and knowledge of technology resources (McLeod et al., 2011; Zhong, 2017). Even fewer studies exist related to principal technology leadership behaviors that lead to successful technology integration in schools (Graves, 2019; McLeod et al., 2011; Schoenbart, 2019; Zhong, 2017). In addition, the
body of research related to principal technology leadership behaviors is primarily anecdotal and focuses on outdated standards that are inappropriate to measure current technology leadership (Graves & Bowers, 2018; McLeod et al., 2011; Schoenbart, 2019; Zhong, 2017). McLeod and McLeod & Richardson (2011) posited in their review of literature related to technology integration that additional research on principal technology leadership behaviors is required due to “a slim empirical core upon which we can draw to make recommendations for educators’ technology leadership practices who are really struggling with much of this and could use our help” (p. 236). As a result, there is a lack of research-based best practices and resources recommended for identifying principal candidates with the competencies appropriate for leading technology integration in schools. The gap in literature coupled with the gap in research serves as justification for an increase in studies that measure principal technology leadership behaviors related to the ISTE-EL standards and make recommendations that could inform principal preparation, selection, and support in the future.

**Research Questions**

The following research questions will be addressed as a part of this study:

1. To what extent do principals report exhibiting technology leadership behaviors?

2. What are the differences in reported principal technology leadership behaviors, if any, across the following demographic factors?

   a. principal demographic groups of gender identity, age, years of experience?

   b. school demographic groups of school type, enrollment, school technology access, and percentage of students eligible for free or reduced lunch?
Conceptual Framework

Technology is changing at a rapid pace (Muro et al., 2017). To prepare students to engage in a technological society, school leaders must implement systematic changes that embed 21st century skills into instructional programs (Graves, 2019; Richardson et al., 2015; Sheninger, 2014). The ISTE-EL are the professional standards that the researcher will use in this study to establish a framework for technology leadership (Appendix A). Researchers identified research-based effective leadership practices a major contributing factor to successful implementation of restructuring initiatives in schools leading to improved student outcomes (Day et al., 2016; Day & Sammons, 2014; Leithwood & Jantzi, 1999; Leithwood et al., 2009; Schoenbart, 2019).

Principal technology leadership, when viewed through the lens of transformational leadership, provided justification for examining the role of principals in leading successful technology implementation initiatives in schools that require large scale changes in practice (Hadjithoma-Garstka, 2011; Klar & Brewer, 2013; Schoenbart, 2019; Vermeulen, Kreijns, van Buuren, & Van Acker, 2017). A comprehensive understanding of technology leadership frameworks, such as the ISTE-EL Standards, may aid principals in the successful implementation of instructional technology in schools (Afshari et al., 2012; Graves & Bowers, 2018; Schoenbart, 2019; Vermeulen, Van Acker, Kreijns, & van Buuren, 2015).

This study examined principal technology leadership behaviors and the differences, if any, in principal technology leadership behaviors across school and principal demographic groups in one public-school division in Virginia that could lead to an increase in student exposure to digital skills in preparation for post-secondary opportunities. Previous studies have identified the impact of principal leadership on systematic change and implementation of initiatives that increase student achievement (Fink & Markholt, 2011; Leithwood & Jantzi, 2006;
There are, however, few studies on principal skills and competencies required to implement systematic technology integration initiatives successfully (McLeod et al., 2011; Rateno, 2019; Schoenbart, 2019; Zhong, 2017). Figure 1 illustrates the conceptual framework developed for this study.

*Figure 1. Conceptual framework identifying the impact of principal technology leadership behaviors on school-wide technology integration plans that increase students’ exposure to digital skills.*

The presence of relationships between principal school leadership behaviors, changes in teacher behaviors, pedagogical shifts, student achievement, and successful implementation of education initiatives are noted in literature (Day, Gu, & Sammons, 2016; Fink & Markholt, 2011; Leithwood & Jantz, 1999; Leithwood & Jantz, 2006; Leithwood et al., 2009). Zhong (2017) reported “principals in digital age should be able to inspire and lead school transformation through technology, create and sustain digital learning culture, support technology-based professional development, provide digital leadership and management, and facilitate and manage social, ethical, and legal issues.” (p. 37). As presented in Figure 1, identifying principal technology leadership behaviors is a potential method for identifying, assigning, and supporting principals that will lead successful technology integration initiatives in schools that increase student exposure to digital skills (Chen, 2008; Graves, 2019; Vermeulen, Kreijns, van Buuren, & Van Acker, 2015).

**Operational Definitions and Acronyms**

The following terms were used throughout the study:
21st **Century skills.** These skills include the ability to solve problems, innovate, and collaborate effectively as members of diverse, often geographically distributed teams (United States Department of Education Office of Educational Technology et al., 2013).

**Digital divide.** “The gap between students who have access to the Internet and devices at school and home and those who do not” (US Department of Education, 2017 p. 7).

**Digital use divide.** The factor that “separates many students who use technology in ways that transform learning from those who use the tools to complete the same activities but with an electronic device (e.g., digital worksheets, online multiple-choice tests)” (United States Department of Education, 2017, p. 7).

**Digital equity.** “The condition in which individuals and communities have the information technology capacity that is needed for full participation in the society and economy of the Unites States” (Digital Equity Act of 2019, p. 4-5).

**Digital leadership.** “Indicators of digital leadership constitute awareness of digital leadership, support from all stakeholders, digital resources, technology modeling, practical professional development, digital learning community, maximized learning achievement, competent personnel, strategic management, robust infrastructure, technology agreement form, and filters.” (Zhong, 2017 p. 37)

**Digital natives.** Seasoned users of technology who are innately or inherently tech savvy, who behave and think differently because of their use of technology (Judd, 2018).

**Digital skills.** The ability and capacity to use and navigate a computer once access is provided. Also, the ability to search for information, select content, manage social and professional contexts online, be aware of potentialities offered by the Internet, engage in self-promotion and increase social and cultural capital (Ragnedda, 2017).
**ISTE-EL Standards.** Framework for technology leadership for educational leaders. International Society for Technology in Education Standard for Education Leader (ISTE-EL) Standards refer to “standards [that] target the knowledge and behaviors required for leaders to empower teachers and make student learning possible” (ISTE, 2018).

**Marginalized students.** “ethnically and culturally diverse or economically disadvantaged student populations that have been traditionally underserved” (Davy, 2016, p. 2).

**Non-cognitive competencies.** These competencies refer to the “successful navigation through tasks such as forming relationships and solving everyday problems. They also include development of self-awareness, control of impulsivity, executive function, working cooperatively, and caring about oneself and others” (United States Department of Education, 2017, p. 10).

**School district/division.** An education agency at the local level that exists primarily to operate public schools or to contract for public school services. Synonyms are “local basic administrative unit” and “local education agency.” (United States Department of Education, 2017, p. 341) In the Commonwealth of Virginia a school division is a geographical area over which the school board has jurisdiction.

**School socioeconomic status.** The percentage of students at each school who are eligible for free and reduced-price lunch.

**Technology.** “Devices like computers, tables, cell phones, and other communication tools, as well as their related hardware and software” (Schoenbart, 2019, p. 9).

**Technology infrastructure.** “High-speed connectivity and devices that are available to teachers and students when they need them. Aside from wires and devices, a comprehensive learning infrastructure includes digital learning content and other resources, as well as
professional development for educators and education leaders” (United States Department of Education, 2017, p. 5).

**Technology leadership.** “Technology leadership refers to leadership practices and behaviors that support effective teaching and learning with technology as characterized by the ISTE-EL standards” (Schoenbart, 2019, p. 9). For example, “principals in digital age should be able to inspire and lead school transformation through technology, create and sustain digital learning culture, support technology-based professional development, provide digital leadership and management, and facilitate and manage social, ethical, and legal issues” (Zhong, 2017, p. 37).

**Type I barrier.** Obstacles that are not in the control of the teacher, which include equipment, training, support, that is either inadequately or not present in the school (Ertmer, 1999).

**Type II barrier.** Obstacles that interfere with the fundamental change necessary to shift a school’s pedagogical culture, such as teacher perception of what education should look like versus what students need to succeed in gaining 21st century skills (Ertmer, 1999).

**Limitations**

There were conditions for this research study in which the researcher did not have control. The boundaries of this research study limited the scope and generalizability of the results. This research study had the following limitations:

1. The data calculated were self-reported using the ELTS; therefore, social desirability bias is possible due to study participants over-reporting their technology leadership behaviors.
2. ELTS measures principal technology leadership behaviors related to the ISTE-EL standards. Technology leadership behaviors as measured by any other standards were not considered.

3. The researcher used a purposive sample within one public-school division in Virginia, thus, limiting the generalizability of study findings to other school divisions.

4. Study participation was voluntary, and therefore, the response rate was small due to participants’ non-response. A small sample size ($n < 30$) may result in a study with low statistical power and limited generalizability.

**Delimitations**

There were conditions in the research study for which the researcher had control. The research study had the following delimitations:

1. The setting of the study was a public-school division in Virginia. The technology leadership behaviors outside this boundary were not considered.

2. The researcher excluded one high school in the setting from the study due to the researcher’s position as principal of the school. The leadership behaviors of a principal of a one-to-one school, where each student is assigned a computing device, could add valuable insight to practices in one-to-one schools compared to non-one-to-one schools.

3. The selection of participants was confined to those who are serving as the school principal during the current school year. Seven of the 39 principals in the sample are new principals and may have limited experience in leading technology education at the time of the study.
**Assumptions**

Below are the researcher assumptions that existed as a part of this research study:

1. Principal technology leadership behaviors differ across principal and school demographics.

2. Principals do not fully exhibit technology leadership behaviors that align with the 2018 ISTE-EL standards.

**Organization of the Study**

In this study, the researcher investigated the technology leadership behaviors of school principals. This dissertation is organized into five chapters with references and appendices. Chapter 1 provides an introduction to the topic, including a historical perspective, problem overview, study significance, research questions, purpose, conceptual framework, definitions, limitations, delimitations, assumptions, and a summary. Chapter 2 presents a review of the literature related to technology education policy and education reform in the United States, the three levels of digital divide, leadership in education, effective school leadership, technology leadership and equity leadership. Chapter 3 explains the quantitative methodology used in the study, including the research design justification and questions, sample selection, data collection and gathering procedures, instrumentation and validation, data treatment and management, and how the researcher will analyze and interpret the data. Chapter 4 reports results, including a descriptive analysis of the sample participants’ and their self-reported technology leadership behaviors. This section will also present comparative data on principal technology leadership behaviors using principal and school demographic data. Chapter 5 provides a summary of this study’s findings, implications for professional practice, recommendations for future research, and the researcher’s reflections.
Chapter 2: Literature Review

The purpose of this review of literature was to examine the current literature and research available regarding digital equity, the digital divide and principal technology leadership. Research analysis included studies that examined the impact of school leadership on student achievement, school leadership frameworks, technology leadership frameworks, implementation of technology initiatives in schools, access to digital resources, and the impact of the digital divide on student outcomes. The researcher identified themes and gaps in previous research to add to the emerging body of literature focusing on the principal’s role in forging school cultures that “promote student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access” (United States Department of Education, n.d.).

This chapter reviews the literature related to the digital divide, barriers to successful technology integration; school leadership practices that lead to improved student achievement and successful technology integration; and, the role that schools play in addressing social justice issues such as digital equity. Through the review of literature three themes emerged: technology in education, the digital divide, and leadership in education. These themes are used to organize this review of literature. The first section focuses on technology in education and the rapid pace of technological advances in society. The second section explains the digital divide in education as a multi-level gap dividing the digital haves from the have-nots (United States Department of Commerce, 1995). The first level of the digital divide represented the foundation for digital equity, which described access to high-speed internet and technology tools that enabled all students to succeed (Ragnedda, 2017; United States Department of Education, 2017). The second level digital divide, or digital use divide, functioned through the purpose and anatomy of use of
technology (Ragnedda, 2017). In the third section, level digital divide explicitly identified how different access and different use further exacerbated social inequalities (Ragnedda, 2017; Ragnedda & Ruiu, 2018). In the following review of literature, the researcher examined the impact of school leadership on school culture, student achievement, and technology integration (Khalifa et al., 2016; Sun & Leithwood, 2012; Theoharis, 2007; Office of Educational Technology, 2016). Finally, the researcher explored equity in technology integration as a function of school leadership through principal self-examination of leadership practices (Graves, 2019; Theoharis, 2007).

Search Process

The researcher conducted the search process using the Virginia Polytechnic Institute and State University Library Discovery Search and Google Scholar to investigate combinations of key words and phrases. The literature search included, but was not limited to, scholarly journal articles, books, and published dissertations discovered using university supported databases, such as EBSCO Host, JSTOR, ProQuest, and VT Ref Works. The researcher conducted general searches on the United States Department of Education, Virginia Department of Education, National Center for Education Statistics, and the International Society for Technology in Education websites.

The literature review began with broad search terms, such as: one-to-one technology in classrooms; digital divide in education; 21st Century skills in education; Information and Communication Technology (ICT) in education; Digital Equity; Digital Inequality; Digital Divide; School Leadership; Transformational Leadership; Digital Leadership; and, technology integration in schools—yielding an average of 2,079,779 results. The researcher narrowed the search results by using combinations of the key terms yielding approximately 211 results. Search
limitations included publications since 2010 that were available as full text, including articles from scholarly publications. The researcher examined the references of these previous works to identify and locate other relevant studies and sources.

**Technology in Education**

Bladergroen, Chigona, Bytheway, Cox, Dumas, & van Zyl (2012) noted that “the rapid growth in Information Communication and Technologies (ICT) have brought remarkable changes in the twenty-first century, as well as affected the demands of modern societies” (p. 136). These technologies can not only replace manual labor, but also expand the capacity of the workforce around the world (Sheninger, 2014). In their report, Muro et al. (2017) stated:

The digitalization of American life may be the fastest, most striking, example yet of the adoption of what economists call a general like (GPT)—a technology purpose technology steam power or electricity so broadly useful that it reorients the entire economy and tenor of life. (p. 5)

Muro et al. (2017) sought to determine the impact of digitalization of the workforce on the job market in the United States. Muro et al. defined digitalization as “the diffusion of digital technologies into nearly every business, workplace, and pocket—continues to remake the U.S. economy and the world of work” (p. 3). The researchers analyzed the changes to the required digital skills of 545 occupations, covering 90% of the workforce in the United States from 2001 through 2016. The researchers found that “the average digitalization score across all occupations rose from 29 in 2002 to 46 in 2016, a 57 percent increase” (p. 17).

Many industries have made significant changes to take advantage of technological advances. Yet, there has been progress incorporating technology into instruction to ensure that students are prepared to meet new technological demands of a globally connected society (Muro
et al., 2017; Sheninger, 2014). If education is to keep pace with what is now considered *general purpose technology* and prepare students to compete globally, schools have an obligation to ensure that students have rich experiences with innovative technology in their learning (Muro et al., 2017). Prensky (2001) provided an example of how industries, outside of education, have begun to meet the needs of their learners and the world:

The US military, which has a quarter of a million 18-year-olds to educate every year, is a big believer in learning games as a way to reach their Digital Natives. They know that their volunteers expect this: “If we don’t do things that way, they’re not going to want to be in our environment.” What’s more, they’ve observed it working operationally in the field. “We’ve seen it time and time again in flying airplanes, in our mission simulators.”

Practical-minded Department of Defense trainers are perplexed by educators who say, “We don’t know that educational technology works – we need to do some more studies.” “We know that the technology works,” they retort. We just want to get on with using it.”

(p. 6)

Prensky (2001) described how non-education sectors have worked to keep pace with changes in technology. Prensky (2001) also identified the impact of technology on the skills needed to access jobs with more earning potential, created by the digitization of the national workforce. Sheninger (2014) and Muro et al. (2017) agree that students must have the ability to problem solve, communicate, collaborate, and engage in ways that coincide with the current use of technology in society.

Education has not completely ignored the global shift from an industrial to a technological society. According to Culp et al. (2005), the work towards developing national education policy to support technology integration started in 1983, with *A Nation at Risk* (p. 5).
In *A Nation at Risk* (1983), researchers identified that the current system of education failed to prepare students for the highly skilled jobs that technology was transforming. According to Culp et al. (2005), *A Nation at Risk* represented the starting point for the national focus on technology education. Culp et al. examined 28 policies over a period of 20 years of technology policy reports, summarizing the findings of each report into seven key recommendations for the changes needed in education to keep pace with technology to:

1. Improve access, connectivity, and requisite infrastructure.
2. Create more high-quality content and software.
3. Provide more sustained, high-quality professional development and overall support for teachers seeking to innovate and grow in this domain.
4. Increase funding from multiple sources for a range of relevant activities.
5. Define and promote the roles of multiple stakeholders, including the public and private sectors.
6. Increase and diversify research, evaluation, and assessment.
7. Review, revise and update regulations and policies that affect in-school use of technology, particularly policies regarding privacy and security. (Culp et al., 2005, p. 1)

Culp et al.’s (2005) recommendations remain relevant as education policy and schools continue to focus on successful technology integration for all students.

**The Digital Divide in Education**

The digital divide received national attention in 1995, when the National Telecommunications and Information Administration (NTIA), under the United States Department of Commerce, coined the term in a published a report that identified that there was
an information disadvantage among poor, minority, senior citizen, and less educated subgroups, who had unequal access to telephone and computer technology (United States Department of Commerce, 1995). Three years later, NTIA revisited the data and found that the digital divide had persisted and updated the profile of the nation’s least connected populations (United States Department of Commerce, 1998). NTIA’s 1998 report highlighted that between 1994 and 1997 Americans had greater access to technology in their homes, with a 51.9% increase in computer ownership, a 139.1% increase in modem ownership, and 397.1% increase in email access. Even with the reported gains in the 1998 report, the researchers noted that the digital divide has persisted and that “Blacks and Hispanics now lag even further behind Whites in their levels of PC-ownership and on-line access” (United States Department of Commerce, 1998, p. 3). The 1999 report identified that the divide has further widened, but NTIA’s *Falling Through the Net* series of reports laid the foundation for schools to assume a pivotal role in creating opportunities for connectivity for all Americans (United States Department of Commerce, 1995, 1998, 1999). The current iteration of the National Education Technology Plan identified that the digital divide continues to grow through education reform policy specifically outlined plans to address the gaps over 20 years ago (United States Department of Education, 2017).

As the United States Department of Commerce continued to research the digital divide, the organization identified the steps necessary to address the growing gaps in access, the report’s findings identified education as a powerful lever to ensure creating more equitable outcomes for all students (United States Department of Commerce, 1993). This led the United States Department of Education to establish policies designed to address the need for education technology in schools. The United States Department of Education published the first iteration of
the National Education Technology Plan (NETP) in 1996, establishing the following goals for educating American students with technology:

1. All teachers in the nation will have the training and support they need to help students learn using computers and the information superhighway.
2. All teachers and students will have access to modern multimedia computers in their classrooms.
3. Every classroom will be connected to the information superhighway.
4. Effective software and online learning resources will be an integral part of every school’s curriculum. (United States Department of Education, 1996, p. 11)

The 1996 NETP not only outlined the goals for ensuring that schools met the demands of the changing technological landscape, but it also provided preliminary guidance for federal, state, and local agencies for supporting and sustaining learning environments rich with technology (United States Department of Education, 1996). Over ten years later, the United States Department of Education released the most recent update to the NETP in 2017. The 2017 NETP update continued to focus on the digital divide in education and the measures that educators must adopt to ensure that students develop the academic and non-cognitive skills necessary for success in the 21st century (United States Department of Education, 2017). The NETP 2017 defined the digital divide as, “the gap between students who had access to the Internet and devices at school and home and those who did not.” (p.7). Though technology is persistent in society Delgado, Wardlow, McKnight, & O’Malley discuss the value of technology to the nation and state, “Technology cannot provide any assistance, and surely any advantages, if students do not have the tools or the access to technology” (p. 410). In recent decades, how people interact and communicate around the world has changed rapidly due to advances in
technology (Delgado et al., 2015). School leaders must not only address the issues of inequity in access to technology for students across the country, but they also must continue to meet federal and state accreditation standards, designed to identify inequitable gaps in student performance. Students cannot fully benefit from integrated technology that increases academic achievement if they do not have access to the tools necessary to develop digital skills for the 21st century (Delgado et al., 2015). School divisions must seek to answer the question of what they can do to address the digital divide and ensure that all students have the access to technology required to be highly competitive in a global society (United States Department of Education, 2017).

Delgado et al. (2015) reported that there were many students that have access to high-speed internet at school or at home. Access to high-speed internet may be true for some students, but Earthman (2013) found that access to technology was a critical issue in school facility planning. Having the right kind of technology and appropriate access are crucial in the implementation of technology for teaching and learning (Jarvis, 2018). As school divisions work to increase technology access for all students through the development and implementation of technology integration plans, the digital divide has transformed from an issue of access alone (Graves, 2019; Ragnedda, 2017). The digital divide is now an issue of how unequal access coupled with different use has created the new civil rights issue for millennials (Graves, 2019; Graves & Bowers, 2018; Ragnedda, 2017). Researchers have separated the digital divide into three distinct levels, each with unique barriers and strategic support mechanisms necessary to close the gap.

First Level Divide: Infrastructure and Access

Infrastructure. Technological infrastructure is one of many barriers preventing full implementation of technology initiatives in schools (Bladergroen et al., 2012; Earthman, 2013;
Gil-Flores, Rodriguez-Santero, & Torres-Gordillo, 2017; United States Department of Education, 2017). In the 2017 National Education Technology Plan Update, the United States Department of Education (2017) defined infrastructure as,

High-speed connectivity and devices that are available to teachers and students when they need them. Aside from wires and devices, a comprehensive learning infrastructure includes digital learning content and other resources as well as professional development for educators and education leaders. (p. 5)

Budget shortfalls make it difficult for school divisions to dedicate the resources to create the technology infrastructure necessary to maintain instructional and communication technology (ICT) for teaching and learning (Delgado et al., 2015). Gil-Flores et al. (2017) reported that “infrastructure is necessary but not sufficient condition” (p. 446) for implementation of technology initiatives in schools. After schools establish technological infrastructures, school divisions must work to ensure there is equitable access to technology across all subgroups to develop the technological skills necessary to thrive in the 21st century.

Access. With proper technology infrastructures in place, schools are enabled to take the steps necessary to ensure that devices and highly skilled teachers – that understand how technology contributes to the learning process – are accessible to all students have access to (United States Department of Education, 2017). Vigdor, Ladd, and Martinez (2014) found that computer prices could be prohibitive to schools due to budget shortfalls, the number of devices required, and price of the devices. Despite budget shortfalls, Delgado et al. (2015) found that technology was rapidly becoming less expensive while simultaneously becoming more powerful. As less expensive computing power and access to rich educational applications is becoming increasingly abundant school divisions must ensure effective implementation plans, that include
training for teachers, are in place to for successful technology integration (Delgado et al., 2015; Sahin, Top, & Delen, 2016; United States Department of Education, 2017). School-level access is increasing due to the decreasing cost of technology and federal E-Rate programs that help school divisions update their infrastructure (United States Department of Educational Office of Education Technology, 2014). E-Rate programs are defined as “a source of federal funding for the internet connectivity in U.S. schools and libraries created by Congress in 1996” (United States Department of Education, 2017, p. 20).

For school leaders to develop robust technology integration plans and train teachers to develop instruction practices that enhance student learning through technology they must work with division leaders to remove barriers to equitable technology integration (Covington, 2012; Ertmer, P.A., 1999; Ertmer & Ottenbreit-Leftwich, 2010; Theoharis & Brooks, 2012). Ertmer (1999) identified two types of access barriers with two distinct sets of characteristics that must be addressed differently by school leaders. Educators must focus on the removal of Type I or first-order barriers to technology integration: those obstacles beyond the control of the teacher (inadequate equipment, training, or support) (Covington, 2012; Ertmer, 1999). Many schools have eliminated Type I barriers to technology through initiatives such as one-to-one device distribution, allowing students to bring their own devices into the classroom (BYOD), and significant investments in technological infrastructure upgrades (Covington, 2012; Earthman, 2013). Even with Type I barriers significantly diminished, researchers have shown that meaningful use of technology in the classroom is still low and Type II barriers continue to hinder full implementation of ICT programs in schools (Covington, 2012; Sheninger, 2014; Office of Educational Technology, 2014).
Ertmer (1999) defined Type II or second-order barriers to technological integration as obstacles that interfere with the fundamental change necessary to shift a school’s pedagogical culture: teachers’ beliefs about pedagogic approach versus the needs of students in the 21st century. Type II barriers are related to teacher belief and are less tangible than Type I barriers that deal with physical resources (Covington, 2012; Ertmer, 1999). The challenge of identifying Type II barriers creates more difficulty in successfully implementing ICT initiatives in schools. Given that Type II barriers derive from educators’ perceptions of teacher-student roles, they require significant changes in pedagogy that extend far beyond automating teacher practices (Ertmer, 1999). Allocating additional funding to increase access technology resources does not guarantee successful integration of technology that enhances student learning (Bladergroen et al., 2012; Graves, 2019; United States Department of Education, 2017).

**Second Level Divide: Purpose and Anatomy of Use**

Today’s students are considered digital natives, meaning they are seasoned users of technology who are innately or inherently tech savvy (Ertmer, 1999; Judd, 2018; Sheninger, 2014). They behave and think differently than previous generations of students because of their use of technology (Judd, 2018). This definition is a stark contrast to many of the pedagogical practices that educators, who have been charged with creating engaging lessons and learning environments for digital natives, currently employ (Prensky, 2001). Although students are accustomed to instant access to information through readily available internet connections, teaching practices still reflect instructional strategies developed over a century ago (Wang, Hsu, Campbell, Coster, & Longhurst, 2014). Antiquated teaching practices leave students unengaged, potentially leading to lower student achievement due to students using technology for non-academic purposes in the classroom. Additionally, students are entering the workforce
unprepared to navigate the technology they are expected to use effectively (Sheninger, 2014). Many teachers use ICT resources as a “book behind glass” or a direct substitution for paper assignments or textbooks (Montrieux, Vanderlinde, Schellens, & De Marez, 2015). This practice does not allow students to learn critical 21st Century skills developed by authentically engaging with digital resources that employers will expect them to use upon entering the workforce. The skills students gain during their educational careers are shaped by the experiences they have in classrooms. Teachers not only ensure that students learn a foundational academic knowledge base, but they also provide them with experiences that will help them excel in a global society. Technology in education affords teachers the opportunity to increase academic achievement and build the necessary non-cognitive skills to thrive in our global society (Bladergroen et al., 2012; United States Department of Education, 2017).

Studies on the impact of technology on student academic achievement have resulted in mixed results (Delgado et al., 2015). In their 2014 study, Vigdor et al. found that there was little data linking student computer usage to positive academic outcomes. Students reported spending more time on leisure activities, watching television and not using computers to complete homework, after the introduction of computers. The researchers also asserted that technology had a negative impact on students’ reading and math scores over time. Montrieux et al. (2015) found that students felt more distracted when using tablets for academic purposes. Though academic achievement results are mixed, researchers agree that technology plays a role in the development of non-academic skills necessary to navigate the 21st Century (Bladergroen et al., 2012; Delgado et al.; Vigdor et al., 2014). Improved research skills (Delgado et al., 2015), increased computer literacy (Vigdor et al., 2014), and an overall increase in non-cognitive competencies represented
positive outcomes of implementation of technology in education (United States Department of Education, 2017).

Teachers are responsible for the success and engagement of students in today’s schools and they are the key to successful technology integration (Ertmer & Ottenbreit-Leftwich, 2010; Montrieux et al., 2015). How teachers use technology directs students’ paths to meaningful and authentic learning experiences (Ertmer & Ottenbreit-Leftwich, 2010; United States Department of Education, 2017). Montrieux et al. (2015) described different use in educational settings by identifying two teacher types — instrumental and innovative — that lead to different student use of technology. In the 2015 qualitative study of students and teachers’ perceptions of technology usage, Montrieux et al. defined the two teacher types as follows:

Instrumental teachers can be linked to teachers, who are stuck in using tablets without a fundamental change in teaching and learning approaches, who use technology as a functional improvement to enhance learning. Innovative teachers can be linked to the highest level of technology integration whereas teachers use tablet devices to transform learning, which opens teaching and learning practices which were previously inconceivable. (p. 12)

Graves (2019) later confirmed the findings of Montrieux et al. (2015) and expanded the typology of teachers who impact technology usage in the school setting from two to four. Dexterous teachers use technology fluidly to provide instruction in the classroom, evaders use technology to complete teacher administrative tasks, presenters use technology to present instruction with little student engagement beyond presentations, and assessors use technology to drill basic skills (Graves, 2019). Variation in teacher types could lead to inconsistent implementation of
technology initiatives and inconsistent use of technology by students in schools (Graves, 2019; Montrieux et al., 2015).

The United States National Technology Plan Update (2017) asserted:

The digital use divide separates many students who use technology in ways that transform their learning from those who use the tools to complete the same activities but now with an electronic device (e.g., digital worksheets, online multiple-choice tests). The digital use divide is present in both formal and informal learning settings and across high- and low-poverty schools and communities. (p. 11)

This definition emphasized the importance of teachers’ use of technology to teach the 21st Century skills and non-cognitive competencies students need after completing their secondary education. In its report, the United States Department of Education (2017) affirmed, “without thoughtful intervention and attention to the way technology is used for learning the digital use divide could grow even as access to technology in schools increases” (p. 20). Researchers have outlined several specific student and teacher factors that contribute to the digital use divide.

**Student factors.** In recent studies, scholars have indicated that marginalized students have a lower chance of gaining the 21st century skills necessary to use technology resources outside of school, thus leaving school as the only place that can level the digital playing field across all student demographics (Vigdor et al., 2014). It is important that education shifts from an institution preparing assembly line workers to preparing digital citizens that can ethically and safely use technology to succeed in the 21st century (Sheninger, 2014; United States Department of Education, 2017). Several factors allow for the successful implementation of technology in schools, but no implementation factors are more important than the teacher (Montrieux et al. 2015). Researchers have identified that change in teacher pedagogical practice is a delicate
balance between self-efficacy, skills, knowledge, pedagogical belief, and school culture (Ertmer & Ottenbreit-Leftwich, 2010).

**Teacher factors.** Teacher attitude is an important factor that influences the integration of technology into classroom instruction (Montrieux et al., 2015). Through technology competency, self-efficacy, and school culture, the teacher is the primary factor that either speeds up or slows down technology integration (Thoonen, Sleegers, Oort, Peetsma, & Geijsel, 2011; United States Department of Education, 2017). Sahin et al. (2016) identified a lack of infrastructure, lack of technical support, lack of professional development, and inconsistent school policies as significant contributors to teachers’ negative attitudes toward technology implementation. Bladergroen et al. (2012) reported that professional development in technology contributes to a positive teacher attitude. Professional development must focus on how educators can apply each technological tool in specific content areas to increase mastery and enhance student learning (Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010).

**Skills and knowledge.** Ertmer and Ottenbreit-Leftwich (2010) asserted that “teaching with technology requires teachers to expand their knowledge of pedagogical practices across multiple aspects of the planning, implementation, and evaluation processes” (p. 260). Sahin et al. (2016) added that the number of personal mobile devices (such as cellphones, laptops, and tables) that a teacher has correlated to their comfort level with teaching with technology. The more experience teachers have with computers the more positive their attitude becomes towards technology (Bladergroen et al., 2012). Yet, knowing how to use technological hardware and software is not enough to ensure that teachers effectively integrate technology into instruction in the classroom (Ertmer & Ottenbreit-Leftwich, 2010). Teachers need strategic, real-time,
professional development aligned with school-wide technology implementation plans to ensure that they know how to integrate technology effectively.

Researchers found that the more professional development teachers receive the more certain teachers feel about their understanding of implementing technology in the classroom and the more likely they are to use these instructional strategies to enhance student learning (Chen, 2008; Thoonen et al., 2011). Access to technology has generally increased in schools, though actual use of technology for education remains low (Delgado et al., 2015). Teachers consistently use technology for administrative purposes (Delgado et al., 2015) or as a “book behind glass” (Montrieux et al., 2015). Teachers use technology as an instrument to replace worksheets, rather than enhancing their pedagogy to incorporate technology as a part of the learning process (Bladergroen et al., 2012; Gil-Flores et al., 2017; Graves & Bowers, 2018; Sahin et al., 2016). Limited technologically enriched resources from textbook publishers (Bladergroen et al., 2012; Montrieux et al., 2015) and a lack of understanding about how technology benefits both teacher and student (Earthman, 2013; Montrieux et al., 2015; Office of Educational Technology, 2014) are critical barriers to ensuring teachers and students know how to use technology for academic purposes successfully.

Chen’s (2008) research supported that of Montrieux et al. (2015), stating that when teachers do not have a clear understanding of technological integration, they may feel disoriented or uncertain about what role ICT plays in teaching and learning. This uncertainty provokes teachers to adopt more conservative teaching practices after the introduction of ICT in the classroom (Montrieux et al., 2015; Thoonen et al., 2011). Teachers cannot receive a new teaching technology with the expectation that they develop engaging lessons that will transform student learning without proper training (United States Department of Education, 2017).
Montrieux et al. (2015) conducted a survey of 32 students, identifying that older students see a need for more training for teachers. The researchers also found that students between the ages of 15 and 18 years old lacked confidence in their teachers’ ability to implement technology for learning (Montrieux et al., 2015). The United States Department of Education (2014) identified high-quality professional development as a requirement for schools to ensure that teachers are prepared to use technology tools for instruction. Teachers must see how technology will support their work and support student learning as essential components to the learning process (Bladergroen et al., 2012; Earthman, 2013; Gil-Flores et al., 2017).

**Teacher belief.** Although teacher experience with and training on technology play a role in their attitudes towards and implementation of technology, they are not the only influencing factors (Sahin et al., 2016). Researchers found that if teachers saw technology as just one more obligation added to an already full plate, they held negative attitudes toward ICT implementation (Bladergroen, 2012; Montrieux et al., 2015; Vanderlinde, Dexter, & Van Braak, 2012). Teachers embracing and adjusting their pedagogy to ensure that students are actively using technology in the learning process leads to improved student outcomes (Montrieux et al., 2015). When stakeholder expectations conflict with teachers’ beliefs about instruction, the conflict leaves teachers feeling uncertain about pedagogical change and less willing to take instructional risks—such as implementing technology into their instruction (Chen, 2008; Ertmer & Ottenbreit-Leftwich, 2010).

**School culture.** Technological innovation is less likely to occur if it deviates from the existing values, beliefs, and practices of the teachers and the administrators in the school (Ertmer & Ottenbreit-Leftwich, 2010). Teacher commitment and internalization of school goals contribute to their ability and their willingness to implement ICT into their instruction (Thoonen
et al., 2011). Committed teachers have a strong moral responsibility to improve not only their own performance, but also that of the organization by incorporating school-wide initiatives—such as ICT—into their daily instruction (Thoonen et al., 2011).

**Third Level Divide: Different Access Intertwined with Different Use**

Increasing digital equity in schools extends beyond increasing access and buying more technology (Graves, 2019; Ragnedda, 2017; Ragnedda & Ruiu, 2018). Technology use and implementation is related to the social, personal, and cultural norms of schools (Ragnedda & Ruiu, 2018; Reich, 2019). Researchers have identified students in marginalized communities as those who have the least access to technological resources. When technology is available, these students do not use it in ways that enhance learning or to develop crucial 21st century skills (Graves & Bowers, 2018; Ragnedda & Ruiu, 2018; Reich, 2019). Graves’s (2019) research study, “a latent class analysis of the NCES Fast Response Survey System Teachers Use of Educational Technology in U.S. Public Schools, 2009 (FRSS 95)”, reported four distinct teacher (n=2,764) typologies related to technology use in schools were identified. Table 1 highlights the results of Graves’ (2019) research finding that 24.4% of teachers surveyed were identified as dexterous, 28.4% of teachers were identified as assessors, 24.8% of teachers surveyed were identified as presenters, and 22.2% of teachers were identified as evaders.
Table 1

**Typology of Technology-Using Teachers**

<table>
<thead>
<tr>
<th>Typology</th>
<th>Definition</th>
<th>% of NCES FRSS 2009 (n=2,764)</th>
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<tbody>
<tr>
<td>Dexterous</td>
<td>Comfortable with any type of technology and ready to learn more</td>
<td>24.4%</td>
</tr>
<tr>
<td>Assessors</td>
<td>Comfortable using technology for drill and practice</td>
<td>28.4%</td>
</tr>
<tr>
<td>Presenters</td>
<td>Comfortable using technology to guide lectures</td>
<td>24.8%</td>
</tr>
<tr>
<td>Evaders</td>
<td>Resistant to using technology in every way to include administrative purposes</td>
<td>22.2%</td>
</tr>
</tbody>
</table>

*Note.* Adapted from “Toward a typology of technology-using teachers in the ‘new digital divide:’ A latent class analysis of the NCES fast response survey system teachers’ use of educational technology in U.S. public schools, 2009 (FRSS 95),” by K. E. Graves and A. J. Bowers, 2018, *Teachers College Record, 120,* 78–79.

Graves (2019) further reported that teachers serving marginalized student populations were 1.36 times more likely to identify as Assessors, rather than Dexterous. Davy (2016) defined *marginalized students* as, “ethnically and culturally diverse or economically disadvantaged student populations that have been traditionally underserved” (Davy, 2016, p. 2). Graves (2019) also noted that school socio-economic status was a predictor of teacher typology membership.

Alexander et al. (2014) reported that providing students with the skills necessary to successfully navigate post-secondary education or entry into the workforce is essential to the continued economic development of our nation. Thus, school leadership plays a key role in ensuring that the digital divide closes for students through critical evaluation of equitable leadership practices that transform schools and support student achievement (Graves, 2019).

**Leadership in Education**

School leaders must adapt the focus of education to prepare students for a globally connected society, while simultaneously addressing institutional inequities that can lead to the
digital divide (Graves, 2019; Sheninger, 2014; Vermeulen, Kreijns, van Buuren, & Van Acker, 2017). School leadership plays a significant role in teachers’ effective integration of technology: the driving factor in changing pedagogy to meet the needs of students (Khalifa et al., 2016; Leithwood, Louis, Anderson, & Wahlstrom, 2009; Pautz & Sadera, 2017; Vermeulen et al., 2015). Previous studies have identified that the role of principals has changed significantly over the past 20 years (Culp et al., 2005; National Policy Board for Educational Administration, 2015). School leaders must appropriately apply effective leadership behaviors to meet the cultural and contextual needs of the communities that they serve (Day, Gu, & Sammons, 2016; Graves, 2019; Khalifa et al., 2016; Leithwood, Harris, & Hopkins, 2008; Leithwood & Jantzi, 2006; Urick & Bowers, 2014). In the Report, Day and Sammons (2014) examined international research on effective school leadership practices, concluding, “it is the way in which leaders apply leadership practices, rather than the actual practices themselves, that demonstrates their ability to respond to the context in which they work” (p. 43).

**Principal as Effective School Leader**

The principal’s role in the facilitation of change and implementation of initiatives into the instructional program of schools is critical to moving instructional programs forward (Leithwood & Jantzi, 2006). Leaders must clearly communicate their vision; develop and monitor policy; and, ensure that there are appropriate supports to facilitate systematic changes that positively impact student achievement (Day et al., 2016; Leithwood et al., 2008; Minkos et al., 2017).

**Professional Standards for Educational Leaders.** The Professional Standards for Educational Leaders (PSEL) were published in 2015 by The National Policy Board for Educational Administration published and connect research-based leadership practices to student
learning outcomes. The standards are “future-oriented,” to provide principals a relevant model for the changing landscape of school leadership through ten professional standards:

**Standard 1: Mission, vision, and core values.** Effective educational leaders develop, advocate, and enact a shared mission, vision, and core values of high-quality education. They also foster the academic success and well-being of each student (p. 9).

**Standard 2: Ethics and professional norms.** Effective educational leaders act ethically and according to professional norms to promote each student’s academic success and well-being (p. 10).

**Standard 3: Equity and cultural responsiveness.** Effective educational leaders strive for equity of educational opportunity and culturally responsive practices to promote each student’s academic success and well-being (p. 11).

**Standard 4: Curriculum, instruction, and assessment.** Effective educational leaders develop and support intellectually rigorous and coherent systems of curriculum, instruction, and assessment to promote each student’s academic success and well-being. (p.12)

**Standard 5: Community of care and support for students.** Effective educational leaders cultivate an inclusive, caring, and supportive school community that promotes the academic success and well-being of each student. (p. 13)

**Standard 6: Professional capacity of school personnel.** Effective educational leaders develop the professional capacity and practice of school personnel to promote each student’s academic success and well-being. (p. 14)
Standard 7: Professional community for teachers and staff. Effective educational leaders foster a professional community of teachers and other professional staff to promote each student’s academic success and well-being. (p. 15)

Standard 8: Meaningful engagement of families and community. Effective educational leaders engage families and the community in meaningful, reciprocal, and mutually beneficial ways to promote each student’s academic success and well-being. (p.16)

Standard 9: Operations and management. Effective educational leaders manage school operations and resources to promote each student’s academic success and well-being. (p. 17)

Standard 10: School improvement. Effective educational leaders function as agents of continuous improvement to promote each student’s academic success and well-being. (National Policy Board for Educational Administrators, 2015, p. 18)

These standard were developed as a framework for school leaders to achieve more equitable student outcomes and improve student learning and replaced the Interstate School Leader Licensure (ISLLC) standards developed in 2008 due to lack of language specifically related to leading school that meet the demands of the 21st century (National Policy Board for Educational Administrators, 2015).

Principal as Technology Leader

Effective school leadership is imperative, school leaders must have the skills and knowledge to support technology initiatives through observation and feedback cycles that create technology-rich learning environments that enhance student learning (Covington, 2012; Office of Educational Technology, 2016; Richardson et al., 2015). Ertmer (1999) asserted that “it is both
ineffective and inefficient to address first-order barriers if we do not know what we want to do, first without, and then with, technology” (p. 54). First order, or Type I, barriers are those that are not in control of the teacher such as equipment, training, support, that is either inadequately or not present in the school (Covington, 2017; Ertmer, 1999). Afshari et al. (2012) surveyed 320 Iranian principals and reported that individual leaders’ technology competence has a positive relationship with leading the implementation of technology initiatives in schools. These findings confirm the findings of Hadjithoma-Garstka (2011) study which reported school leaders not only need training in basic computer skills but should also be trained in the leadership styles that promote implementation. Principals must not only demonstrate effective leadership but model the technological skills necessary to lead, implement and monitor complex initiatives such as technology integration and meet the goals set in the United States Department of Education’s National Education Technology Plan (Fink & Markholt, 2011; United States Department of Education, 2016; United States Department of Education, 2017 Vanderlinde et al., 2012). The 2017 National Education Technology Plan outlines five principles and supporting goals to guide schools in bridging the digital divide:

   
   Goal: All learners will have engaging and empowering learning experiences in both formal and informal settings that prepare them to be active, creative, knowledgeable, and ethical participants in our globally connected society. (United States Department of Education, 2017, p. 9)

2. Teaching – Teaching with Technology
   
   Goal: Educators will be supported by technology that connects them to people, data, content, resources, expertise, and learning experiences that can empower and inspire
them to provide more effective teaching for all learners. (United States Department of Education, 2017, p. 28)

3. Leadership – Creating a Culture and Conditions for Innovation and Change
   Goal: Embed an understanding of technology-enabled education within the roles and responsibilities of education leaders at all levels and set state, regional, and local visions for technology in learning. (United States Department of Education, 2017, p.42)

4. Assessment – Measuring for Learning
   Goal: At all levels, our education system will leverage the power of technology to measure what matters and use assessment data to improve learning. (United States Department of Education, 2017, p. 55)

5. Infrastructure – Enabling Access and Effective Use
   Goal: All students and educators will have access to a robust and comprehensive infrastructure when and where they need it for learning. (United States Department of Education, 2017, p. 69)

The NETP further outlines the leadership needed to create technology enriched learning environments by stating:

   For these systemic changes in learning and teaching to occur, education leaders need to create a shared vision for how technology best can meet the needs of all learners and to develop a plan that translates the vision into action. (United States Department of Education, 2017, p. 5)

The shift towards effective technology leadership in education has been identified by researchers as digital leadership (Graves, 2019, Sheninger, 2014; Zhong, 2017). Zhong (2017) defined digital leadership as:
Using instructional technology, including digital devices, services, and resources, to inspire and lead school digital transformation, create and sustain digital learning culture, support and enhance technology-based professional development, provide and maintain digital organization management, and facilitate and manage digital citizenship. (p. 28)

In an effort to provide specific characteristics and behaviors for digital leadership, the International Society for Technology in Education (ISTE) published the first set of professional standards for technology leadership entitled ISTE-A in 2009 (ISTE, 2009). As technology integration and equity in education continued to evolve, so did the ISTE standards associated with technology leadership. In 2018, the ISTE Standards for Administrators (2009), were replaced by ISTE-EL which incorporated equity leadership in technology education to increase access and opportunity for all learners. The 2018 ISTE Standards for Education Leaders (ISTE-EL) outline effective leadership practices that support technology-rich digital learning environments and indicate the required knowledge and behaviors for technology leaders (ISTE, 2018). ISTE-EL standards are defined as:

**Standard 1: Equity and citizenship advocate.** Leaders use technology to increase equity, inclusion, and digital citizenship practices. (ISTE, 2018, p. 1)

**Standard 2: Visionary planner.** Leaders engage others in establishing a vision, strategic plan, and ongoing evaluation cycle for transforming learning with technology. (ISTE, 2018, p. 1)

**Standard 3: Empowering leader.** Leaders create a culture where teachers and learners are empowered to use technology in innovative ways to enrich teaching and learning. (ISTE, 2018, p.1)
Standard 4: Systems designer. Leaders build teams and systems to implement, sustain, and continually improve the use of technology to support learning. (ISTE, 2018, p. 2)

Standard 5: Connected learner. Leaders model and promote continuous professional learning for themselves and others. (ISTE, 2018, p. 2)

The ISTE-EL standards provide a nationally recognized framework for technology leadership that supports school leaders in meeting the goals of the National Education Technology Plan developed by the United States Department of Education (2017). Principals must exhibit technology leadership, in their individual school settings, to ensure equitable learning outcomes for all students (Gu & Johansson, 2014; Leithwood et al., 2004; Zhong 2017)

Principal as Equity Leader

Theoharis (2007) claimed that “it takes more than what traditionally has been understood as good leadership to achieve greater equity” (p. 253). School leaders must adapt their leadership practices to meet the specific cultural needs of the schools that they serve. Additionally, they need adequate instructional content knowledge to lead teams in identifying and addressing inequitable practices (Gu & Johansson, 2013; Khalifa et al., 2016; Theoharis & Brooks, 2012). Researchers have linked specific principal leadership practices to increased student outcomes in marginalized communities (Graves, 2019; Khalifa et al., 2016; Minkos et al., 2017; Theoharis & Brooks, 2012).

Theoharis and Brooks (2012) identified a conceptual framework for equitable leadership practices that focus on specific content areas with three key areas of influence: access, process, and outcomes. First, access pertains to the responsibility of school leaders to ensure high-quality instruction is accessible to all students by examining the distribution of human resources (Theoharis & Brooks, 2012). Second, process pertains to how school leaders identify, develop,
and adjust cultural norms that drive the change necessary to serve all students (Theoharis & Brooks, 2012). Finally, outcomes pertain to two specific strategies that school leaders must use to measure and evaluate professional growth: self-reflection and student achievement outcomes (Theoharis & Brooks, 2012). Principals are obligated to understand how educators use and provide access to educational technology in ways that address inequality in the classroom (Graves, 2019; Minkos et al., 2017).

Summary

In this literature review, the researcher examined principal technology leadership and the roles of technology leadership in the successful implementation of technology initiatives. This area of research continues to evolve as technology advances, the world’s job market evolves to meet these new technological demands, and schools continue to prepare students for entry into an ever-changing workforce (Bladergroen et al., 2012; Delgado et al., 2015; Montrieux et al., 2015; Vigdor et al., 2014). Significant technological advances have left marginalized populations with imposing hurdles to overcome. The digital divide has evolved from an issue of access alone, to one where disparities in access, use, and the benefits of technology has created the new civil rights issue for the millennium (Graves, 2019; Reich, 2019). It has never been more important for school leaders to reflect critically on the beliefs and practices that directly impact student success (Graves, 2019).

Although technology has changed rapidly, education has progressed little toward fully embracing technology in ways that enhance instruction and develop critical 21st century skills needed to thrive after secondary education concludes (Bladergroen et al., 2012; Sheninger, 2014). Limited access to reliable internet and electronic devices has produced significant variations in how technology is used to educate students; these are pervasive issues that continue
to widen the digital divide for marginalized communities (Graves, 2019; Ragnedda & Ruiu, 2018; Vigdor et al., 2014). Researchers have correlated the digital divide in education with the socioeconomic make-up of schools, which further amplifies the effect of limited digital capital and the future ability of students to compete in the global market (Gil-Flores et al., 2017; Graves, 2019; Reich, 2019). Over the past 20 years, national policy makers have tried to identify the steps necessary to close the digital divide, but policy alone does not change education (Culp et al., 2005).

The burden of significant transformation in schools’ rests on the shoulders of school leaders and teachers (Day et al., 2016; Leithwood et al., 2009; Urick & Bowers, 2014). Today’s leaders must lead schools into the technological age by developing strategic technology integration plans that shift the system of education from the industrial to the digital age (Covington, 2012; Sheninger, 2014). School leaders are second only to teachers in their impact on student achievement, and therefore, they must construct effective technology integration plans that are required to ensure that students are equipped with digital skills needed in society (Leithwood & Jantzi, 2006). Although school leadership for equity is a just approach, researchers have identified that school leaders must merge intentionality, content knowledge, and strategic planning to ensure access, process, and outcomes benefit all students (Graves, 2019; Khalifa et al., 2016; Theoharis & Brooks, 2012). Leadership for digital equity goes beyond “just good leadership,” educational leaders must reflect on their understanding of equity, technology, and leadership to recognize the impact of leadership practices on the digital divides (Graves, 2019; Richardson et al., 2015).

The challenges of technology integration into schools, the role of principals in leading change initiatives, and model technology standards for educational leaders are clearly identified
in the literature, however identifying current technology leadership behaviors of principals using up to date standards remains an area needing further research. This gap in literature supports research studies that might assist in determining the needs of principals charged with leading technology integration initiatives. This research study examined the following areas:

- Self-reported technology leadership behaviors of school principals.

- Differences, if any, in technology leadership behaviors of principals based on gender identity, age, and years of experience.

- Differences, if any, in technology leadership behaviors of principals based on school type, enrollment, school technology access, and percentage of students eligible for free or reduced lunch.
Chapter 3: Methodology

The research methodology and study design are described in this chapter.

Purpose of the Study

The purpose of this research study was to identify the current self-reported technology leadership behaviors of principals in one public-school division in Virginia. Additionally, this study identified the difference, if any, in the self-reported technology leadership behaviors of principals across principal and school demographics. Technology leadership refers to, principal leadership behaviors that support the effective integration of technology in schools and principal behaviors that are aligned with the 2018 ISTE-EL standards (Schoenbart, 2019). The researcher collected data using an online version of the Education Leaders Technology Survey (ELTS), which assessed the 2018 ISTE-EL standards.

Schoenbart (2019) identified that each of the ELTS items align to specific leadership behaviors indicated in the 2018 International Society for Technology Standard for Educational Leaders (ISTE-EL) standards (Schoenbart, 2019). The 2018 ISTE-EL standards divide technology leadership into five standards: (a) equity and citizenship advocate, (b) visionary planner, (c) empowering leader, (d) systems designer, and (e) connected learner (ISTE, 2018). Overall, the researcher used technology leadership mastery and demographic data to describe and compare principal technology leadership behaviors.

Research Design and Justification

This study included a non-experimental quantitative descriptive and comparative design to examine the research questions. The use of a self-reported survey instrument and participants’ current assignment as a school principal in the division necessitated a non-experimental design. The researcher selected a quantitative design to make inferences about relationships among the
variables identified in the research questions and to contribute a quantitative study to the body of research on principal technology leadership behaviors (Creswell & Creswell, 2018; Schoenbart, 2019). McMillan and Wergin (2010) stated, “a nonexperimental study is one which there is no control over what may influence subjects’ responses. The researcher is interested in studying what occurred or occurs naturally” (p. 4). The researcher had no control over what may influence participant technology leadership responses and did not assign interventions to the group for experimental purposes to determine technology leadership behaviors.

**Research Questions**

The following research questions guided the methods and framework of this study:

1. To what extent do principals report exhibiting technology leadership behaviors?
2. What are the differences in reported principal technology leadership behaviors, if any, across the following demographic factors?
   a. principal demographic groups of gender identity, age, years of experience?
   b. school demographic groups of school type, enrollment, school technology access, and percentage of students eligible for free or reduced lunch?

**Site and Sample Selection**

The researcher used a non-random, single-stage convenience sample as the design for this study. Convenience sampling was selected by the researcher to provide a readily available, easily accessible, and limited group for invitation to participate in the study (Salkind, 2010). Though convenience samples are not easily generalizable to other settings due to the limited focus, a convenience sampling method is effective for the purpose of this study as the ELTS 2018 was only recently developed in 2019 (Salkind, 2010; Schoenbart, 2019). The researcher used a
single-stage sampling procedure due to the researcher’s access to the names, email addresses, and office phone numbers of the principals in the sample (Creswell & Creswell, 2018).

One public-school division in Virginia served as the setting for this study. Within the school division, the population included elementary, middle, and high school principals assigned to the schools during the 2019-2020 school year. The public-school division in Virginia educates a wide range of students from various socio-economic and ethnic backgrounds. This population of principals was selected because of the convenience to the researcher and the school division’s focus on technology integration. Currently the division has two one-to-one high schools, where each student is assigned a Chromebook, one one-to-one middle/high combination school, and in all secondary schools all English classes have access to Chromebook carts. Approximately 28,680 students are served across five early childhood centers, 24 elementary schools, seven middle schools, four high schools, and one middle/high combination school.

As outlined in Table 2, the school division’s demographic data reflect a student population that is largely Black (53.8%), White (22.7%), and Hispanic (13.7%). Students with disabilities form approximately 12% of the population. In addition, a majority of the students in the division are identified as economically disadvantaged (75.7%), based on their free and reduced meal eligibility.
The researcher collected contact email address information for potential principal participants through the school division’s website. After receiving notification of IRB exempt status from the Virginia Polytechnic Institute and State University Human Research Protection Program (HRPP), the researcher requested approval from the school division Research Authorization Committee. Once approved by the division’s RAC, the researcher sent the survey instrument to participants’ school division’s email from the researcher’s Virginia Polytechnic Institute and State University Google email address. The researcher emailed an invitation to participate in the research study to 39 principals. Surveys were returned from 23 principals for a 59% response rate and the 23 respondents were included in this research study.

**Instrument Design and Validation**

The researcher requested that participants complete the Education Leaders Technology Survey (ELTS) (Schoenbart, 2019) (Appendix B). The researcher selected this instrument due to
the instrument measuring the ISTE-EL 2018 standards, established reliability of the instrument, and time required for administration. The ELTS has been made free to use for educational research by Dr. Schoenbart.

The ELTS is a 45-question survey used to measure principal technology leadership behaviors exhibited during the 2019-2020 school year, using a five-point Likert scale (Schoenbart, 2019). The item responses were: 1 = not at all; 2 = minimally; 3 = somewhat; 4 = significantly; and 5 = fully (Schoenbart, 2019, p. 74). The instrument provided an overall technology leadership score and technology leadership score for each of the five standards identified in the ISTE-EL standards of Standard 1: Equity and Citizenship Advocate; Standard 2: Visionary Planner; Standard 3: Empowering Leader; Standard 4: Systems Designer; and, Standard 5: Connected Learner (Schoenbart, 2019, p. 73). The researcher calculated the technology leadership opportunity score but did not include it in the technology leadership score for each standard because it does not represent a technology leadership behavior. The Table of ISTE-EL Standards and Associated ELTS Items (Appendix C) provides the standard each survey item assessed, and the indicators used to calculate the technology leadership score for this study (Schoenbart, 2019). The researcher calculated the technology leadership opportunity score using data collected through items 9, 20, 31, 39, and 45 of the ELTS.

The development of Schoenbart’s (2019) ELTS was informed by the Principals’ Technology Leadership Assessment (PTLA). The PTLA was a valid instrument, developed through a grant-funded initiative of the University Council for Educational Administration (UCEA) Center for the Advanced Study of Technology Leadership in Education (CASTLE), which assessed principal technology leadership behaviors based on the NETS-A (McLeod, 2017). Zhong (2017) supported the need to develop a new instrument to measure technology
leadership behaviors: “It is not appropriate to use a ten-year old instrument to describe today’s digital leadership” (p. 28). Schoenbart (2019) conducted a study ($n = 48$) using a new instrument and established face validity through field testing the ELTS with 12 education technology leaders.

The instrument was revised by Schoenbart based on the feedback provided during field testing and shared the results with two educational leaders with limited technology leadership for pre-testing and feedback. Pre-testing feedback enabled the researcher to revise and clarify direction, definitions, and questions in the instrument. The researcher then shared the revised survey via social media for feedback from education leaders on further clarification needed in the directions, definitions of terms, and clarifications of questions. According to Creswell and Creswell (2018), “this testing is important to establish the content validity of scores on an instrument; to provide an initial evaluation of the internal consistency of the items; and to improve questions, format, and instructions.” (p.153). Additionally, Schoenbart (2019) used triangulated the qualitative and quantitative results during the interviews to assess the face validity of the ELTS and found a high level of agreement from interview participants.

Schoenbart (2019) reported “the data from the ELTS revealed that the survey had a high degree of internal reliability as a tool to study technology leadership behaviors.” (p. 137). Schoenbart used Cronbach’s alpha test via Statistical Package for Social Sciences (SPSS) software to determine ELTS internal reliability. The Cronbach’s alpha results of the instrument related to each ISTE-EL were: Standard 1 ($\alpha = 0.83$), Standard 3 ($\alpha = 0.84$), and Standard 5 ($\alpha = 0.84$) were measured as good, while ISTE-EL Standard 2 ($\alpha = 0.93$) and Standard 4 ($\alpha = 0.94$) had an excellent internal reliability (Schoenbart, 2019). According to Creswell and Creswell (2018), “a scale’s internal consistency is quantified by a Cronbach’s alpha ($\alpha$) value that ranges
between 0 and 1, with optimal values ranging between .7 and .9” (p.153), confirming the internal reliability of the ELTS in measuring principal technology leadership behaviors.

**Data Collection Procedures**

The researcher collected principal technology leadership behaviors, principal demographic data, and school demographic data electronically by administering the ELTS to the 23 principals in the final sample. The ELTS collected data on principal technology leadership behaviors and opportunities as described in the ISTE-EL standards. Figure 2 outlines the procedures used by the researcher to collect the data from the principals in the identified school division.

*Figure 2. Data collection flowchart illustrates the procedure used by the researcher to collect data from study participants.*

**Data Gathering Procedures and Timeline**

Application was submitted to the Virginia Polytechnic Institute and State University’s HRPP office and this study met the criteria for exemption from IRB review on December 15, 2019 (Appendix E). Upon notification of exemption, the researcher requested permission from the identified school division’s Research Authorization Committee (RAC) to conduct the study with school division principals. The RAC guidelines and procedures for the participating school division were followed and approval to conduct the research study was granted on December 18, 2019 (Appendix F).

Upon receiving the division’s approval to conduct research, the researcher administered the ELTS online, through a Virginia Polytechnic Institute and State University HRPP-approved electronic survey platform, Qualtrics. The study design included three participant contacts to include an introduction and invitation to participate in the study, a phone invitation to participate in the study, and a final reminder regarding participation. The researcher initiated all contact through the school division’s email and Voice Over Internet Phone (VoIP) systems. The researcher sent the first email to potential study participants on January 6, 2020, which included the Study Cover Letter, link to the Education Leader’s Technology Survey (ELTS) in Qualtrics and ELTS informed consent agreement (Appendix G). This e-mail communication explained the research being conducted, presented HRPP review and the school division’s RAC approval, explained that participation is voluntary, confirmed the confidentiality of responses, provided instructions for accessing the ELTS, presented details regarding the use of participants information captured through the survey during and after study completion, and explained that participant completion of the survey implies consent to participate in the study. Study participants were prompted with an electronic copy of the ELTS informed consent agreement (Appendix H) at the beginning of the survey and were required to confirm consent prior to
beginning the research study by selecting “I consent, begin the research study” at the beginning of the survey (Appendix B).

Four days after the initial email (January 10, 2020), the researcher used her personal cell phone to make contact a second time with all potential participants’ using office phone numbers listed on the school division’s website. This call provided verbal clarification that an invitation was sent and explained the date of the initial contact. The researcher developed a script for the second contact that was used when speaking with participants or left as a voicemail for participants who are unavailable (Appendix I). The final e-mail contact took place five days after the phone contact (Appendix J), which included the Cover Letter, an appreciation email for participants who have submitted their response, a reminder to participate for those who have yet to complete the survey, and a comment that indicated the study closing date of January 17, 2020.

The timeline of the study was as follows:

- December 2, 2019: Successful completion of prospectus examination.
- December 15, 2019: Received Human Research Protection Program and Institutional Review Board (IRB) exempt determination from Virginia Polytechnic Institute and State University.
- December 18, 2019: Received permission to conduct study from the identified school division’s Research and Authorization Committee (RAC)
- January 6, 2020: Email introduction and invitation to participate in the study sent to principals.
- January 10, 2020: Follow-up phone call made with prompt for participation in the study.
- January 15, 2020: Emailed final invitation to participate in the study to principals.
• February 2020: Collected and analyzed data.
• March 2020: Defended dissertation.

Data Treatment and Management

The use of web-based surveys has grown over the past 30 years and has many advantages, such as enhanced data security, enhanced reliability through control of presentation constraints, limiting variation in response formats, and potential reduction of social desirability bias due to perceived anonymity (Hewson, 2017). Each participant received instructions for accessing the Qualtrics ELTS survey. The researcher will maintain the confidentiality of all collected survey data through the use of secure, password-protected files developed using the SPSS program. To maintain the security and confidentiality of participants and the school division, the researcher will maintain all data in a secure location for a full three years after study completion. Hard copies of the data are maintained in a locked file cabinet in the researcher’s home to which only the research has the key. Electronic survey data will be stored in Qualtrics and in a password protected SPSS file. After three full years, all electronic documents and hard copies associated with the study will be purged and shredded by the researcher.

Data Analysis

This study included both a descriptive and a comparative design. The researcher analyzed Education Leaders Technology Survey (ELTS) data using the SPSS software package in two phases.

Descriptive. The first phase of the study focused on research question 1: to what extent are principals exhibiting technology leadership behaviors? This phase had quantitative descriptive design, which sought to determine the technology leadership behaviors of principals in the selected school division. The ELTS used a five-point Likert scale anchored at: 1 = not at
all, 2 = minimally, 3 = somewhat, 4 = significantly, and 5 = fully. Survey instructions directed principals to, “As you answer the questions, think of your actual behaviors over the course of this school year. Do not take into account planned or intended behaviors” (Schoenbart, 2019). The 2018 ISTE-EL standards were broken down into 22 indicators across the larger standards of (a) equity and citizenship advocate, (b) visionary planner, (c) empowering leader, (d) systems designer, and (e) connected learner (ISTE, 2018; Schoenbart, 2019). Appendix C presents the number of items indicators in the ELTS for each of the ISTE-EL Standards. The researcher used descriptive statistics to provide a summary of the participants’ technology leadership behaviors for each ISTE-EL Standard and overall technology leadership as a construct based on aggregated data for each standard. The researcher calculated descriptive statistics and frequencies—including median, standard deviation, skewness, and kurtosis—for each survey question.

**Comparative.** The second phase of the study focused on research question 2: What are the differences in reported principal technology leadership behaviors, if any, across the following demographic factors? This phase had a quantitative comparative design, which sought to determine the difference, if any, of principal technology leadership behaviors across school and participant demographics. Nine demographic questions were used to collect data from participants. The questions collected principal (five questions) and school (4 questions) demographic characteristics as reported by the participants. Two questions collected categorical data (gender identity and school type) by requiring participants to select the response that best represented themselves or their schools. For example, participants were provided with the option of early childhood center, elementary school, middle school, or high schools to identify their current school type.
The remaining six questions collected data related participant age, years in education, years as school principal, years since classroom teacher, school type, school current enrollment, school access to technology, and school percentage of students receiving free or reduce-price lunch. Principals were provided with the Virginia Department of Education’s National School Lunch Program Free and Reduced-Price Eligibility Report via a link embedded in the instrument to ensure accurate reporting of school percentage of students receiving free and reduced-priced lunch. The researcher determined frequency data for principal demographic groups, school demographic groups, and each ELTS item indicator. In addition, the researcher conducted one t-test and eight one-way analysis of variances (ANOVAs) to investigate differences across school and principal demographic groups.

**Summary of Methodology**

The purpose of this research study was to identify the current self-reported technology leadership behaviors of principals in one public-school division in Virginia. Additionally, this study identified the difference, if any, in the self-reported technology leadership behaviors of principals across principal and school demographics. Forty-one principals in one public-school division in Virginia were invited to participate in the study based on their assignment as principal at their current school for the 2019-2020 school year. The school levels represented in the identified school division were five early childhood centers, 24 elementary schools, seven middle schools, four high schools, and one middle/high combination school. Principals’ were asked to provide their perceptions of their technology leadership behaviors during the current school year using the Education Leaders Technology Survey (Schoenbart, 2019).

The ELTS was created to measure principal technology leadership behaviors based on the 2018 ISTE-EL standards (Schoenbart, 2019). The quantitative descriptive portion of the study
described the demographic characteristics of the participants, demographic characteristics of the schools, overall technology leadership behaviors and technology leadership behaviors based on each of the five ISTE-EL Standards. The 2018 ISTE-EL standards divide technology leadership into five standards: (a) equity and citizenship advocate, (b) visionary planner, (c) empowering leader, (d) systems designer, and (e) connected learner (ISTE, 2018; Schoenbart, 2019). The quantitative comparative portion of the study compared self-reported principal technology leadership behaviors across demographic groups and describe the differences, if any, in principal self-reported technology leadership behaviors across these groups.
Chapter 4: Analysis of Data

The purpose of this research study was to identify the current self-reported technology leadership behaviors of principals in one public-school division in Virginia. Additionally, this study identified the difference, if any, in the self-reported technology leadership behaviors of principals across principal and school demographics. Technology leadership refers to, principal leadership behaviors that support the effective integration of technology in schools and principal behaviors that are aligned with the 2018 ISTE-EL standards (Schoenbart, 2019). The researcher collected data using an online version of the Education Leaders Technology Survey (ELTS), which assessed the 2018 ISTE-EL standards. Schoenbart (2019) identified that each of the ELTS items align to specific leadership behaviors indicated in the 2018 International Society for Technology Standard for Education Leaders (p. 139). The 2018 ISTE-EL standards divide technology leadership into five standards: (a) equity and citizenship advocate, (b) visionary planner, (c) empowering leader, (d) systems designer, and (e) connected learner (ISTE, 2018). Overall, the researcher used technology leadership mastery and demographic data to describe and compare principal technology leadership behaviors.

The literature on principal technology leadership behaviors is limited. As noted previously, there are insufficient studies related to technology leadership behaviors that lead to successful technology integration in schools (Graves, 2019; McLeod et al., 2011; Schoenbart, 2019; Zhong, 2017). In addition, the body of research related to technology leadership behaviors is primarily anecdotal and focused on outdated standards that are inappropriate to measure current technology leadership (Graves & Bowers, 2018; McLeod et al., 2011; Schoenbart, 2019; Zhong, 2017). This chapter reports and analyzes the data collected from the ELTS in order to answer the following research questions:
1. To what extent do principals report exhibiting technology leadership behaviors?

2. What are the differences in reported principal technology leadership behaviors, if any, across the following demographic factors?
   a. principal demographic groups of gender identity, age, years of experience?
   b. school demographic groups of school type, enrollment, school technology access, and percentage of students eligible for free or reduced lunch?

**Descriptive Sample Data Analysis**

**Survey response rate.** The ELTS was administered online through Qualtrics to 39 principals who currently serve early childhood centers, elementary schools, middle schools, and high schools in one public-school division in Virginia. An email invitation to participate along with a follow-up phone call and final survey reminder email were sent to principals in the selected public-school division regarding voluntary participation in the study. Invited principals were those assigned to their current school during the 2019-2020 school year. The overall response rate of 59% was calculated by dividing the number of completed survey responses (n = 23) by the number of invited participants.

**Principal demographic data.** Principal demographic data collected via the ELTS included gender, age, years in education, years as a school principal, and years since working as a classroom teacher. Five questions on the 54-item survey collected data to describe the demographic characteristics of principal participants and demographic groups were also used as variables to compare technology leadership behaviors across principal demographics. Table 3 presents the principal demographic descriptive statistics for study participants.
Table 3

*Descriptive Statistics for Principal Demographics*

<table>
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<tr>
<th>Characteristic</th>
<th>Percent</th>
<th>Total</th>
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</tr>
<tr>
<td>Female</td>
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<td><strong>Age</strong></td>
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<td>20-29</td>
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<td>30-39</td>
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<tr>
<td>40-49</td>
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<td>50-59</td>
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<td>8</td>
</tr>
<tr>
<td>60+</td>
<td>4.35%</td>
<td>1</td>
</tr>
<tr>
<td><strong>Years in Education</strong></td>
<td></td>
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<tr>
<td>Less than 10 years</td>
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<tr>
<td>11-15</td>
<td>8.70%</td>
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<tr>
<td>16-20</td>
<td>21.74%</td>
<td>5</td>
</tr>
<tr>
<td>21-25</td>
<td>30.43%</td>
<td>7</td>
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<tr>
<td>26-30</td>
<td>30.43%</td>
<td>7</td>
</tr>
<tr>
<td>31-35</td>
<td>8.70%</td>
<td>2</td>
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<tr>
<td>36+</td>
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<td>0</td>
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<tr>
<td><strong>Years as School Principal</strong></td>
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<tr>
<td>1-4</td>
<td>34.78%</td>
<td>8</td>
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<tr>
<td>5-9</td>
<td>43.48%</td>
<td>10</td>
</tr>
<tr>
<td>10-14</td>
<td>13.04%</td>
<td>3</td>
</tr>
<tr>
<td>15-19</td>
<td>4.35%</td>
<td>1</td>
</tr>
<tr>
<td>20-24</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>25+</td>
<td>4.35%</td>
<td>1</td>
</tr>
<tr>
<td><strong>Years Since Teacher</strong></td>
<td></td>
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<tr>
<td>1-4</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>5-9</td>
<td>26.09%</td>
<td>6</td>
</tr>
<tr>
<td>10-14</td>
<td>43.48%</td>
<td>10</td>
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<tr>
<td>15-19</td>
<td>17.39%</td>
<td>4</td>
</tr>
<tr>
<td>20-24</td>
<td>8.70%</td>
<td>2</td>
</tr>
<tr>
<td>25+</td>
<td>4.35%</td>
<td>1</td>
</tr>
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Of the participating principals over 95% are age 40 or older and none of the participants were below the age of 30. Females represented 78.26% of participants, and males represented
21.48% of participants. Though the option of prefer not to respond was provided for gender identity, none of the participants selected this as an option. All participants have been working in education for 11 or more years. Over 78% of the participants have been a principal for less than 10 years. Finally, 73.91% of participants report working as a classroom teacher, or in a similar position, more than 10 years ago. The principal demographics are consistent with the findings of Taie and Goldring’s 2019 report on characteristics of principals in the United States using 2017-2018 National Teacher and Principal Survey data. Of the public-school principals sampled ($n = 9,180$) in the 2019 study, it was reported that 60.7% of public-school principals were female, the average years of experience for public-school principals was 6.8 year, and the average age of public principals was 48 years old (Taie & Goldring, 2019).

**School demographic data.** School demographic data collected in the ELTS included school type (early childhood center, elementary, middle, high), current enrollment, regular access to technology, and percentage of students eligible for free or reduced-price lunch. Four questions on the 54-item survey collected data to describe the demographic characteristics of the participants’ schools’ participants and school demographic groups were used as variables to compare technology leadership behaviors across school demographic groups. Regular access to technology was defined as “devices and tools like computers, tables, cellphone and other related tools, as well as their related hardware and software” (Schoenbart, 2019, p. 183). Principals were provided with the Virginia Department of Education’s National School Lunch Program Free and Reduced-Price Eligibility Report via a link embedded in the instrument to ensure accurate reporting of school percentage of students receiving free and reduced-priced lunch. Table 4 presents the school demographic descriptive statistics for study participants.
Over 55% percent of schools identified as Elementary (52.17%) or an Early Childhood Center (ECC) (4.35%). A majority (65.21%) of participants indicate leading schools with fewer than 750 students enrolled. Full access to technology was reported by 56.52% of schools, 43.48% of schools reported having significant access to technology, and no schools identified as having only some access to technology. Schools with greater than 75% of students receiving free or reduced-priced lunch (high poverty) represents 56.52% of the participants and no schools in the sample identified as having 25% or fewer students receiving free or reduced-price lunch (low-poverty). The data presented in Table 4 suggests that there is equitable access to technology
in the sample though a majority of the schools report having greater than 50% of students eligible for free and reduced lunch.

**Descriptive ELTS Data Analysis**

Principal technology leadership behaviors were measured using the ELTS developed by Schoenbart (2019). The ELTS is a 54-item instrument used to measure self-reported principal technology leadership behaviors based on the 2018 ISTE-EL standards, collect principal demographic data, and collect school demographic data. The ELTS used a five-point Likert scale anchored at: 1 = not at all, 2 = minimally, 3 = somewhat, 4 = significantly, and 5 = fully. Survey instructions directed principals to, “As you answer the questions, think of your actual behaviors over the course of this school year. Do not take into account planned or intended behaviors” (Schoenbart, 2019). The 2018 ISTE-EL standards were broken down into 22 indicators across the larger standards of (i) equity and citizenship advocate, (ii) visionary planner, (iii) empowering leader, (iv) systems designer, and (v) connected learner (ISTE, 2018; Schoenbart, 2019). Appendix C presents the number of items indicators in the ELTS for each of the ISTE-EL Standards. An aggregate overall technology leadership behavior score and a score for each of the ISTE-EL Standards were obtained. The frequency data, mean, and standard deviations for each ELTS item indicator — grouped by ISTE-EL Standard— and overall mean and standard deviation for each ISTE-EL Standard were calculated.

**Standard 1: Equity & Citizenship Advocate.** Principal self-reported technology leadership behaviors for Standard 1: Equity & Citizenship Advocate was measured across 10 item indicators that measured participant use of technology to increase digital citizenship, equity, and inclusion in schools. Item 9, regarding technology leadership opportunity in Standard 1, was not included in the overall technology leadership score because it does not represent an actual
technology leadership behavior. Table 5 represents the percentage of participant response, mean and standard deviation for each item indicator. In addition, Table 5 provides an overall technology leadership score for Standard 1: Equity & Citizenship Advocate.
Table 5

**ETLS Standard 1 Results Including Mean and Standard Deviation Overall and by Question**

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<tbody>
<tr>
<td></td>
<td>Technology Leadership Behavior Standard 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.50</td>
<td>0.64</td>
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<tr>
<td></td>
<td>To what extent did you ensure that all students had skilled teachers who were actively using technology (definition: devices and tools like computers, tablets, cell phones, and other communication tools, as well as their related hardware and software) to meet student needs?</td>
<td>0.00%</td>
<td>4.35%</td>
<td>47.83%</td>
<td>43.48%</td>
<td>4.35%</td>
<td>3.48</td>
<td>0.65</td>
</tr>
<tr>
<td>1</td>
<td>To what extent did you ensure all students had access to the technology necessary to participate in engaging learning opportunities?</td>
<td>0.00%</td>
<td>0.00%</td>
<td>17.39%</td>
<td>52.17%</td>
<td>30.43%</td>
<td>4.13</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>To what extent did you ensure all students had access to the connectivity (e.g. Internet access) necessary to participate in engaging learning opportunities?</td>
<td></td>
<td>4.35%</td>
<td>4.35%</td>
<td>13.04%</td>
<td>43.48%</td>
<td>34.78</td>
<td>1.02</td>
</tr>
<tr>
<td>2</td>
<td>To what extent did you model digital citizenship (definition: the behaviors, skills, and knowledge necessary for appropriate and responsible technology use) by critically evaluating online resources?</td>
<td>0.00%</td>
<td>17.39%</td>
<td>56.52%</td>
<td>21.74%</td>
<td>4.35%</td>
<td>3.13</td>
<td>0.74</td>
</tr>
<tr>
<td>3</td>
<td>To what extent did you model digital citizenship by engaging in civil discourse online?</td>
<td>17.39%</td>
<td>17.39%</td>
<td>52.17%</td>
<td>4.35%</td>
<td>8.70%</td>
<td>2.70</td>
<td>1.08</td>
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</tr>
<tr>
<td>6</td>
<td>To what extent did you model digital citizenship by using digital tools to contribute to positive social change?</td>
<td>13.04%</td>
<td>17.39%</td>
<td>52.17%</td>
<td>13.04%</td>
<td>4.35%</td>
<td>2.78</td>
<td>0.98</td>
</tr>
<tr>
<td>7</td>
<td>To what extent did you cultivate responsible online behaviors?</td>
<td>8.70%</td>
<td>4.35%</td>
<td>13.04%</td>
<td>47.83%</td>
<td>26.09%</td>
<td>3.78</td>
<td>1.14</td>
</tr>
<tr>
<td>8</td>
<td>To what extent did you cultivate the safe, ethical and legal use of technology?</td>
<td>0.00%</td>
<td>13.04%</td>
<td>8.70%</td>
<td>43.48%</td>
<td>34.78%</td>
<td>4.00</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Overall, to what extent did you have the opportunity to use technology to increase equity, inclusion, and digital citizenship practices?

0.00% 17.39% 30.43% 47.83% 4.35% 3.39 0.82

*Note. n=23*
As presented in Table 5, the mean technology leadership behaviors score across the sample was 3.50. According to the ELTS, a mean of 3.50 indicated that participants reported that their demonstrated technology leadership behaviors for Standard 1: Equity & Citizenship Advocate fell between the somewhat and significantly range. Ensuring all students had access to technology to participate in learning opportunities represented the highest mean \( (M = 4.13) \) for Standard 1: Equity & Citizenship Advocate. Participants reported the lowest demonstration of technology leadership behaviors in items related to modeling digital citizenship. Item indicator five “To what extent did you model digital citizenship by engaging in civil discourse online”, resulted in the lowest mean \( (M = 2.70) \) for this standard. Followed by item indicator six “To what extent did you model digital citizenship by using digital tools to contribute to positive social change”, \( (M = 2.78) \) and item indicator four “To what extent did you model digital citizenship (definition: the behaviors, skills, and knowledge necessary for appropriate and responsible technology use) by critically evaluating online resources” \( (M = 3.14) \). The results for Standard 1: equity & Citizenship Advocate indicated that principals perceived their leadership in the area of modeling digital citizenship as their least demonstrated technology leadership behavior. The data related to ensuring equitable access to technology is consistent with the results reported in Table 4 that indicated as a school division there is equitable access to technology regardless of school demographic group membership.

**Standard 2: Visionary Planner.** Principal self-reported technology leadership behaviors for Standard 2: Visionary Planner was measured across 10 item indicators that measure participants’ engagement of stakeholders in creating a vision, plan and evaluation cycle for using technology to transform learning. Item 20, regarding technology leadership opportunity in Standard 2, was not included in the overall technology leadership score because it does not
represent an actual technology leadership behavior. Table 6 represents the percentage of participant response, mean and standard deviation for each item indicator. In addition, Table 6 provides an overall technology leadership score for Standard 2: Visionary Planner.
### Table 6

**ETLS Standard 2 Results Including Mean and Standard Deviation Overall and by Question**

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<tbody>
<tr>
<td>10</td>
<td>Technology Leadership Behavior Standard 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.00</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td>To what extent did you engage education stakeholders (definition: anyone who is invested in the welfare and success of a school and its students, including administrators, teachers, staff members, students, parents, families, community members, local business leaders, elected officials, etc.) in developing and adopting a shared vision for using technology to improve student success?</td>
<td>13.04%</td>
<td>17.39%</td>
<td>52.17%</td>
<td>13.04%</td>
<td>4.35%</td>
<td>2.78</td>
<td>0.98</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>To what extent did you build on the shared vision by collaboratively creating a strategic plan that articulated how technology would be used to enhance learning?</td>
<td>4.35%</td>
<td>26.09%</td>
<td>43.48%</td>
<td>17.39%</td>
<td>8.70%</td>
<td>3.00</td>
<td>0.98</td>
</tr>
<tr>
<td>12</td>
<td></td>
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<tr>
<td></td>
<td>To what extent did you evaluate progress on a strategic plan for using technology to transform learning?</td>
<td>4.35%</td>
<td>26.09%</td>
<td>52.17%</td>
<td>13.04%</td>
<td>4.35%</td>
<td>2.87</td>
<td>0.85</td>
</tr>
<tr>
<td>13</td>
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<tr>
<td></td>
<td>To what extent did you make changes to improve how technology is being used to transform learning?</td>
<td>4.35%</td>
<td>13.04%</td>
<td>34.78%</td>
<td>43.48%</td>
<td>4.35%</td>
<td>3.30</td>
<td>0.91</td>
</tr>
<tr>
<td>14</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>To what extent did you measure the impact of using technology to transform learning?</td>
<td>4.35%</td>
<td>8.70%</td>
<td>52.17%</td>
<td>30.43%</td>
<td>4.35%</td>
<td>3.22</td>
<td>0.83</td>
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</tr>
<tr>
<td>15</td>
<td>To what extent did you encourage the development and growth of effective approaches for using technology to transform learning?</td>
<td>0.00%</td>
<td>4.35%</td>
<td>34.78%</td>
<td>43.48%</td>
<td>17.39%</td>
<td>3.74</td>
<td>0.79</td>
</tr>
<tr>
<td>16</td>
<td>To what extent did you communicate effectively with stakeholders to gather input on a strategic technology plan?</td>
<td>13.04%</td>
<td>30.43%</td>
<td>39.13%</td>
<td>8.70%</td>
<td>8.70%</td>
<td>2.70</td>
<td>1.08</td>
</tr>
<tr>
<td>17</td>
<td>To what extent did you communicate effectively with stakeholders to celebrate the successes of a strategic technology plan?</td>
<td>13.04%</td>
<td>26.09%</td>
<td>52.17%</td>
<td>4.35%</td>
<td>4.35%</td>
<td>2.61</td>
<td>0.92</td>
</tr>
<tr>
<td>18</td>
<td>To what extent did you communicate effectively with stakeholders to continually improve a strategic technology plan?</td>
<td>8.70%</td>
<td>26.09%</td>
<td>47.83%</td>
<td>13.04%</td>
<td>4.35%</td>
<td>2.78</td>
<td>0.93</td>
</tr>
<tr>
<td>19</td>
<td>To what extent did you share the impacts of learning with technology (e.g. lessons learned, best practices, challenges) with other education leaders who want to learn from this work?</td>
<td>4.35%</td>
<td>21.74%</td>
<td>47.83%</td>
<td>26.09%</td>
<td>0.00%</td>
<td>2.96</td>
<td>0.81</td>
</tr>
<tr>
<td>20</td>
<td>Overall, to what extent did you have the opportunity to engage others in establishing a vision, strategic plan, and ongoing evaluation cycle for transforming learning with technology?</td>
<td>4.35%</td>
<td>21.74%</td>
<td>52.17%</td>
<td>17.39%</td>
<td>4.35%</td>
<td>2.96</td>
<td>0.86</td>
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*Note. n=23*
As presented in Table 6, the mean technology leadership behaviors score for Standard 2: Visionary Planner was 3.00. According to the ELTS, a mean of 3.00 indicated that participants reported that they *somewhat* demonstrated technology leadership behaviors that engaged stakeholders in creating a vision, plan and evaluation cycle for using technology to transform learning. Item indicator 15, “to what extent did you encourage the development and growth of effective approaches for using technology…” represent the highest mean ($M = 3.74$) for Standard 2: Visionary Planner. This indicates that principals are confident in their demonstration of technology leadership behavior to encourage the effective use of the technology that is accessible to their schools.

Participants reported the lowest demonstration of technology leadership behaviors in items related to communicating effectively with education stakeholders about technology strategic plans. Celebrating technology strategic plan success resulted in the lowest technology leadership behaviors item indicator ($M = 2.61$) for Standard 2. Similarly, item indicator 16 ($M = 2.70$) and item indicator 18 ($M = 2.78$) were reported in the *minimally* and *somewhat* range for participants communicating effectively with stakeholder to gather input on and improve strategic technology plans. Item indicators related to involving stakeholders presented the lowest technology leadership behavior score, indicating that principals are not fully engaging stakeholders in creating, communicating, or planning a vision for technology integration.

**Standard 3: Empowering Leader.** Principal self-reported technology leadership behaviors for Standard 3: Empowering Leader was measured across 10 item indicators that measured participants’ self-reported ability to create a school culture that empowers teachers and learners to innovate teaching and learning through the use of technology. Item 31, regarding technology leadership opportunity in Standard 3, was not included in the overall technology
leadership score because it does not represent an actual technology leadership behavior. Table 7 represents the percentage of participant response, mean and standard deviation for each item indicator. In addition, Table 7 provides an overall technology leadership score for Standard 3: Empowering Leader.
### Table 7

**ETLS Standard 3 Results Including Mean and Standard Deviation Overall and by Question**

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<tbody>
<tr>
<td></td>
<td>Technology Leadership Behavior Standard 3</td>
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<td></td>
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<td></td>
<td>3.75</td>
<td>0.54</td>
</tr>
<tr>
<td>21</td>
<td>To what extent did you empower educators to exercise professional agency (definition: to take responsibility for and ownership of goals and learning and work strategies)?</td>
<td>0.00%</td>
<td>4.35%</td>
<td>21.74%</td>
<td>43.48%</td>
<td>30.43%</td>
<td>4.00</td>
<td>0.83</td>
</tr>
<tr>
<td>22</td>
<td>To what extent did you empower educators to build teacher leadership skills?</td>
<td>0.00%</td>
<td>4.35%</td>
<td>4.35%</td>
<td>47.83%</td>
<td>43.48%</td>
<td>4.30</td>
<td>0.75</td>
</tr>
<tr>
<td>23</td>
<td>To what extent did you empower educators to pursue personalized professional learning?</td>
<td>0.00%</td>
<td>0.00%</td>
<td>4.35%</td>
<td>65.22%</td>
<td>30.43%</td>
<td>4.26</td>
<td>0.53</td>
</tr>
<tr>
<td>24</td>
<td>To what extent did you build the competency of educators to put the ISTE Standards for Students and Educators into practice?</td>
<td>4.35%</td>
<td>26.09%</td>
<td>34.78%</td>
<td>30.43%</td>
<td>4.35%</td>
<td>3.04</td>
<td>0.95</td>
</tr>
<tr>
<td>25</td>
<td>To what extent did you inspire an innovative learning environment that allowed the time and space to explore digital tools?</td>
<td>0.00%</td>
<td>0.00%</td>
<td>39.13%</td>
<td>47.83%</td>
<td>13.04%</td>
<td>3.74</td>
<td>0.67</td>
</tr>
<tr>
<td>26</td>
<td>To what extent did you support educators in using technology to advance learning that met the diverse learning needs of individual students?</td>
<td>0.00%</td>
<td>0.00%</td>
<td>17.39%</td>
<td>60.87%</td>
<td>21.74%</td>
<td>4.04</td>
<td>0.62</td>
</tr>
</tbody>
</table>
### Standard 3: Empowering Leader

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<tbody>
<tr>
<td>27</td>
<td>To what extent did you support educators in using technology to advance learning that met the diverse cultural needs of individual students?</td>
<td>0.00%</td>
<td>0.00%</td>
<td>30.43%</td>
<td>47.83%</td>
<td>21.74%</td>
<td>3.91</td>
<td>0.72</td>
</tr>
<tr>
<td>28</td>
<td>To what extent did you support educators in using technology to advance learning that met the diverse social-emotional needs of individual students?</td>
<td>0.00%</td>
<td>8.70%</td>
<td>30.43%</td>
<td>39.13%</td>
<td>21.74%</td>
<td>3.74</td>
<td>0.90</td>
</tr>
<tr>
<td>29</td>
<td>To what extent did you develop learning assessments that provided a personalized view of student progress in real time?</td>
<td>0.00%</td>
<td>21.74%</td>
<td>30.43%</td>
<td>47.83%</td>
<td>0.00%</td>
<td>3.26</td>
<td>0.79</td>
</tr>
<tr>
<td>30</td>
<td>To what extent did you develop learning assessments that provided an actionable view (e.g. specific feedback to drive instruction) of student progress in real time?</td>
<td>8.70%</td>
<td>13.04%</td>
<td>30.43%</td>
<td>43.48%</td>
<td>4.35%</td>
<td>3.22</td>
<td>1.02</td>
</tr>
<tr>
<td>31</td>
<td>Overall, to what extent did you have the opportunity to create a culture where the school community was empowered to use technology in innovative ways?</td>
<td>0.00%</td>
<td>0.00%</td>
<td>34.78%</td>
<td>52.17%</td>
<td>13.04%</td>
<td>3.78</td>
<td>0.66</td>
</tr>
</tbody>
</table>

*Note. n=23*
Table 7 presents the mean technology leadership behaviors score for Standard 3: Empowering Leader as 3.75. According to the ELTS, a mean of 3.75 indicates that participants reported exhibiting the ability to create a school culture that empowers teachers and learners to innovate teaching and learning through the use of technology close to the significant range. The lowest self-reported technology leadership behavior ($M = 3.04$) for Standard 3: Empowering Leader occurred on item indicator 24, which determined the extent to which principals “…build the competency of educators to put the ISTE Standards for Students and Educators into practice”. This indicates that principals may not be familiar with the ISTE Standards for Students and Educators, therefore they are not demonstrating leadership behavior related to building teacher capacity directly related to the standards. Alternatively, item indicator 22 ($M = 4.30$) was reported as the highest indicator for this standard, where participants report significantly (65.22%) or fully (30.43%) empowering teachers to build leadership skills. In addition, participants reported item indicator 23 ($M = 4.26$) as significantly (47.83%) or fully (43.48%) empowering educators pursue personalized professional learning. Empowering educators to pursue personalized learning and building teacher leadership skills are areas where principals feel they excel in demonstrating technology leadership behaviors.

**Standard 4: Systems Designer.** Principal self-reported technology leadership behaviors for Standard 4: Systems Designer was measured across 7 item indicators that measured participants’ self-reported ability to continually improve technology integration to support learning through building teams and systems that implement and sustain technology initiatives. Item 39, regarding technology leadership opportunity in Standard 4, was not included in the overall technology leadership score because it does not represent an actual technology leadership behavior. Table 8 represents the percentage of participant response, mean and standard deviation
for each item indicator. In addition, Table 8 provides an overall technology leadership score for Standard 4: Systems Designer.
Table 8

ETLS Standard 4 Results Including Mean and Standard Deviation Overall and by Question

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<tr>
<td>32</td>
<td>Technology Leadership Behavior Standard 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.22</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>To what extent did you lead teams to collaboratively establish robust infrastructure to implement a strategic plan?</td>
<td>4.35%</td>
<td>17.39%</td>
<td>39.13%</td>
<td>30.43%</td>
<td>8.70%</td>
<td>3.22</td>
<td>0.98</td>
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<tr>
<td>33</td>
<td>To what extent did you ensure that resources for supporting the effective use of technology for learning were sufficient to meet future demand?</td>
<td>0.00%</td>
<td>13.04%</td>
<td>52.17%</td>
<td>30.43%</td>
<td>4.35%</td>
<td>3.26</td>
<td>0.74</td>
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<tr>
<td>34</td>
<td>To what extent did you ensure that resources for supporting the effective use of technology for learning could anticipate and meet future needs?</td>
<td>0.00%</td>
<td>17.39%</td>
<td>39.13%</td>
<td>39.13%</td>
<td>4.35%</td>
<td>3.30</td>
<td>0.80</td>
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<tr>
<td>35</td>
<td>To what extent did you protect privacy by ensuring that students and staff observed effective privacy and data management policies?</td>
<td>0.00%</td>
<td>21.74%</td>
<td>21.74%</td>
<td>43.48%</td>
<td>13.04%</td>
<td>3.48</td>
<td>0.97</td>
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<tr>
<td>36</td>
<td>To what extent did you establish partnerships that supported a strategic vision?</td>
<td>0.00%</td>
<td>43.48%</td>
<td>47.83%</td>
<td>8.70%</td>
<td>0.00%</td>
<td>2.65</td>
<td>0.63</td>
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<tr>
<td>37</td>
<td>To what extent did you establish partnerships to achieve learning priorities?</td>
<td>0.00%</td>
<td>13.04%</td>
<td>52.17%</td>
<td>26.09%</td>
<td>8.70%</td>
<td>3.30</td>
<td>0.80</td>
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</tr>
<tr>
<td>38</td>
<td>To what extent did you establish partnerships that improve operations?</td>
<td>0.00%</td>
<td>17.39%</td>
<td>47.83%</td>
<td>21.74%</td>
<td>13.04%</td>
<td>3.30</td>
<td>0.91</td>
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<tr>
<td>39</td>
<td>Overall, to what extent did you have the opportunity to build teams and systems to implement, sustain,</td>
<td>0.00%</td>
<td>8.70%</td>
<td>60.87%</td>
<td>26.09%</td>
<td>4.35%</td>
<td>3.26</td>
<td>0.67</td>
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</tr>
<tr>
<td></td>
<td>Standard 4: Systems Designer</td>
<td>and continually improve the use of technology to support learning?</td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

Note. $n = 23$
Table 8 presents the mean technology leadership behaviors score for Standard 4: Systems Designer is 3.22. According to the ELTS, a mean of 3.22 indicated that participants reported that they demonstrate the ability to continually improve technology integration to support learning through building teams and systems that implement and sustain technology initiatives slightly above *somewhat*. The least demonstrated technology leadership behavior was item indicator 36 which measured respondent’s establishment of partnerships that support a strategic vision ($M = 2.65$). Similar to item indicators related to strategic planning and stakeholder engagement in Standard 2: Visionary Planner, principals overwhelming (91.31%) feel that they lack technology leadership behavior related to “…establishing partnerships that supported a strategic vision” in Standard 4: Systems Designer. Of the participants, 91.31% identified exhibiting technology leadership behaviors to establish partnerships as *minimally* (43.48%) or *somewhat* (47.83%). No item in Standard 4 exceeded the mean of item indicator 35 ($M = 3.48$) which measured participants’ protection of privacy through ensuring staff and student observed effective privacy and data management policies in the range of *somewhat* and *significantly* exhibiting technology leadership behaviors. Principals report they are working to protect privacy through effective data management and privacy policies but are not fully protecting sensitive information through their leadership.

**Standard 5: Connected Learner.** Principal self-reported technology leadership behaviors for Standard 5: Connected Learner was measured across 5 item indicators that measured participants’ self-reported ability to continually improve technology integration to support learning through building teams and systems that implement and sustain technology initiatives. Item 45, regarding technology leadership opportunity in Standard 4, was not included in the overall technology leadership score because it does not represent an actual technology
leadership behavior. Table 9 represents the percentage of participant response, mean and standard deviation for each item indicator. In addition, Table 9 provides an overall technology leadership score for Standard 5: Connected Learner.
<table>
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<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>To what extent did you set goals to remain current on emerging technologies for learning?</td>
<td>0.00%</td>
<td>13.04%</td>
<td>56.52%</td>
<td>26.09%</td>
<td>4.35%</td>
<td>3.22</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>To what extent did you participate regularly in online professional learning networks (definition: use of social media and technology to collect, communicate, collaborate, and create with connected colleagues anywhere at any time)?</td>
<td>0.00%</td>
<td>26.09%</td>
<td>30.43%</td>
<td>30.43%</td>
<td>13.04%</td>
<td>3.30</td>
<td>1.00</td>
</tr>
<tr>
<td>42</td>
<td>To what extent did you use technology to regularly engage in reflective practices that supported professional growth?</td>
<td>0.00%</td>
<td>13.04%</td>
<td>30.43%</td>
<td>52.17%</td>
<td>4.35%</td>
<td>3.48</td>
<td>0.77</td>
</tr>
<tr>
<td>43</td>
<td>To what extent did you develop the skills needed to lead change (e.g. building buy-in, listening, mentoring)?</td>
<td>0.00%</td>
<td>8.70%</td>
<td>30.43%</td>
<td>52.17%</td>
<td>8.70%</td>
<td>3.61</td>
<td>0.77</td>
</tr>
<tr>
<td>44</td>
<td>To what extent did you develop the skills needed to promote a mindset of continuous improvement for how technology can improve learning?</td>
<td>0.00%</td>
<td>0.00%</td>
<td>52.17%</td>
<td>43.48%</td>
<td>4.35%</td>
<td>3.52</td>
<td>0.58</td>
</tr>
<tr>
<td>45</td>
<td>Overall, to what extent did you have the opportunity to model continuous professional learning?</td>
<td>0.00%</td>
<td>0.00%</td>
<td>30.43%</td>
<td>60.87%</td>
<td>8.70%</td>
<td>3.78</td>
<td>0.59</td>
</tr>
</tbody>
</table>

*Note. n = 23*
Table 9 reports the mean technology leadership behaviors for Standard 5: Connected Learner as 3.43. A mean of 3.43, according to the ELTS, indicated that participants reported to be *somewhat* promoting and modeling continuous professional learning. Though all participants report at least *somewhat* exhibiting technology leadership behaviors to “develop the skills needed to promote a mindset of continuous improvement for how technology can improve learning” ($M = 3.52$), item indicator 43 was ranked slightly higher ($M = 3.61$) with 68% of participants identifying their leadership behaviors related to leadership skill development as *significantly* (52.17) or *fully* (8.70%) being demonstrated during this school year. This data indicates that principals are working to develop their own change in leadership skills at a higher level than they are developing leadership skills that will assist in promoting a mindset of continuous improvement that can lead to systematic changes in schools.

**Research Question Data Analysis**

**Research question one.** To what extent do principals report exhibiting technology leadership behaviors? The researcher created scale scores to determine the extent of principals’ technology leadership behaviors and to determine individual scale scores of self-reported principal technology leadership behaviors for each of the five ISTE-EL standards measured in the ELTS. Item indicators associated with principal’s opportunity for technology leadership were omitted in the calculation of the overall and standard specific scale scores due to the item indicators measurement of perceived opportunity for technology leadership behaviors, which is not characterized as leadership behavior. Following the calculation of individual scale score by ISTE-EL Standard, a scale score including all technology leadership item indicators was created to achieve a single scale score for technology leadership behavior measured using the ELTS. The overall technology leadership behaviors for the participants ($M = 3.38$) indicates that principals
are only somewhat exhibiting leadership behaviors that fulfill the ISTE-EL Standards. Mean, standard deviation, skewness and kurtosis for the technology leadership behaviors scale score are presented in Table 10. Skewness and kurtosis fell within the range of ± 1.9 and is considered acceptable (Wagner & Gillespie, 2019).

Table 10

<table>
<thead>
<tr>
<th>ELTS Technology Leadership Scale Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Index</strong></td>
</tr>
<tr>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Technology Leadership</td>
</tr>
<tr>
<td>Standard 1: Equity &amp; Citizenship Advocate</td>
</tr>
<tr>
<td>Standard 2: Visionary Planner</td>
</tr>
<tr>
<td>Standard 3: Empowering Leader</td>
</tr>
<tr>
<td>Standard 4: Systems Designer</td>
</tr>
<tr>
<td>Standard 5: Connected Learner</td>
</tr>
<tr>
<td>Opportunity Index</td>
</tr>
</tbody>
</table>

*Note. n = 23*

The technology leadership scale score for each of the ISTE-EL Standards ranged between mean values of 3.00 to 3.75, positioned between the Likert scale anchor of somewhat and significantly exhibiting technology leadership behaviors. This range reflects that principals report having acted as a technology leader in many respects during the 2019-2020 school year. Participants reported the highest self-reported technology leadership behaviors in Standard 3: Empowering Leader ($M = 3.75$). Empowering Leader behaviors is described as “Leaders create a culture where teachers and learners are empowered to use technology in innovative ways to enrich teaching and learning.” (ISTE-EL, 2018, p.1) This indicates a majority of the participants were nearing significant in their demonstration of Standard 3. Standard 2: Visionary Planner ($M = 3.00$) and Standard 4: Systems Designer ($M = 3.22$) reported the lowest median values. The behaviors of a Visionary Planner are demonstrated when “Leaders engage others in establishing
a vision, strategic plan and ongoing evaluation cycle for transforming learning with technology” (ISTE-EL, 2018, p.1).

Additionally, behaviors that are identified as Systems Designer are demonstrated when “Leaders build teams and systems to implement, sustain and continually improve the use of technology to support learning.” (ISTE-EL, 2018, p.2). In Standard 2 and Standard 4, the finding dedicated that the majority of participants were somewhat exhibiting technology leadership behaviors in these standards. The overall technology leadership behaviors for the respondents ($M = 3.38$) indicates that principals are only somewhat exhibiting leadership behaviors that fulfill the ISTE-EL Standards. This indicates that principals perceive their technology leadership is not aligned with the ISTE-EL standards and suggests that principals are inconsistently leading technology integration initiatives in ways that lead to the effective use of technology for student learning.

Participants reported having an opportunity to exhibit technology leadership behaviors ($M = 3.43$) at a slightly higher level than they report acting as a technology leader ($M = 3.38$). The technology leadership opportunity scale score and Standard 5: Connected Learner ($M = 3.43$) were the third highest means of the scale score. Table 11 compares the ISTE-EL means for each standard with the mean value for each standard’s technology leadership opportunity item indicator. For example, Standard1: Equity & Citizenship Advocate’s mean value was 3.50 and the mean value for item indicator 9 was 3.39.

Table 11

<table>
<thead>
<tr>
<th>ISTE-EL Standard</th>
<th>Opportunity</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 1: Equity &amp; Citizenship Advocate</td>
<td>3.39</td>
<td>3.50</td>
</tr>
<tr>
<td>Standard 2: Visionary Planner</td>
<td>2.96</td>
<td>3.00</td>
</tr>
</tbody>
</table>
As illustrated in Table 11, participants reported having more opportunity to exhibit technology leadership behaviors in standard 5, 4, and 3. Conversely, participants reported exhibiting more technology leadership behaviors in standards 1 and 2 than their perceived opportunity.

**Research question two.** What are the differences in reported principal technology leadership behaviors, if any, across the following demographic factors?

**Principal demographic groups.** Two statistical tests were used to establish the extent to which principal technology leadership behaviors differ across demographic groups. A t-test was used to determine the difference, if any, in overall technology leadership behaviors based on gender identity and four separate one-way ANOVA were run for the remaining principal demographic groups of age, years in education, years as a school principal, and years since working as a classroom teacher.

**Gender identity.** To examine the extent to which principals’ overall technology leadership behaviors differed across the gender identity demographic group an independent samples t-test was performed. Participants were provided with the options of male, female and prefer not to answer. No participants selected the prefer not to answer option related to gender identity. Table 12 presents t-test results for technology leadership behaviors across participants’ self-reported gender identity.

Table 12  
\[
\begin{array}{llllll}
\text{Technology Leadership} & n & M & SD & t & \text{t-crit} & df & p \\
\hline
\text{Standard 3: Empowering Leader} & 3.78 & 3.75 \\
\text{Standard 4: Systems Designer} & 3.26 & 3.22 \\
\text{Standard 5: Connected Learner} & 3.78 & 3.43 \\
\end{array}
\]

*Note. n = 23*
As shown in Table 13, there is no significant difference in reported overall technology leadership behaviors between men (M = 3.33, SD = .01) and women (M = 3.39, SD = .26); t (21) = - .51, p = .31. Table 3 identified over 78% of participants identified as female which supports the *t*-test results that indicate no significant difference in self-reported technology leadership behaviors.

*Age, years in education, years as principal, years since teacher.* To determine the extent principal’s technology leadership behaviors differed across age, years in education, years as principal, and years since working as a classroom teacher demographic groups, an analysis of variance (ANOVA) was conducted for each demographic group. Table 13 provides a summary of self-reported principal demographic characteristics and data for the one-way ANOVA conducted across each principal demographic group related to overall technology leadership behaviors.
Table 13

Analysis of Variance for Principal Demographic Groups

<table>
<thead>
<tr>
<th>Technology Leadership</th>
<th>df</th>
<th>M</th>
<th>SD</th>
<th>F</th>
<th>p</th>
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<tr>
<td>Age</td>
<td></td>
<td></td>
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<tr>
<td>20-29</td>
<td>3</td>
<td>3.38</td>
<td>.44</td>
<td>.82</td>
<td>.50</td>
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<tr>
<td>30-39</td>
<td>1</td>
<td>4.07</td>
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<tr>
<td>40-49</td>
<td>13</td>
<td>3.37</td>
<td>.37</td>
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<tr>
<td>50-59</td>
<td>8</td>
<td>3.32</td>
<td>.58</td>
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<tr>
<td>60+</td>
<td>1</td>
<td>3.28</td>
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<tr>
<td>Years in Education</td>
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<tr>
<td>Less than 10 years</td>
<td>4</td>
<td>3.38</td>
<td>.44</td>
<td>.57</td>
<td>.69</td>
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<td>11-15</td>
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<td>3.62</td>
<td>.64</td>
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<td>16-20</td>
<td>5</td>
<td>3.32</td>
<td>.40</td>
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<td>21-25</td>
<td>7</td>
<td>3.47</td>
<td>.43</td>
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<tr>
<td>26-30</td>
<td>7</td>
<td>3.37</td>
<td>.53</td>
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<tr>
<td>31-35</td>
<td>2</td>
<td>2.98</td>
<td>.42</td>
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<tr>
<td>36+</td>
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<tr>
<td>Years as Principal</td>
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<tr>
<td>1-4</td>
<td>8</td>
<td>3.24</td>
<td>.46</td>
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<tr>
<td>5-9</td>
<td>10</td>
<td>3.48</td>
<td>.44</td>
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<tr>
<td>10-14</td>
<td>3</td>
<td>3.69</td>
<td>.34</td>
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<tr>
<td>15-19</td>
<td>1</td>
<td>2.68</td>
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<td>20-24</td>
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<tr>
<td>25+</td>
<td>1</td>
<td>3.28</td>
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<tr>
<td>Years Since Teacher</td>
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<tr>
<td>1-4</td>
<td>0</td>
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<tr>
<td>5-9</td>
<td>6</td>
<td>3.44</td>
<td>.39</td>
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<tr>
<td>10-14</td>
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<td>3.42</td>
<td>.56</td>
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<tr>
<td>15-19</td>
<td>4</td>
<td>3.40</td>
<td>.36</td>
<td></td>
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</tr>
<tr>
<td>20-24</td>
<td>2</td>
<td>2.99</td>
<td>.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25+</td>
<td>1</td>
<td>3.28</td>
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</table>

There was no significant difference in overall technology leadership behaviors across the principal demographic groups of age, \( F(3,19) = .82, p = .49 \); years in education, \( F(4,18) = .57, p = .68 \); years as principal \( F(5,17) = 1.01, p = .44 \); and years since working as a classroom teacher, \( F(5,17) = .29, p = .91 \).
Data for principal demographic groups showed no significant difference in principal technology leadership behavior which suggests that principals are somewhat \( M = 3.38 \) exhibiting behaviors that lead to successful integration of technology in schools. Data presented in Table 3 indicates that no significant difference is expected due to the homogeneity of the sample. Table 3 identified 95% of participants reported being age 40 or older, 78.26% of participants identified as female, and over 78% of participants reported being a principal for less than 10 years.

School demographic groups. An analysis of variance (ANOVA) for each school demographic factor was used to determine the extent principal’s technology leadership behaviors differed across the school demographic groups of school type, current reenrollment, regular access to technology, and percentage of students eligible for free or reduced lunch. Table 14 provides a summary of self-reported school demographic characteristics and data for the one-way ANOVA conducted across each school demographic group related to overall technology leadership behaviors.
Table 14

Analysis of Variance for School Demographic Groups

<table>
<thead>
<tr>
<th>Technology Leadership</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>df between</th>
<th>df within</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
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<td>% Free or Reduced Lunch</td>
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<td>26% - 50%</td>
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<td>3.26</td>
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<td>51% - 75%</td>
<td>3</td>
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<td>Greater than 75%</td>
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There was no significant difference in overall technology leadership behaviors between groups for age, $F(3,19) = .82, p = .49$; years in education, $F(4,18) = .57, p = .68$; years as principal, $F(5,17) = 1.01, p = .44$; and years since working as a classroom teacher, $F(5,17) = .29, p = .91$. This data indicates that though there are differences in school demographics there is no difference in the overall principal self-reported technology leadership behaviors and that principals, regardless of the schools they lead, are somewhat ($M = 3.38$) exhibiting technology leadership behavior. Table 4 reported data related to school demographics that suggests that
schools in the sample are nearly homogeneous in access to technology and percentage of students receiving free and reduced lunch which aligns with the results form Table 14.

**Summary of Data Analysis**

Chapter Four provided an analysis of the descriptive and comparative data for the study sample based on the ELTS responses to address the research questions below:

1. To what extent do principals report exhibiting technology leadership behaviors?

2. What are the differences in reported principal technology leadership behaviors, if any, across the following demographic factors?

   a. principal demographic groups of gender identity, age, years of experience?

   b. school demographic groups of school type, enrollment, school technology access, and percentage of students eligible for free or reduced lunch?

Data analysis for each of the ISTE-EL Standards reported principals feel that they *somewhat* demonstrate leadership specifically related to technology strategic planning, stakeholder engagement, and digital citizenship. The aforementioned areas are critical to ensuring the creation of a shared vision for technology integration, that is clearly communicated and effectively implemented to transform learning with technology. In contrast, principals are *significantly* exhibiting technology leadership behaviors related access to technology and empowering education to develop leadership skills through personalized professional learning.

Data analysis for research question one identified the current self-reported technology leadership behaviors of school principals overall and on each of the 5 ISTE-EL Standards. Additionally, principal opportunity to demonstrate technology leadership overall and on each of the 5 ISTE-EL Standards was determined based on the responses collected via the ELTS. Self-reported data showed that principals *somewhat* ($M = 3.38$) demonstrated technology leadership
behaviors and felt they have a somewhat ($M = 3.43$) higher opportunity to demonstrate technology leadership behaviors. Additionally, data analysis for research question two described the difference, if any, in the self-reported technology leadership behaviors of principals across principal and school demographics. The data showed no significant difference in technology leadership behaviors across principal or school demographic groups. Findings, implications, and recommendations for future research obtained from the data are discussed in Chapter Five.
Chapter 5: Findings, Implications and Recommendations

The purpose of this research study was to identify the current self-reported technology leadership behaviors of principals in one public-school division in Virginia. Additionally, this study identified the difference, if any, in the self-reported technology leadership behaviors of principals across principal and school demographics. The literature on principal technology leadership behaviors is limited and there are insufficient studies related to principal technology leadership behaviors that bring about successful technology integration in schools (Graves, 2019; McLeod et al., 2011; Schoenbart, 2019; Zhong, 2017). In addition, the body of research related to technology leadership behaviors is primarily anecdotal and focused on outdated standards that are inappropriate to measure current technology leadership (Graves & Bowers, 2018; McLeod et al., 2011; Schoenbart, 2019; Zhong, 2017). Data was collected via the Education Leaders Technology Survey (ELTS) which measures principal self-reported technology leadership behavior for each of the five ISTE-EL Standards (Schoenbart, 2019). Self-reported technology leadership mastery and demographic data were used to describe and compare current principal technology leadership behaviors.

This study addressed the following research questions:

1. To what extent do principals report exhibiting technology leadership behaviors?

2. What are the differences in reported principal technology leadership behaviors, if any, across the following demographic factors?
   a. principal demographic groups of gender identity, age, years of experience?
   b. school demographic groups of school type, enrollment, school technology access, and percentage of students eligible for free or reduced lunch?
Data analysis revealed several findings that are presented in this chapter. A summary of findings organized by research question, implications for practice, recommendations for future research and researcher reflections are also reported.

**Findings**

Data analysis for this study resulted in several findings related to self-reported principal technology leadership behavior. Differences in principal technology leadership behavior as measured by the ELTS (Schoenbart, 2019) were also revealed.

**Finding One. Principals reported the highest technology leadership behavior in ISTE-EL Standard 3: Empowering Leader.** Standard 3: Empowering Leader measured participants’ self-reported ability to create a school culture that empowers teachers and learners to innovate teaching and learning through the use of technology (ISTE, 2018). Across the participating schools, principals reported exhibiting the highest level \((M = 3.75)\) of technology leadership behaviors related to ISTE-EL Standard 3: Empowering Leader. A mean score above 3.5 in this standard indicated that participating principals feel that they *somewhat to significantly* exhibit behaviors that empower teachers and learners to use technology in ways that enhance learning.

Findings from this study were consistent with Rateno’s (2019) research indicating Standard 3: Empowering Leader as the highest self-reported technology leadership behavior exhibited by principals \((M = 3.54)\). Though Schoenbart (2019) found that principals reported exhibiting the most technology leadership behaviors in Standard 1: Equity and Citizenship Advocate \((M = 3.94)\), Standard 3: Empowering Leader was reported as the second highest \((M = 3.60)\) standard for exhibiting technology leadership by principals. The reported level of technology leadership behavior for Standard 3: Empowering Leader in this study along with both
Rateno (2019) and Schoenbart (2019) suggests that principals *somewhat* exhibit technology leadership behavior related to empowering teachers and learners to use technology to enhance learning.

Analysis of the 10 item indicators in for **ISTE-EL** Standard 3: Empowering Leader shows a range of mean responses from 3.04 – 4.30. Principals reported exhibiting the most technology leadership in item indicators connected with empowering teachers to build leadership skills and pursue personalized professional learning. Participants understand choice in learning and empowering leaders fosters a culture of trust that supports a positive teacher attitude towards implementing initiatives, develops teachers’ instructional skills, and demonstrates how initiatives are relevant to teacher specific content areas (Montrieux et al., 2015, Sahin et al., 2016; Thoonen et al., 2011; United States Department of Education, 2017). Principals reported exhibiting the least technology leadership behavior ($M = 3.04$) related to building teacher capacity in the ISTE Standards for Educator and Students. The ISTE standards were updated and published in 2018. The selected school division has not focused on technology integration using the ISTE standards which could contribute to the lower reported scores for this item indicator. This is consistent with the research of Rateno (2019) and Schoenbart (2019) who found principals reported lower technology leadership related to the ISTE Standards for Educators and Students.

**Finding Two. Principals reported the lowest technology leadership behavior in**

**ISTE-EL Standard 2: Visionary Planner.** Standard 2: Visionary Planner measured participants’ engagement of stakeholders in creating a vision, plan and evaluation cycle for using technology to transform learning (ISTE, 2018). Across the participating schools, principals reported exhibiting the lowest level ($M = 3.00$) of technology leadership behaviors related to **ISTE-EL** Standard 2: Visionary Planner. A mean score of 3.00 in this standard indicated that participating
principals feel that they *somewhat* exhibit behaviors of strategic planning for technology.

Findings from this study were consistent with Rateno’s (2019) and Schoenbart’s (2019) research indicating Standard 2: Empowering Leader as the lowest self-reported technology leadership behavior exhibited by principals ($M = 3.29$ and $M = 3.20$).

Analysis of the 10 item indicators in for [ISTE-EL](https://www.iste.org/standards/EL) Standard 2: Visionary Planner shows a range of mean responses from 2.61 – 3.74. Principals reported exhibiting the most technology leadership in the area of development and growth of effective practices using technology to enhance learning. Conversely, principals reported involving stakeholders as the lowest technology leadership behavior scores, indicating that principals are not fully engaging stakeholders in creating, communicating, or planning a vision for technology integration. To facilitate systematic changes leaders must clearly communicate their vision; develop and monitor policy; and, ensure that there are appropriate supports are in place to support technology integration (Day et al., 2016; Fink & Markholt, 2014; Leithwood et al., 2009; Vermeulen et al., 2015). In traditional K-12 school districts, those directly involved in strategic and technology planning are division level leaders. Though there may be principal representation on strategic planning teams, all principals do not participate in the process of strategic planning for the school district. Lack of participation in strategic plan development, monitoring, and communication are factors that could lead to lower self-reported scores for participants.

**Finding Three. Principals report somewhat exhibiting technology leadership behavior during the 2019-2020 school year.** An overall mean technology leadership score was determined by calculating the overall mean for item indicators that assessed technology leadership behaviors related to the five [ISTE-EL](https://www.iste.org/standards/EL) Standards. Technology leadership behavior is identified a principal leadership behaviors that support the effective integration of technology in
schools and principal behaviors that are aligned with the 2018 ISTE-EL standards (Schoenbart, 2019). Data analysis showed that principals report only somewhat \( M = 3.38 \) exhibiting technology leadership behavior in their schools. No ISTE-EL standard score indicated that principals feel they are fully exhibiting technology leadership behavior in this study (Table 10).

These findings are consistent with the limited body of research regarding principal technology leadership using the 2018 ISTE-EL Standards (Graves, 2019; McLeod & Richardson, 2011; Schoenbart, 2019; Zhong, 2017). Rateno (2019) and Schoenbart (2019) both found that principals reported somewhat meeting technology leadership standards. In order to implement systematic changes necessary to integrate technology in ways that close the digital divides, principals must improve their understanding of the roles and responsibilities of technology leaders (Graves, 2019; Schoenbart, 2019; Sheninger, 2014; United States Department of Education, 2017; Zhong, 2017). Lack of consistent technology leadership could contribute to inconsistent teacher implementation of technology and result in sporadic use of technology to enhance learning (Graves, 2019; McLeod et al., 2011; Schoenbart, 2019; Theoharis & Brooks, 2014).

**Finding Four. There is no significant difference in self-reported technology leadership behavior across principal or school demographic groups.** Demographic item indicators focused on gender identity, age, and years of experience for school leaders, as well as school level, size, access to technology, and free and reduced lunch eligibility for schools. Multiple one-way analysis of variance tests (ANOVA) were run to examine the relationship between the variables. This study found no significant relationships were found for the demographic variable measured. This is consistent with the results of similar studies conducted by Schoenbart (2019) and Rateno (2019). Though Graves (2019) identified four technology-
using teacher types across school demographics, based on the data presented in this study technology leadership may not be impacted by demographics.

**Summary of Findings**

Research questions one described the self-reported technology leadership behaviors of principals in one public-school division in Virginia. The results detailed in Finding Three indicated that principals report *somewhat* exhibiting technology leadership behavior though they recognized they have slightly more opportunity to exhibit these behaviors in Finding Four. Findings One and Two identified that principals feel they exhibited the most technology leadership in Standard 3: Empowering Leader and exhibited the least technology leadership in Standard 2: Visionary Planner. Research question two compared technology leadership behavior across principal and school demographic groups. Multiple analysis of variance tests (ANOVA) were run for each variable. Finding Five outlined that there was no significant relationship between principal or school demographics and self-reported technology leadership behavior.

**Implications for Practice**

Limitations of this study included voluntary self-reporting of technology leadership behaviors, measuring technology leadership only related to the ISTE-EL standards, the use of a purposive convenience sample within a single school division, and a small sample size due to non-response to survey invitations. Despite these limitations, the study findings have implications for education leaders when considering measuring technology leadership behaviors exhibited by principals. The implications of the findings for this study are discussed below.

**Implication One.** Division leaders and principal preparation programs should provide training for principals on the ISTE Standard for Students and Educators to support developing a school culture of technology integration. The results of Finding One
indicated that while principals report the highest level of technology leadership for Standard 3: Empowering Leader, principals reported room for growth related to building the confidence and competency of teachers in the ISTE Standard for Students and Educators (ISTE, 2018). School leaders are second only to teachers in their impact on student achievement, and therefore, they must develop, implement and monitor effective technology integration plans to ensure students are equipped with digital skills needed in society (Ertmer & Ottenbreit-Leftwich, 2010; Leithwood & Jantzi, 2006). If principals are not knowledgeable about quality instruction enhanced by technology, they are unable to effectively identify gaps in access, evaluate processes that support consistent quality instruction, and create outcomes that increase student achievement (Gu & Johansson, 2013; Theoharis & Brooks, 2014). It is critical that divisions and principal preparation programs recognize the changing role of principals as technology leaders and provide the training necessary to prepare them to lead technology integration initiatives.

**Implication Two. Division leaders and principal preparation programs should ground professional development in effective leadership practices that focus on developing and communicating a shared vision for moving schools forward.** The results of Finding Two indicated that principals reported the lowest technology leadership in Standard 2: Visionary Planning. Leaders must clearly communicate their vision; develop and monitor policy; and ensure that there are appropriate supports to facilitate systematic changes, but in order to do so they must have the requisite skills and knowledge (Leithwood 2006, Fink & Markholt 2014).

**Implication Three. Division leaders should revise principal evaluation standards to include explicit language that addresses technology leadership.** The results of Finding 3 indicate that principals report somewhat demonstrating technology leadership. Technology leadership goes beyond just good leadership and must be evaluated using tools that assess all
aspects of school leadership (Day et al., 2015; Graves, 2019; Richardson et al., 2015). Principal evaluation tools should be revised to include specific technology leadership measures to enable school divisions to identify the individual needs of principals and the supports necessary to lead technology integration.

**Implication Four.** School leaders should develop a better understanding of the ISTE-EL standards and become familiar with the research supporting a critical need for technology leadership to successfully lead technology integration in ways that enhance teaching and learning. The results of Finding Five did not report a significant difference in self-reported principal technology leadership behavior across principal or school demographic groups. These findings are supported by the limited body of research measuring principal technology leadership behavior using the ISTE-EL standards and consistent with these study findings that principals are somewhat exhibiting technology leadership behavior (Rateno, 2019; Schoenbart, 2019; Zhong, 2017). The addition of technology integration into ESSA’s goals as a means to address issues of inequity in education outcomes for students requires that principals have a deep understanding of their role as technology leader and best practices in technology leadership that increases student access to technology to fully implement technology integrations plans that support the goals of ESSA (Graves, 2019; Office of Education Technology, 2017).

**Recommendations for Future Research**

Based on the review of available literature as well as the finding and implications outlined in this chapter, the following recommendations for future research are provided:

1. *Improving the Education Leaders Technology Survey.* This research study measured principal self-reported technology leadership behaviors. Future research should attempt to collect not only principal self-reported behaviors but include teacher and division
leadership perceptions of principal technology leadership behavior as a means to validate principal responses on the ELTS. Additionally, item indicators in Standard 2: Visionary Planner should be revised to specify school level strategic planning initiatives to determine how leaders are creating, implementing, communicating, and monitoring technology integration plans in the buildings they lead. This will allow researchers to identify strategic planning at the building level versus how principals create division-wide strategic plans.

2. *Increase the sample and expand the setting of the study.* This research study represented participants from one public-school division in Virginia. Future research should attempt to replicate this study including principals in other school divisions. Additionally, the sample should be increased to include other school leadership roles that impact implementing technology integration plans.

3. *Increase the use of the most current ISTE-EL Standards in research studies.* This research study was based on the 2018 ISTE-EL Standards. The researcher found only two other research studies that used these up-to-date standards to explore technology leadership. Future research studies are needed using the 2018 ISTE-EL Standards to determine if the revised standards have a significant impact on technology integration and increase students’ digital skills.

4. *Assessing principals’ knowledge of the ISTE-EL Standards.* This research study required principals to report their perception of their current technology leadership behavior. Future studies should assess principals’ knowledge of the ISTE-EL Standards as means to identify areas of focus for principal preparation programs and division leadership as they work to prepare and support principals.
Conclusions

The purpose of this research study was to identify the current self-reported technology leadership behaviors of principals in one public-school division in Virginia. Additionally, this study identified the difference, if any, in the self-reported technology leadership behaviors of principals across principal and school demographics. Study findings identified that principals are somewhat exhibiting technology leadership behavior and that there is no significant difference in principal technology leadership behavior across school and principal demographic groups. Findings did lead to implication for practice regarding principal support, professional development, evaluation and preparation. Additionally, study implications leave open the continued examination of principal technology leadership behavior as a means to differentiate support and development opportunities provided to principals and the schools they lead.

Researcher Reflections

As a sixth-year principal of a Governor’s Science Technology Engineering and Mathematics (STEM) Academy that also serves non-STEM Academy students, the findings of my study were not what I expected. Based on limitations to my study design and recommendations for future research, I believe that principals need to be better equipped and supported to act as technology leaders for the schools they lead. This belief is supported by my own experience as a technology leader and my work with division leaders to develop technology integration plans that support quality learning for all students. One of the conclusions that I have drawn from my study findings is that the school division has already ensured access to technology for all schools and that principals are beginning to transition into the role of technology leader. Though no principal self-report their technology leadership behavior at or above significant, the study provides a starting point to improve technology leadership for
schools. Changes recommended to researchers looking to replicate this study include expanding data collection beyond principal self-reporting to include teacher and division leader perceptions of principal technology leadership behavior and increasing the sample size and setting to allow for more in-depth examination of principal technology leadership behavior across varying school, school district, and leader types.

Findings aside, the coursework throughout this program and the dissertation process have contributed to my continuous growth as an educational leader. My view of equity, effective school leadership, and technology leadership has been broadened through the review of literature and have made me more aware of behavior that will contribute to the success of schools. Gaps in division level support to develop technology leadership were revealed and challenges of leading effective technology integrations without clear connections to strategic planning were identified.

The success of technology integration at the school I lead is not related to specific supports or training received to lead technology integration. My personal level of technology competence, ability to demonstrate effective school leadership, and knowledge of the importance of digital capital were applied simultaneously in the context of my school setting. When presented with the opportunity to provide all students at my school with Chromebooks three years ago, I quickly agreed because I knew my students deserved the opportunity to gain digital skills. I was unaware of the scope of background technology knowledge needed to lead the transition of technology integration. Fortunately, my technology competency, willingness to seek expert support, and leadership experience assisted me in developing a plan that integrated technology into our school culture.

My intentions are to continue to expand my impact as an educational leader who models technology leadership behaviors. This experience helped me realize the potential for creating a
shared vision that includes technology, aligning technology integration with strategic goals, clearly communicating how technology supports strategic goals, and the need for intentional reflection on technology leadership at all levels. Technology’s impact on our society cannot be ignored. Though not a new concept, technology integration in schools continues to be a challenge faced by many school leaders and I argue that intentional development of technology leadership is imperative for the success of schools. The future success of children, our communities, and our nation are dependent on the leadership of schools. If effective instructional practices that prepare students for the “real world” are expected of teachers, it should be equally required of school and division leaders when making decisions that impact the integration of technology into strategic plans that drive the work of schools.

I look forward to sharing my experiences and knowledge gained as a part of this doctoral process to advance the opportunities for school leaders, teachers, and students through technology leadership. It is my belief that a shared vision for technology, that is clearly communicated, and consistently monitored will help school leaders develop the skills needed to effectively lead technology integration by identifying gaps in professional practice that can be filled with professional development. I have gained a deeper understanding of the challenges school districts and school leaders face in development of technology integration plans. I have also developed a better understanding of the supports needed for teachers to carry out technology integration and hope to contribute to the overall development of technology integration plans that support all stakeholders.

As I complete this dissertation, our nation is in the midst of the 2020 COVID-19 Pandemic. Businesses, government organizations, churches and schools across the nation have been forced to close in an effort limit the spread of the virus. School closure does not mean
teaching and learning has ceased; it means that education the way we have known it has no longer exists. Students, parents, teachers and principals have been thrusts into the unfamiliar waters of online learning environments. Working, communication and leading remotely through the use of technology is our new normal and school leaders are expected to continue to lead schools that meet the needs of all learners. Now, more than ever, school leaders must rely on their technology leadership to guide school communities towards unlocking the potential the benefits of online learning. Education must not go back to the way it was when this crisis ends. We must use what we have learned about educating students through these events to re-image what education could be in a technologically connected society.
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https://doi.org/10.1007/s11423-014-9355-4


Appendix A: ISTE Standard for Education Leaders (ISTE-EL)

ISTE STANDARDS
FOR EDUCATION LEADERS

1. Equity and Citizenship Advocate
   Leaders use technology to increase equity, inclusion, and digital citizenship practices. Education leaders:
   a. Ensure all students have skilled teachers who actively use technology to meet student learning needs.
   b. Ensure all students have access to the technology and connectivity necessary to participate in authentic and engaging learning opportunities.
   c. Model digital citizenship by critically evaluating online resources, engaging in civil discourse online and using digital tools to contribute to positive social change.
   d. Cultivate responsible online behavior, including the safe, ethical, and legal use of technology.

2. Visionary Planner
   Leaders engage others in establishing a vision, strategic plan and ongoing evaluation cycle for transforming learning with technology. Education leaders:
   a. Engage education stakeholders in developing and adopting a shared vision for using technology to improve student success, informed by the learning sciences.
   b. Build on the shared vision by collaboratively creating a strategic plan that articulates how technology will be used to enhance learning.
   c. Evaluate progress on the strategic plan, make course corrections, measure impact and scale effective approaches for using technology to transform learning.
   d. Communicate effectively with stakeholders to gather input on the plan, celebrate successes and engage in a continuous improvement cycle.
   e. Share lessons learned, best practices, challenges and the impact of learning with technology with other education leaders who want to learn from this work.

3. Empowering Leader
   Leaders create a culture where teachers and learners are empowered to use technology in innovative ways to enrich teaching and learning. Education leaders:
   a. Empower educators to exercise professional agency, build teacher leadership skills and pursue personalized professional learning.
   b. Build the confidence and competency of educators to put the ISTE Standards for Students and Educators into practice.
   c. Inspire a culture of innovation and collaboration that allows the time and space to explore and experiment with digital tools.
   d. Support educators in using technology to advance learning that meets the diverse learning, cultural, and social-emotional needs of individual students.
   e. Develop learning assessments that provide a personalized, actionable view of student progress in real time.

iste.org/standards
4. Systems Designer

Leaders build teams and systems to implement, sustain and continually improve the use of technology to support learning. Education leaders:

a. lead teams to collaboratively establish robust infrastructure and systems needed to implement the strategic plan.

b. Ensure that resources for supporting the effective use of technology for learning are sufficient and scalable to meet future demand.

c. Protect privacy and security by ensuring that students and staff observe effective privacy and data management policies.

d. Establish partnerships that support the strategic vision, achieve learning priorities and improve operations.

5. Connected Learner

Leaders model and promote continuous professional learning for themselves and others. Education leaders:

a. Set goals to remain current on emerging technologies for learning, innovations in pedagogy and advancements in the learning sciences.

b. Participate regularly in online professional learning networks to collaboratively learn with and mentor other professionals.

c. Use technology to regularly engage in reflective practices that support personal and professional growth.

d. Develop the skills needed to lead and navigate change, advance systems and promote a mindset of continuous improvement for how technology can improve learning.

For more information, contact standards@iste.org. ISTE Standards for Education Leaders, ©2018, ISTE (International Society for Technology in Education), iste.org. All rights reserved.
Appendix B: Education Leaders Technology Survey

Informed Consent

Welcome to the Education Leaders Technology Survey!

You are invited to participate in a study being conducted by Shameka N. Gerald, Doctoral Candidate at Virginia Polytechnic Institute and University. Participation should take approximately 15 minutes to complete the survey.

Title of Research Study: Measuring Principal Technology Leadership and Behaviors: A Quantitative Study [Protocol Number: 19-1096]

Key Information: The following is a short summary of this study to help you decide whether or not to be a part of this study. More detailed information can be found by clicking here to access or download the detailed informed consent document.

Why am I being invited to take part in a research study?
We invite you to take part in a research study because you are a principal in the selected school division for the 2019-2020 school year.

What should I know about being in a research study?

• Someone will explain this research study to you
• Whether or not you take part is up to you
• You can choose not to take part
• You can agree to take part and later change your mind
Your decision will not be held against you
You can ask all the questions you want before you decide

What should I know about this research study?

**Purpose of Study:** You are being asked to participate in a research study conducted as part of a doctoral dissertation for Virginia Polytechnic Institute and University. The purpose of this study is to explore the role of principals as technology leaders. The data collected will help school divisions, principal preparation programs, and researchers better understand the technology leadership behaviors of principals and how-to best support principals’ development of technology leadership.

**What to expect:** Participation in this study will require approximately 15 minutes to complete the Education Leaders Technology Survey (ELTS). You will be asked to complete the ELTS electronically using a link provided via email. More detailed information about the study procedures can be found under “What happens if I say yes, I want to be in this research?” by clicking here.

**Risks:** The researcher perceives minimal risk from your involvement in the research study. There are minor inconveniences due to the time required to complete the survey. More detailed information about the risks of this study can be found under “Is there any way being in this study could be bad for me? (Detailed Risks)” by clicking here.

**Benefits:** There are no benefits to you from your taking part in this research. We cannot promise any benefits to others from your taking part in this research. However, possible benefits include an expanded understanding of technology leadership behaviors and their potential impacts.

**Participation/Withdrawal:** Taking part in research is completely up to you. You can decide to participate or not to participate. If you are a student, the decision whether to participate or not participate will have no effect on your grades or relationship with Virginia Tech.
If you have any questions regarding this study, you may contact a member of the research team: Shameka N. Gerald or sngerald@vt.edu or Dr. Ted S. Price, PhD. or pted7@vt.edu.

If you have any questions or concerns about this study’s conduct, your rights as a research subject, or need to report a research related injury or event, you may contact VT HRPP at (540) 231-3732 or irb@vt.edu. [Protocol Number: 19-1096]

Please note that this survey will be best displayed on a laptop or desktop computer. Some features may be less compatible for use on a mobile device.

**ELECTRONIC CONSENT:**

Please select your choice below. You may print a copy of this consent form for your records. Selecting “I consent, begin the study” below indicates that:

- You have read the above information
- You voluntarily agree to participate
- You are 18 years of age or older
- You are a principal in the selected school division during the 2019-2020 school year

0 I consent, begin the study
0 I do not consent, I do not wish to participate

**ELTS**

**Education Leaders Technology Survey Directions**

The Education Leaders Technology Survey (ELTS) is intended to assess education leaders’ technology leadership behaviors and activities over the course of the last school year. ELTS questions are based on the 2018 International Society for Technology in Education (ISTE) Standards for Education Leaders, and the survey was inspired by the Principals Technology Leadership Assessment (PTLA). The ELTS
is being used as a part of a research study entitled Measuring Principal Technology Leadership and Behaviors: A Quantitative Study [Protocol Number: 19-1096]

As you answer the questions, think of your actual behavior over the course of this school year. Do not take into account planned or intended behavior. Answer as many of the questions as possible. If a specific question is not applicable to your role or experiences, select "not at all."
For the purposes of this survey, definitions and examples appear in some questions; keep these definitions in mind as you read the items and make your responses.

If you have any questions about this survey, please contact:
Shameka N. Gerald [REDACTED] or sngerald@vt.edu
Dr. Ted S. Price, PhD. [REDACTED] or pted7@vt.edu

**Standard 1: Equity and Citizenship Advocate**

<table>
<thead>
<tr>
<th>Not at all</th>
<th>Minimally</th>
<th>Somewhat</th>
<th>Significantly</th>
<th>Fully</th>
</tr>
</thead>
</table>

1. To what extent did you ensure that all students had skilled teachers who were actively using technology (definition: devices and tools like computers, tablets, cell phones, and other communication tools, as well as their related hardware and software) to meet student needs?

2. To what extent did you ensure all students had access to the technology necessary to participate in engaging learning opportunities?

3. To what extent did you ensure all students had access to the connectivity (e.g. Internet access) necessary to participate in engaging learning?
opportunities?

4. To what extent did you model digital citizenship (definition: the behaviors, skills, and knowledge necessary for appropriate and responsible technology use) by critically evaluating online resources?

5. To what extent did you model digital citizenship by engaging in civil discourse online?

6. To what extent did you model digital citizenship by using digital tools to contribute to positive social change?

7. To what extent did you cultivate responsible online behavior?

8. To what extent did you cultivate the safe, ethical and legal use of technology?

9. Overall, to what extent did you have the opportunity to use technology to increase equity, inclusion, and digital citizenship practices?

Block 4

**Standard 2: Visionary Planner**

10. To what extent did you engage education stakeholders (definition: Not at all Minimally Somewhat Significantly Fully)

https://virginiatech.ca1.qualtrics.com/Q/EditSection/Blocks/Ajax/GetSurveyPrintPreview
anyone who is invested in the welfare and success of a school and its students, including administrators, teachers, staff members, students, parents, families, community members, local business leaders, elected officials, etc.) in developing and adopting a shared vision for using technology to improve student success?

11. To what extent did you build on the shared vision by collaboratively creating a strategic plan that articulated how technology would be used to enhance learning?

12. To what extent did you evaluate progress on a strategic plan for using technology to transform learning?

13. To what extent did you make changes to improve how technology is being used to transform learning?

14. To what extent did you measure the impact of using technology to transform learning?

15. To what extent did you encourage the development and growth of effective approaches for using technology to transform learning?

16. To what extent did you communicate effectively with stakeholders to gather input on a strategic technology plan?

17. To what extent did you communicate effectively with stakeholders to celebrate the successes of a strategic technology plan?
18. To what extent did you communicate effectively with stakeholders to continually improve a strategic technology plan?

19. To what extent did you share the impacts of learning with technology (e.g. lessons learned, best practices, challenges) with other education leaders who want to learn from this work?

20. **Overall**, to what extent did you have the opportunity to engage others in establishing a vision, strategic plan, and ongoing evaluation cycle for transforming learning with technology?

**Block 5**

**Standard 3: Empowering Leader**

Not at all  Minimally  Somewhat  Significantly  Fully

21. To what extent did you empower educators to exercise *professional agency* (definition: to take responsibility for and ownership of goals and learning and work strategies)?

22. To what extent did you empower educators to build teacher leadership skills?

23. To what extent did you empower educators to pursue personalized professional learning?
Block 7

Standard 4: Systems Designer

32. To what extent did you lead teams to collaboratively establish robust infrastructure to implement a strategic plan?

33. To what extent did you ensure that resources for supporting the effective use of technology for learning were sufficient to meet future demand?

34. To what extent did you ensure that resources for supporting the effective use of technology for learning could anticipate and meet future needs?

35. To what extent did you protect privacy by ensuring that students and staff observed effective privacy and data management policies?

36. To what extent did you establish partnerships that supported a strategic vision?

37. To what extent did you establish partnerships to achieve learning priorities?

38. To what extent did you establish partnerships that improve operations?

39. **Overall**, to what extent did you have
24. To what extent did you build the competency of educators to put the ISTE Standards for Students and Educators into practice?

25. To what extent did you inspire an innovative learning environment that allowed the time and space to explore digital tools?

26. To what extent did you support educators in using technology to advance learning that met the diverse learning needs of individual students?

27. To what extent did you support educators in using technology to advance learning that met the diverse cultural needs of individual students?

28. To what extent did you support educators in using technology to advance learning that met the diverse social-emotional needs of individual students?

29. To what extent did you develop learning assessments that provided a personalized view of student progress in real time?

30. To what extent did you develop learning assessments that provided an actionable view (e.g., specific feedback to drive instruction) of student progress in real time?

31. **Overall**, to what extent did you have the opportunity to create a culture where the school community was empowered to use technology in innovative ways?
the opportunity to build teams and systems to implement, sustain, and continually improve the use of technology to support learning?

Block 6

Standard 5: Connected Learner

40. To what extent did you set goals to remain current on emerging technologies for learning?

41. To what extent did you participate regularly in online professional learning networks (definition: use of social media and technology to collect, communicate, collaborate, and create with connected colleagues anywhere at any time)?

42. To what extent did you use technology to regularly engage in reflective practices that supported professional growth?

43. To what extent did you develop the skills needed to lead change (e.g. building buy-in, listening, mentoring)?

44. To what extent did you develop the skills needed to promote a mindset of continuous improvement for how technology can improve learning?

45. Overall, to what extent did you have
the opportunity to model continuous professional learning?

Demographics

46. What is your gender identity?
   - Male
   - Female

47. What is your age?
   - 20-29
   - 30-39
   - 40-49
   - 50-59
   - 60+

48. How many years have you worked in education?
   - Less than 10 years
   - 11-15
   - 16-20
   - 21-25
   - 26-30
   - 31-35
   - 36+
49. How many years have you worked as a school principal?

- [ ] 1-4
- [ ] 5-9
- [ ] 10-14
- [ ] 15-19
- [ ] 20-24
- [ ] 25+

50. How many years has it been since you worked as a classroom teacher (or similar position)?

- [ ] 1-4
- [ ] 5-9
- [ ] 10-14
- [ ] 15-19
- [ ] 20-24
- [ ] 25+

51. Which school type best describes your school?

- [ ] Early Childhood Center
- [ ] Elementary School
- [ ] Middle School
- [ ] High School
52. How many students are currently enrolled in your school?

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

53. To what extent does your school have regular access to technology (definition: devices and tools like computers, tablets, cell phones, and other communication tools, as well as their related hardware and software)?

- Some
- Significant
- Full

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

If you are unsure of your school’s percentage, feel free to access the Virginia Department of Education’s National School Lunch Program Free and Reduced Price Eligibility Reports by clicking here:


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

Block 3
## Appendix C: Table of ISTE-EL Standards and Associated ELTS Items

<table>
<thead>
<tr>
<th>ISTE-EL Standard</th>
<th>ELTS Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 1: Equity and Citizenship Advocate</td>
<td>Q1 - Q9</td>
</tr>
<tr>
<td>Standard 2: Visionary Planner</td>
<td>Q10 - Q20</td>
</tr>
<tr>
<td>Standard 3: Empowering Leader</td>
<td>Q21 - Q31</td>
</tr>
<tr>
<td>Standard 4: System Designer</td>
<td>Q32 - Q39</td>
</tr>
<tr>
<td>Standard 5: Connected Learner</td>
<td>Q40 - Q45</td>
</tr>
</tbody>
</table>
Appendix D: HRPP Training Certificate

Certificate of Completion

This certifies that
Shameka Nicole Gerald
Has completed
Training in Human Subjects Protection
On the following topics:
Historical Basis for Regulating Human Subjects Research
The Belmont Report
Federal and Virginia Tech Regulatory Entities, Policies and Procedures
on
June 25, 2018
Appendix E: HRPP Notification of Exemption

MEMORANDUM

DATE: December 16, 2019
TO: Ted S Price, Shameka Nicole Gerald
FROM: Virginia Tech Institutional Review Board (FWA00000572, expires October 29, 2024)
PROTOCOL TITLE: Measuring Principal Technology Leadership and Behaviors: A Quantitative Study
IRB NUMBER: 19-1096

Effective December 15, 2019, the Virginia Tech Human Research Protection Program (HRPP) and Institutional Review Board (IRB) determined that this protocol meets the criteria for exemption from IRB review under 45 CFR 46.104(d) category(ies) 2(ii).

Ongoing IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities impact the exempt determination, please submit a new request to the IRB for a determination.

This exempt determination does not apply to any collaborating institution(s). The Virginia Tech HRPP and IRB cannot provide an exemption that overrides the jurisdiction of a local IRB or other institutional mechanism for determining exemptions.

All investigators (listed above) are required to comply with the researcher requirements outlined at: https://secure.research.vt.edu/external/irb/responsibilities.htm

(Please review responsibilities before beginning your research.)

PROTOCOL INFORMATION:

Determined As: Exempt, under 45 CFR 46.104(d) category(ies) 2(ii)
Protocol Determination Date: December 15, 2019

ASSOCIATED FUNDING:

The table on the following page indicates whether grant proposals are related to this protocol, and which of the listed proposals, if any, have been compared to this protocol, if required.
Appendix F: School Division Research & Authorization Committee Approval Letter

Office of Academic Data Analytics

DATE: December 18, 2019
TO: Shameka N. Gerald
FROM: [Signature]
Research Authorization Committee

SUBJECT: Research Authorization Request, Virginia Tech, IRB #19-1906

TITLE: Measuring Principal Technology Leadership and Behaviors: A Quantitative Study

Thank you for submitting your research authorization request to Newport News Public Schools. After a thorough review of your request and accompanying documentation, I am pleased to inform you that your study has been approved for data collection.

Please note that the standard conditions of approval made by Newport News Public Schools are:

   a) Conduct the study strictly in accordance with the proposal as submitted, including any amendments or revisions made to the proposal as required by Newport News Public Schools;
   b) Make submission for approval of amendments to the approved study before implementing such changes;
   c) Provide Newport News Public Schools with an executive summary upon completion of the study;
   d) Advise Newport News Public Schools in writing if the study is discontinued.

Additionally, please note the Newport News Public Schools does not provide research assistance, and cannot assist with contacting administrators, teachers, and/or students pursuant to your study.

APPROVAL NUMBER: SY1920-05
Appendix G: Study Cover Letter and Invitation

Email Subject Line: Invitation to Participate in Research Study

January 6, 2020

Dear Public-School Principal:

I am currently a doctoral candidate in the Educational Leadership and Policy Studies program at Virginia Polytechnic Institute and State University. I am undertaking a research study entitled, “Measuring Principal Technology Leadership and Behaviors: A Quantitative Study”. The purpose of this research study is to examine the technology leadership behaviors of principals and the differences, if any, between the technology leadership behaviors of principals across school and principal demographics.

The Virginia Polytechnic Institute and State University Human Research Protection Program (HRPP) has reviewed this research study [IRB Protocol Number: 19-1096] and it has been approved by your division’s Research Authorization Committee. In order to complete the study, I am requesting that principals in your school division complete a survey that will take approximately 15 minutes to complete. The first section of the survey will collect information regarding principal technology leadership behaviors followed by the second section that will collect demographic information.

This study is entirely voluntary and anonymous. No identifying information linking you or your school will be included in the data and participation will not have any effect on your employment within the school division. Data obtained from the study will be analyzed statistically and results will only be reported as a part of dissertation defense and possible publishing when completed, with the objective to inform practices that impact principal technology leadership behaviors. I have included a detailed Informed Consent Agreement as an attachment to this email. The Informed Consent Agreement provides further details regarding the research study, confidentiality, participation, withdrawal, and how data will be used, manage, and protected.

If you have any questions regarding this study, you may contact a member of the research team: Shameka N. Gerald or sngerald@vt.edu, Dr. Ted S. Price, PhD. or pted7@vt.edu

If you have any questions or concerns about this study’s conduct, your rights as a research subject, or need to report a research related injury or event, you may contact VT HRPP at (540) 231-3732 or irb@vt.edu. [IRB Protocol Number: 19-1096]

Please click the included link to access the survey and complete the survey no later than January 17, 2020.

Your completion of the survey will imply your consent to participate in the study. You may withdraw from the study at any time.
Click the link below to be directed to the Education Leaders Technology Survey: ELTS Survey Link

As a principal, I understand that your time is extremely valuable and appreciate your consideration regarding participation in this study.

Respectfully,
Shameka N. Gerald
Doctoral Candidate, Virginia Tech
Appendix H: ELTS Informed Consent

Measuring Principal Technology Leadership and Behaviors: A Quantitative Study
[Protocol Number: 19-1096]

Welcome to the Education Leaders Technology Survey!

You are invited to participate in a research study being conducted by Shameka N. Gerald, Doctoral Candidate at Virginia Polytechnic Institute and University. Participation should take approximately 15 minutes to complete the survey.

Title of Research Study: Measuring Principal Technology Leadership and Behaviors: A Quantitative Study [IRB Protocol Number: 19-1096]

Key Information: The following is a short summary of this research study to help you decide whether or not to be a part of this research study. More detailed information can be found by clicking here to access or download the detailed informed consent agreement.

Why am I being invited to take part in a research study?
We invite you to take part in a research study because you are a principal in the selected school division for the 2019-2020 school year.

What should I know about being in a research study?
- Someone will explain this research study to you
- Whether or not you take part is up to you
- You can choose not to take part
- You can agree to take part and later change your mind
- Your decision will not be held against you
- You can ask all the questions you want before you decide

What should I know about this research study?
- Purpose of Research Study: You are being asked to participate in a research study conducted a part of a doctoral dissertation for Virginia Polytechnic Institute and University. The purpose of this research study is to explore the role of principals as technology leaders. The data collected will help school divisions, principal preparation programs, and researchers better understand the technology leadership behaviors of principals and how-to best support principals’ development of technology leadership.

- What to expect: Participation in this research study will require approximately 15 minutes to complete the Education Leaders Technology Survey (ELTS). You will be asked to complete the ELTS electronically using a link provided via email. The survey has the option to proceed forward, backward, or pause for review later. More detailed information about the research study procedures can be found under "What happens if I say yes, I want to be in this research?" by clicking here.

- Risks: The researcher perceives minimal risk from your involvement in the research study. There are minor inconveniences due to the time required to complete the survey. More detailed information about the risks of this research study can be found under "Is there any way being in this research study could be bad for me? (Detailed Risks)" by clicking here.

- Benefits: There are no benefits to you from your taking part in this research. We cannot promise any benefits to others from your taking part in this research. However, possible benefits include an expanded understanding of technology leadership behaviors and their potential impacts.

- Participation/Withdrawal: Taking part in research is completely up to you. You can decide to participate or not to participate. If you wish to opt-out of this research study, please reply to the invitation email with the word unsubscribe in the subject line to be removed from future emails.
Measuring Principal Technology Leadership and Behaviors: A Quantitative Study  
[Protocol Number: 19-1096]

regarding this research study if you are a student, the decision whether to participate or not participate will have no effect on your grades or relationship with Virginia Tech.

If you have any questions regarding this research study, you may contact a member of the research team: Shameka N. Gerald or sngerald@vt.edu or Dr. Ted S. Price, PhD or pted7@vt.edu.

If you have any questions or concerns about this research study's conduct, your rights as a research subject, or need to report a research related injury or event, you may contact VT HRPP at (540) 231-3732 or irb@vt.edu. [IRB Protocol Number: 19-1096]

Please note that this survey will be best displayed on a laptop or desktop computer. Some features may be less compatible for use on a mobile device.

**ELECTRONIC CONSENT:** Please select your choice below. You may print a copy of this consent form for your records. Selecting "I consent, begin the research study" below indicates that:

- You have read the above information
- You voluntarily agree to participate
- You are 18 years of age or older
- You are a principal in the selected school division during the 2019-2020 school year

☐ I consent, being the research study  
☐ I do no consent, I do now wish to participate
Appendix I: Second Invitation to Participate (Phone Contact Script)

Greetings Mr./Ms./Dr. (insert name of invited participants),

My name is Shameka Gerald and I am currently a doctoral candidate in the Educational Leadership and Policy Studies program at Virginia Polytechnic Institute and State University (Virginia Tech). I am completing a research study entitled “Measuring Principal Technology Leadership and Behaviors: A Quantitative Study” [IRB Protocol Number 19-1096]. The purpose of this study is to examine the technology leadership behaviors of principals and the differences, if any, between the technology leadership behaviors of principals across school and personal demographics.

I am calling to follow-up regarding an introduction to the study, invitation to participate, and informed consent agreement originally sent to you at your school division email address on January 6, 2020. It is my hope that you will agree to be a participant in this voluntary and anonymous study. I am requesting that principals in your school division complete the Education Leaders Technology Survey that will take approximately 15 minutes. Your completion of the survey will imply your consent to participate in the study.

I would be happy to answer any questions regarding my study and as well as forward my original invitation to you again if you request.

(For voicemail only) I can be reached by phone at [redacted] or sngerald@vt.edu

Thank you for your time and I appreciate your consideration.
Appendix J: Final Invitation to Participate

Email Subject Line: Final-Invitation to Participate in Research Study

January 15, 2020

Dear Public-School Principal:

During the past two weeks you have received an e-mail and voice invitation to participate in a research study entitled, “Measuring Principal Technology Leadership and Behaviors: A Quantitative Study” [IRB Protocol Number: 19-1096]. Thank you to those of you who have already taken the time to participate in the research study by completing the survey.

If you have not yet completed the study survey, this is a final invitation to participate. A copy of the original invitation email and detailed informed consent agreement and survey link are included. The purpose of this research study is to examine the technology leadership behaviors of principals and the differences, if any, between the technology leadership behaviors of principals across school and personal demographics.

In order to complete this research study, I am requesting that principals in your school division complete the Education Leaders Technology Survey (ELTS) which measures principal technology leadership behaviors. The survey will take approximately 15 minutes to complete.

The deadline for submission of the survey is January 17, 2020. The survey can be accessed at the link below. By completing the survey your will imply your consent to participate in the research study. You may withdraw from this research study at any time without penalty. Please refer to the detailed informed consent agreement for directions on study withdrawal.

Click the link below to be directed to the Education Leaders Technology Survey:
ELTS Survey Link

If you have any questions regarding this research study you may contact a member of the research team:
Shameka N. Gerald or sngerald@vt.edu
Dr. Ted S. Price, PhD. or pted7@vt.edu

If you have any questions or concerns about this research study’s conduct, your rights as a research subject, or need to report a research related injury or event, you may contact VT HRPP at (540) 231-3732 or irb@vt.edu. [IRB Protocol Number: 19-1096]

The deadline for submission of the survey is January 17, 2020. Your completion of the survey will imply your consent to participate in the study. You may withdraw from the study at any time.

Your input is critical in this research study and I appreciate your consideration concerning participation in this research study.
Respectfully,
Shameka N. Gerald
Doctoral Candidate, Virginia Tech