TEACHER PERCEPTIONS OF SUPPORTS THAT PROMOTE COMPUTER SELF-EFFICACY AND TRANSFORMATIONAL DIGITAL PEDAGOGY IN ONE-TO-ONE LEARNING ENVIRONMENTS

Paula Kent, B.S., M.S.

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APPROVED:

Robert Voelkel, Major Professor
Frances Van Tassell, Co-Major Professor
Royce George, Committee Member
Noelle Paufler, Committee Member
Melinda Defelice, Committee Member
Misty Sailors, Chair of the Department of Teacher Education and Administration
Randy Bomer, Dean of the College of Education
Victor Prybutok, Dean of the Toulouse Graduate School

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Although one-to-one technology programs are rapidly expanding in secondary schools, the literature about how to effectively leverage these programs to improve teaching and learning is relatively small. Little guidance is available for school leaders attempting to improve teachers' willingness and ability to incorporate technology effectively into their instruction. The purpose of this mixed-methods case study was to discovery what supports school leaders provide to promote high levels of computer self-efficacy and transformational digital pedagogies in one-to-one learning environments. Data were collected from English language arts, Social Studies, and science teachers in three high schools in a suburban school district in northeast Texas using an online survey, eight virtual semi-structured interviews, and two virtual focus group interviews. Data were analyzed using descriptive statistics and deductive and inductive analysis. The findings of the study reveal most teachers perceived their ability to effectively deliver digital instruction as strong, and most were able to incorporate technology into their lessons at transformational levels. The following themes emerged from data regarding teachers' perceptions of support: shared vision, realistic and supportive climate, collaboration, encouragement, job-embedded professional learning, continuous improvement, equity, and safe, legal, and ethical use. The findings of this study serve as a foundation for understanding how school leaders can best support teachers as they attempt to integrate one-to-one technology into their lessons.

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CHAPTER 1

INTRODUCTION TO THE STUDY

The integration of technology into instruction has been an ongoing journey for more than a century. During the 20th century, innovation after innovation made its way into classrooms, including radio, film, television, and finally, personal computers. With each innovation came an expectation for a transformation of the educational system. By the 1980s, radio, film, and television were relegated to only supplemental use by educators, as the influx of these technologies failed to produce substantial changes in pedagogy or significant increases in student achievement. To the contrary, student achievement declined. In 1983, *A Nation at Risk*, an open letter to the American people, presented by the Secretary of Education, T. H. Bell, painted a bleak picture of the state of the United States (US) education system. Secretary Bell reported that American students had fallen behind students in other industrialized nations; millions were functionally illiterate; scores on standardized tests and college entrance exams were dramatically declining; and many high school students lacked the intellectual capacity to solve complex problems in mathematics, draw reasonable inferences, or write persuasive essays. Secretary Bell asserted that the decline of the American education system put the economy in jeopardy and was a matter of national security.

In addition to simply chronicling the problems with the American education system, *A Nation at Risk* (Gardner, 1983) included several recommendations as remedies. Ironically, despite the failures of radio, film, and television to increase student achievement, computers were a central part of the report's strategies for improvement. The report elevated the subject of computer science as a basic subject, along with reading, writing, mathematics, social studies, and science, and recommended that computers be used "in the study of the other basics" (p. 25).

These recommendations ushered in the modern era of ubiquitous classroom computing. By 2016, public schools in the US had invested $8 billion in computer software and hardware and provided at least one computer for every five students (Herold, 2016).

Although there is limited evidence that the addition of computers to the classroom improves learning outcomes, legislators continue to compel school systems to provide computer technology and integrate it into curricula (Herold, 2016). Provisions of the *No Child Left Behind Act of 2001* (NCLB, 2002), an updated version of the *Elementary and Secondary Education Act of 1965* (ESEA, 1965), mandated the acquisition and use of technology in classrooms, and required that teachers become trained in how to effectively incorporate this technology into the curricula. The *Every Child Succeeds Act of 2015* expanded upon this mandate to include digital assessments of student learning, training for teachers in implementing blended learning, and the expansion of digital learning to include student collaboration with experts and peers. Provisions of Public Law 115-141 Consolidated, enacted on March 23, 2018 as an amendment of ESEA, increased the emphasis on professional development for technology integration. Thus, it is evident that legislators have an expectation for technology to continue playing a critical role in US education.

One-to-one laptop computing programs are among the fastest-growing methods for infusing computer technology into teaching and learning (Lei & Zhao, 2008). These programs place laptop computers in the hands of all teachers and students and are built around the premise that robust access to devices, solid infrastructure, and technical support are required to effectively integrate technology into the classroom (Shapely et al., 2011). Although access to devices has become ubiquitous in most educational settings, effective use of these resources has not (Lawless, 2012). Additionally, evidence is mixed regarding the impact the provision of these devices made on teaching practices or learning outcomes, causing critics to question the potential of these programs to ultimately improve student achievement (Macado & Chang, 2015; Weston & Bain, 2010; Zheng et al., 2013).

Numerous researchers contributed the disappointing academic gains associated with one-to-one laptop initiatives to a lack of pedagogical change accompanying the provision of these devices (Cavanaugh et al., 2011; Livingstone, 2011; Sung et al., 2016; Weston & Bain, 2010; Zheng et al., 2013). McLeod (2015) observed that teachers in one-to-one learning environments clung to traditional practices found in analog classrooms, while Machado and Chung (2015) noted schools with one-to-one programs "do not show the kind of transformative technology integration where students use technology in meaningful ways" (p. 44). To understand the slow up-take and ineffective use of computer technology by teachers, researchers identified two major categories of barriers to effective technology integration: first- and second-order barriers (Ertmer, 1999, 2005; Ertmer et al., 2012). First-order barriers are described by Ertmer and colleagues as external, institutional barriers, such as insufficient internet connectivity or a lack of technical support. They described second-order barriers as being internal to the teacher, including attitudes, beliefs, knowledge, and skills. Second-order barriers, particularly teachers' beliefs about their abilities to use computers to improve student learning, have proven to be the most significant impediments to changes in teacher practice (Ertmer, 2005; Ertmer et al., 2012; Machado & Chung, 2015).

To better understand how the beliefs teachers hold inhibit changes in practice related to technology integration, researchers turned to the social cognitive theory and the construct of self-efficacy (Celik & Yesilyurt, 2013; Heath, 2017; Paraskeva et al., 2008; Topkaya, 2010; Wang et al., 2014). According to the seminal work of Bandura (1977), efficacy beliefs are perceptions of task-specific capabilities and are key mechanisms of behavioral change for individuals and organizations. “People plagued by self-doubts anticipate futility of efforts” and “produce little change even in environments that provide many potential opportunities” (Bandura, 1993, p. 125). Computer self-efficacy (CSE), a related construct developed by Compeau and Higgins (1995), “represents an individual’s perception of his or her ability to use computers to accomplish a task” (p. 191). Topkaya (2010) asserted that “if teachers are expected to be effective users of computer technologies, it is essential that they have positive attitudes and high self-efficacy in using them” (p. 143). Additionally, Topkaya posited that the “acceptance of computers and their use in teaching and learning is largely determined by beliefs, perceptions, and attitudes of teachers. Therefore, not only should these psychological constructs be investigated closely, but also ways to improve them should be sought” (p. 145).

Statement of the Problem

The problem of practice for this study was to identify supports that increase teachers’ CSE and promote transformational digital pedagogy in one-to-one learning environments. Although one-to-one programs are rapidly expanding in US schools, the literature about how to effectively leverage these programs to improve teaching and learning is relatively small (Hull & Duch, 2019). While numerous barriers to effective technology integration have been identified (Ertmer, 1999; Hew & Brush, 2007; Hull & Duch, 2019), the educational research community has been slow to respond to the needs of leaders struggling to support teachers attempting to alter their practice when faced with school-mandated technology initiatives (McLeod et al., 2015). Additionally, educational research related to leadership practices in one-to-one learning environments has not kept pace with the rapid growth of these initiatives (Machado & Chung, 2015; McLeod, 2015; McLeod & Richardson, 2013; Richardson et al., 2012).

If the true potential of one-to-one programs is to be realized, more investigation is needed to help teachers gain the skills and confidence required to use technology in innovative ways that promote collaboration, investigation, and creation (Marlatt, 2019). Unfortunately, educational researchers offer little guidance for school leaders attempting to navigate the institutional and cultural complexities associated with teachers' willingness and ability to incorporate technology into their instruction effectively (Puttick et al., 2015). The current study was designed in response to the lack of research connecting the supports provided by school leaders, the enhancement of teachers' CSE, and transformational digital pedagogy.

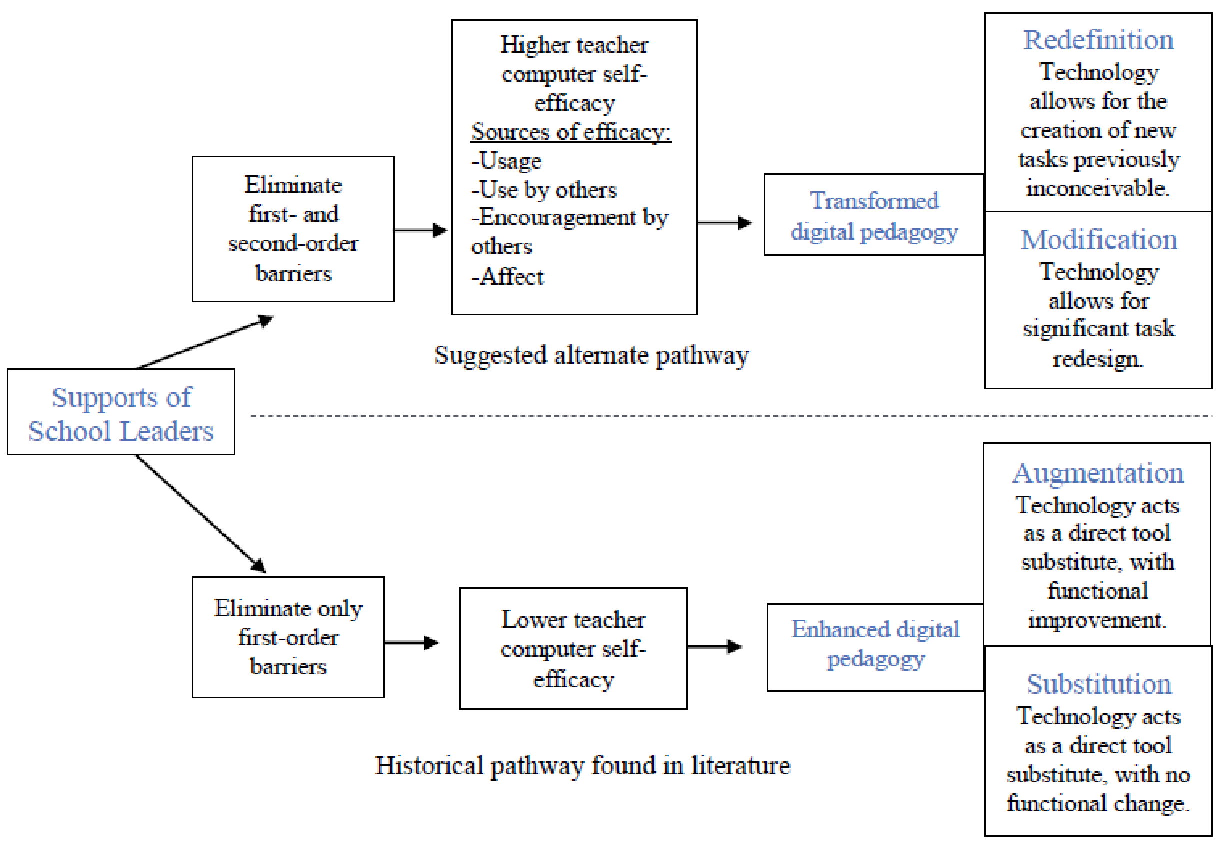
Conceptual Framework

According to Roberts and Hyatt (2019), a framework is how a study is viewed and includes the elements of a study that guided the researcher. They explained that a conceptual framework informs readers about how the main things the researcher studied are interrelated while a theoretical framework shows how assumptions and generalizations are related. This study was guided by both, using a conceptual approach to pull together two well-known theoretical frameworks. The conceptual framework for this study (Figure 1) illustrates two alternate pathways related to technology integration that result from supports provided by school leaders. The bottom pathway illustrates a common scenario described in the literature where school leaders eliminate first-order barriers to technology integration, only to realize modest enhancements to teachers' practice. The top pathway adds the elimination of second-order barriers by leaders because teachers' doubts about their ability to utilize computer technology to improve student learning have been identified as the most significant impediment to effective technology integration (Ertmer, 2005; Ertmer et al., 2012). The elimination of second-order barriers is depicted as leading to teachers' high CSE.

Compeau and Higgins' (1995) construct of CSE was built on the work of Bandura (1977, 1982, 1986). Accordingly, Celik and Yesilyurt (2013) found that CSE was an important predictor of teachers' use of effective computer supported pedagogies. Thus, high CSE is depicted in this conceptual framework as an antecedent to transformational levels of digital pedagogy. This conceptual framework incorporates research related to first- and second-order barriers to technology integration (Ertmer, 1999, 2005), the construct of CSE (Compeau & Higgins, 1995), and an adaptation of Puentedura's (2006) substitution, augmentation, modification, and redefinition (SAMR) model proposed as a theoretical framework for evaluating digital pedagogies.

Figure 1

School Leader Support and Digital Pedagogy Conceptual Framework



An adaptation of the substitution, augmentation, modification, and redefinition (SAMR) model (Puentedura, 2006) was incorporated into the conceptual framework for this study as a theoretical framework to distinguish between enhanced digital pedagogies (substitution and augmentation) and those that are transformational (modification and redefinition). Hockly (2013) asserted that the true potential of one-to-one programs to increase student achievement can only be realized when teachers incorporate technology at the transformational level of the SAMR model. Unfortunately, many schools appear to be fixated in the substitution stage of the SAMR model in which students primarily use technology for consumption rather than creation (Marlatt, 2019). The higher pathway illustrated in this conceptual framework presents a possible alternative to this current reality by proposing that leaders eliminate both first- and second-order barriers to technology integration to foster teachers' high CSE to facilitate transformational digital pedagogy, as described by the SAMR model.

Purpose of the Study

A paucity of literature exists regarding school leaders' supports that serve as antecedents to high levels of CSE in one-to-one learning environments (Hull & Duch, 2019). While much research exists regarding barriers to effective technology integration, few researchers examined the lived experiences of teachers who demonstrated strong CSE and acted toward successful implementation of technology initiatives (Heath, 2017). High CSE related to technology integration may serve as a pre-requisite condition to the emergence of transformational digital technologies, as high CSE can help teachers cross barrier thresholds (Heath, 2017). Therefore, the purpose of this study was to discover what supports school leaders provide to promote high levels of teacher CSE and transformational digital pedagogies in one-to-one learning environments.

Research Questions

To examine leadership supports that impact CSE, and the relationship between CSE and the emergence of transformational digital pedagogies, the following research questions guided this study:

1. What are the levels of teachers' perceived computer self-efficacy for technology integration in schools with mature one-to-one laptop programs?
2. To what extent does computer self-efficacy predict teachers' ability to incorporate transformational levels of digital pedagogy in one-to-one learning environments?
3. According to teachers' perceptions, what supports do leaders in schools with mature one-to-one programs employ to increase teachers' computer self-efficacy related to digital pedagogy?

Significance of the Study

One-to-one programs are one of the fastest growing and costliest initiatives in education, yet results are mixed concerning the impact of these programs on teaching and learning (Herold, 2016; Lei & Zhoa, 2008; Macado & Chang, 2015; Weston & Bain, 2010; Zheng et al., 2013). Schools that implement a one-to-one program incur tremendous financial costs simply to eliminate first-order barriers, such as the purchase of devices, adequate infrastructure for internet connectivity, and technicians for technical support (Herold, 2016; Hull & Duch, 2019). While researchers agree that the mere provision of technology will not guarantee changes in teacher practice (Sung et al., 2016; Wang et al., 2014), they provide little guidance as to how school leaders can address second-order barriers, such as low CSE, that persist even when first-order barriers are eliminated (Hull & Duch, 2019; McLeod, 2015). The purpose of this study was to identify supports school leaders provide to eliminate both first- and second-order barriers to the effective integration of laptop technology. In addition, the impact that elimination of these barriers has on teachers' CSE was examined. Additionally, the extent to which strong CSE can predict emergence of transformational digital technologies was investigated. The results of this study may provide insight for leaders attempting to overcome the computer efficacy barriers that currently inhibit the wide-spread adoption of transformational pedagogies in one-to-one learning environments. Once transformational digital pedagogies become common, the promise of one-to-one laptop computing may finally be realized.

Delimitations

Delimitations are variables intentionally included or excluded from a study and represent choices made by the researcher (Simon & Goes, 2013). The delimitations of the current study relate to the selection of participants, the timeframe for the collection of data, the choice of a conceptual framework, and restrictions to the scope of the study. Participants of the current study included English, social studies, and science teachers from one suburban district in Texas that was implementing a one-to-one program in its three high schools. School leaders were not included as participants. Insights regarding the leadership supports that foster CSE and transformational pedagogy were derived solely from the perspective of the teachers. Data were collected during the 2020-2021 school year. The CSE Scale for Technology Integration (Wang et al., 2014) was selected to measure teachers' CSE. Although there are other theoretical frameworks for evaluating instructional practices related to technology integration, this study was guided by an adaptation of the SAMR model because this model was most closely aligned with the purpose of the study. Attempts to correlate changes in digital pedagogy with student achievement were beyond the scope of the study.

Assumptions

The primary assumption for this study was that participants would openly and honestly share their experiences related to the district's one-to-one program. For the study findings to yield valuable insights, it was imperative that teachers provide detailed accounts of how they have (or have not) changed their pedagogy due to the provision of the devices, and how leaders have (or have not) helped them to realize effective change.

Operational Definitions

The terms listed below are used throughout the study. To provide clarity, the following definitions were developed.

- *Computer self-efficacy (CSE)*. CSE is defined as "a judgement of one's capacity to use a computer" (Compaeu & Higgins, 1995, p. 91). "A strong sense of computer self-efficacy can affect the extent as well as the way computer technology will be used in everyday instructional practices" (Paraskeva et al., 2008, p. 1085).
- *Digital pedagogy*. For this study, digital pedagogy refers to the "way computer technology will be used in everyday instructional practices" (Paraskeva et al., 2008, p. 1085).
- *Educational technology*. Educational technology refers to any innovation beyond the teacher's voice that makes education more efficient and stimulating (Cuban, 1986).
- *First-order barriers.* Such barriers are the institutional barriers to technology integration, including access to technology (infrastructure, internet access, devices, etc.) and technology training for acquisition of the technical skills needed to adjust current practice (Ertmer, 1999).
- *Mobile learning (mLearning).* Mobile learning refers to learning using mobile devices, including mobile phones, smart phones, laptop computers, and tablets. These devices have the unique ability to place learning in context, as they can be used in formal and informal learning environments, both inside and outside of the classroom, increasing the time and settings available for learning (Hockly, 2013).

- *One-to-one programs.* These are programs in which "all students in a class, grade, school, or district are provided computers for use throughout the school day, and in some cases, at home" (Zheng et al., 2013, p. 1053). In the current study, a one-to-one program referred to the provision of laptop computers, to both teachers and students, for both school and home use.
- *School leaders.* In the current study, school leaders included district or campus leaders in positions to support teachers integrating one-to-one technology into their classrooms, including, but not limited to, the superintendent, directors, coordinators, principals, assistant principals, instructional coaches, and teacher leaders.
- *Second-order barriers.* These are internal and cultural barriers, including the lack of knowledge and skills needed in technology-enabled classrooms, lack of vison for effective teaching and student learning using technology, and teachers' beliefs that they are unable to leverage technology to impact student learning. Once first-order barriers are eliminated, lingering second-order barriers typically result in teachers using technology primarily for administrative tasks and traditional uses, such as drill-and-practice and digital slide-show presentations (Ertmer, 1999, 2005; Ertmer et al., 2012; Heath, 2017).
- *Technology integration*. Technology integration refers to attempts by educators, both successful and unsuccessful, to incorporate educational technology into their instruction.

Organization of the Study

This dissertation includes five chapters. Chapter 1 provides the context of the study by providing background information, the problem statement, conceptual framework, research questions, significance of the study, delimitations, assumptions, and definitions related to technology integration, one-to-one programs, and leadership supports. Chapter 2 presents a review of literature related to the history of technology integration and one-to-one computing programs, benefits and challenges of these programs, and pedagogical and leadership concerns related to these initiatives, including first- and second-order barriers to technology integration and the construct of CSE. Chapter 3 details the methodology and research design for the current study, including data collection strategies, analysis methods, and limitations. Chapter 4 presents an analysis of the findings of the study. Chapter 5 concludes with a discussion of the results of the study, implications for practice, and recommendations for future research.

Summary

The purpose of the current study was to determine teachers' perceptions of how school leaders eliminate first- and second-order barriers to effective technology integration to strengthen teachers' CSE and facilitate transformational levels of digital pedagogy in one-to-one learning environments. Existing research related to one-to-one programs focused primarily on student achievement and provides only tertiary and vague descriptions of transformational levels of digital pedagogy or accounts of how to lead changes in teacher practice in one-to-one learning environments. This chapter includes an introduction to the current study, aimed at understanding the relationship between these two understudied areas. Chapter 2 provides an analysis of the published literature that relates to the purpose of the study.

CHAPTER 2

REVIEW OF THE LITERATURE

According to Lei and Zhao (2008), "One-to-one computing is one of the fastest growing yet controversial phenomena in American classrooms" (p. 98). After three decades of these programs, changes in teacher pedagogy because of provision of these devices is still not well understood (Diemer et al., 2013). Even when technical barriers to effective technology integration are eliminated (e.g., lack of access to devices and internet connectivity), teachers continue to cling to the same instructional practices used in traditional, analog classrooms (McLeod et al., 2015). For teachers to develop the skills and confidence needed to effectively integrate one-to-one technology into their classrooms, leaders must create the supportive conditions that facilitate changes in teacher practice. Using an adaptation of the substitution, augmentation, modification, and redefinition (SAMR) model (Puentedura, 2006) as a framework for evaluating the level of digital pedagogy in one-to-one classrooms, the purpose of this study was to identify transformational levels of technology integration and determine which supports foster these high levels of teacher practice. Specifically, the purpose was to determine how school leaders eliminate first- and second-order barriers to effective technology integration to strengthen teachers' CSE and facilitate transformational levels of digital pedagogy. Results of the current research may help leaders develop a clear vision for technology integration and an understanding of how to best support teachers struggling to adapt their practice in one-to-one learning environments.

This review of literature begins with a brief history of the past 100 years of integration of technology into classrooms, including radio, film, television, and mobile learning devices, including one-to-one laptop computers. Large-scale one-to-one laptop initiatives, including the

Apple Classrooms of Tomorrow (ACOT), Maine Learning Technology Initiative (MLTI), Texas Technology Immersion Pilot (TIP), and the Florida Leveraging Laptops program are discussed, with an overview of each program and summaries of their outcomes. This section is followed by a detailed description of the conceptual framework for the current study, including a discussion of school leadership as it relates to technology integration, first- and second-order barriers to technology integration, the constructs of computer self-efficacy (CSE) and its sources, and the SAMR model as a framework for evaluating digital pedagogy. Following the description of the conceptual framework is a section describing the reported benefits of mobile learning devices, common criticisms of one-to-one laptop programs, a synthesis of research regarding teacher pedagogy related to technology integration, and a discussion of school leadership as related to technology integration. The review of literature ends with a summary of these topics.

A Historical Perspective of Technology Integration

The first seven decades of the 20th century brought several waves of technology into the classroom, including radio, film, and television. While advocates of these mediums expected them to transform education, each, in its turn, failed to have the desired positive impact on pedagogy and student achievement. Beginning in the 1980s, a new technology, personal computers, emerged. Unlike radio, film, and television, computers became ubiquitous in American classrooms. This trend continues as one-to-one computing programs become more prevalent. This section of the literature review examines the history of technology integration prior to personal computers and the past three decades of one-to-one laptop programs, including a summary of four early, large-scale one-to-one programs.

A Century of Technology Changes in Education

Reform of public education is a constant, and for the past 100 years, technology has been a part of that reform. In his book, *Teachers and Machines: The Classroom Use of Technology Since 1920*, Cuban (1986) chronicled the ever-changing landscape of educational technology. Cuban described educational technology as any innovation beyond the teacher's voice that made education more efficient and stimulating. Cuban (1986, 2001) reported little optimism for computer technology to have a transformative impact on teacher practices, as he detailed the hope and failure of each successive innovation. Radio was one of the first major innovations described by Cuban (1986), who claimed that educational reformers envisioned radio as a means of bringing the best teachers to the entire world. By the 1940s, radio had fallen out of favor with educators, due to a myriad of problems, including lack of equipment, poor reception, a lack of curriculum, and scheduling issues.

The next innovation Cuban (1986) denounced was film. In the early 20th century, this notion had momentum. The first school that used films for educational purposes was the Rochester Public Schools in New York, in 1910. In 1914, Thomas Edison maintained a library of educational motion pictures he made available for rent. The first educational film catalog was published in 1919 by George Kleine (Seattler, 2004). According to Seattler, Edison penned a letter to Klein in 1909 predicting that the motion picture would make books obsolete in schools. Cuban reported that the revolution in education, expected to be brought about by the innovation of film, ultimately failed to materialize. By mid-century, film was only used as a supplemental tool, with traditional teaching remaining the staple of public education. The factors that led to the marginalization of film were similar to those that determined the fate of radio, including cost, limited access to films related to curriculum, and unreliable, difficult to use projectors.

By the middle of the 20th century, yet another technological innovation made its way to the forefront of education, that of television. Cuban (1986) described the expectations of television's advocates for it to transform the educational system. Television was expected to be a panacea for a myriad of educational problems, including a teacher shortage. In the late 1960s and early 1970s, heavy investments were made in the development of educational television by the federal government and private investors, such as Henry Ford (Cuban, 1986; Saettler, 2004). Saettler reported that well-designed television programs can teach, however early educational programming was not as accepted by the public as commercial television. Ultimately, the process of teaching and learning was little changed by television. Cuban reported that, by the end of the 1970s, television was relegated to only supplemental use in classrooms, with teachers, once again, taking center stage as the drivers of instruction.

Three Decades of One-to-One Computing

With decades of failures to transform education through technology during the 20th century, it is little wonder that skepticism abounds about the ability of any educational technology to transform education, including one-to-one laptop computing (Cuban, 2001; Weston & Bain, 2010; Zheng et al., 2013). Despite the apprehension of some educators to see one-to-one laptop computing programs as a catalyst for change, optimism for the final innovation of the 20th century, personal computers, lingers into the 21st century, with two caveats. First, the affordance of these devices must be accompanied by changes in instruction (Cavanaugh et al., 2011; Geer et al., 2017; Heath, 2017; Lawless, 2016; Livingstone, 2012; Puttick et al., 2015; Shapely et al., 2011; Sung et al., 2016). Second, before teachers can change their instructional practices, school leaders must do a better job of supporting teachers who are attempting to effectively integrate technology into their lessons (Machado & Chung, 2015; McLeod, 2015; McLeod et al., 2015; McLeod & Richardson, 2013; Richardson et al., 2012). Although gaps exist in the research regarding how to lead change that results in transformational-level technology integration, the results of studies of early one-to-one programs revealed evidence of modest progress regarding changes in teacher instruction and increased student achievement.

Apple Classrooms of Tomorrow (ACOT). The first one-to-one computing initiative began in 1985 as a joint effort between selected public schools in California, universities, research agencies, and Apple Computers, Inc. (Baker et al., 1990). The initiative was grounded in a student-centered, constructivist ideology in which students would use laptop computers as tools for collaboration, creating media-rich products, and using simulations and models to drive their own learning. Baker et al. reported promising results about the first two years of the program, including improved student essays and increased higher level thinking. Student achievement on standardized tests did not improve, but previous levels of achievement on these measures were maintained. Teachers reported their experiences in the program as rewarding but did admit the growth was stressful.

Maine Learning Technology Initiative (MLTI). Launched in 2001, the MLTI was the first state-wide one-to-one computing initiative in the United States (Weston & Bain, 2010). At a cost of $120 million, the initiative provided all 7^{th} and 8^{th} grade teachers and students with Apple iBook computers (Apple Inc., Cupertino, CA) for school and home use, school-wide wireless networks, technical assistance, educational software, and on-going professional development (Berry & Wintle, 2009; Russell et al., 2004). During the seventh year of the initiative, Berry and Wintle (2009) compared students in technology-rich science classrooms with students in classrooms in which educators had clung to more traditional methodologies. The researchers reported optimistic results, including higher levels of student engagement and increased comprehension and retention of content. Despite these findings, critics of one-to-one computing initiatives posited that the MLTI failed to meet its intended goal of increased student achievement (Weston et al., 2010).

Texas Technology Immersion Pilot (TIP). Created by the Texas Legislature in 2006, the TIP program aimed to correct the state's incoherent approach to instructional technology integration (Texas Center for Educational Research, 2008). The program, funded through a competitive grant process, targeted high-need middle schools, providing 7^{th} and 8^{th} grade teachers and students with laptop computers for school and home use (Shapely et al., 2011). Initial studies of the pilot program boasted a number of positive outcomes, including increased technology proficiency, especially for disadvantaged students; increased student engagement; increased learner-centered practices, such as small group work; a progression toward more intellectually demanding and relevant assignments; decreased discipline referrals; and statistically significant improvements of student scores on the state's standardized achievement test in mathematics, especially for students who were economically disadvantaged. No conclusive improvements on the state's standardized tests were noted in reading, writing, social studies, or science (Shapely et al., 2011; Texas Center for Educational Research, 2008). Despite the positive strides made toward improving both teaching and learning made by the TIP program, because the improvements in student achievement were not universal in all subject areas, critics uphold the TIP program as an example of computer technology's inability to increase student achievement (Weston & Bain, 2010).

Florida's Leveraging Laptops program. Cavanaugh et al. (2011) reported findings for Florida's Leveraging Laptops program, similar to the findings of the study of the TIP program. The Leveraging Laptops program partnered with 11 school districts, 440 teachers, and 47 K-12 schools in Florida. Multiple universities were recruited to study outcomes of the program. Schools were afforded autonomy in how the program was implemented, as one of the program goals was to find an effective model of implementation. Some schools chose to implement one-to-one technology only during the school day, while others allowed students and teachers 24-hour access to devices. Professional learning opportunities varied as well, including summer in-service, online learning, learning communities, coaching, modeling, external trainers, and off-site experiences. Cavanaugh et al. reported a significant positive impact of the program on teaching practices, including decreased direct instruction, increased student-centered learning, and more meaningful uses of technology for project-based learning. As with the TIP program, student engagement and pockets of student achievement increased while discipline issues decreased. However, like both the MLTI and TIP programs, the Leveraging Laptops initiative failed to produce significant, wide-spread gains in student achievement on the state's standardized tests.

Conceptual Framework

The intended goal of the proposed study was to suggest a pathway by which leaders can facilitate transformational instructional practices within their one-to-one programs. Leaders charged with the implementation of one-to-one programs must intentionally eliminate first- and second-order barriers to technology integration and create conditions that foster teacher computer-efficacy before transformational digital pedagogies will emerge. To this end, the conceptual framework depicted in Figure 1 combines the constructs of first- and second-order barriers described by Ertmer (1999, 2005), with the construct of CSE developed by Compeau and Higgins (1995). Also included in the conceptual framework is an adaptation of the SAMR model developed by Puentedura (2006), as the theoretical framework by which to evaluate digital pedagogy.

Leading and Supporting Technology Integration

The International Society for Technology Education (ISTE) (2009) outlined five standards to serve as guidelines for school administrators, regarding technology integration. These standards include: (1) visionary leadership, (2) digital age learning culture, (3) excellence in professional practice, (4) systematic improvement, and (5) digital citizenship. As visionary leaders, the ISTE encouraged administrators to "inspire and facilitate among all stakeholders a shared vision of purposeful change that maximizes the use of digital resources to meet and exceed learning goals, support effective instructional practice, and maximize performance of district and school leaders…" (p. 1). The second ISTE standard requires that administrators "create, promote, and sustain a dynamic, digital learning age culture that provides rigorous, relevant, and engaging education for all students" (p. 1). The third standard obliges educational administrators to "promote an environment of professional learning and innovation that empowers educators to enhance student learning through the infusion of contemporary technologies and digital resources" (p. 1). The fourth standard compels administrators to systematically "lead purposeful change to maximize the achievement of learning goals through appropriate use of technology and media-rich resources…" (p. 2). Finally, the ISTE standards called on administrators to ensure digital citizenship by providing "equitable access to appropriate digital tools and resources to meet the needs of all learners" and to "promote, model and establish policies for safe, legal, and ethical use of digital information and technology…" (p. 2).

The lofty goals set by the ISTE were designed to provide guidance for leaders supporting technology integration, but read more like a to-do list than a how-to list. McLeod et al. (2015) urged leaders to embrace the ISTE Standards for Administrators (2009) as guiding principles for technology leadership but admitted that the educational research "lacks concrete examples of how activities occur in the field of technology leadership" (p. 106). In a review of literature related to technology leadership, Richardson et al. (2012) found a paucity of articles about the ISTE standards and called for further research around all five standards. McCleod et al. (2015) added that more research is needed regarding the critical leadership behaviors required to facilitate successful technology initiatives and went on to criticize university educational leaders for offering too many courses that focus on technological tools, and too few courses about leadership issues related to technology integration. The authors stated, “If we want more powerful models of technology-infused learning to emerge in our schools, leaders need assistance with how to create and enable those kinds of learning environments, not just how to use a few technology tools” (p. 119). These authors’ call for more research was punctuated with a bleak assessment of the current reality of technology integration, as they noted that the students, teachers, and administrators in technology-enabled schools engaged in virtually the same activities as students, teachers, and administrators in analog environments, but with more expensive tools. This 2015 assessment of classroom computing echoed the predictions of Cuban (1986) that every student would eventually have a computer, but there would be no fundamental changes in teaching practices.

In a seminal work, Ertmer (1999) identified two major categories of barriers to effective technology integration. First-order barriers are external, or institutional, barriers related to the provision of devices, connectivity, and support, while second-order barriers are barriers internal to teachers, including teachers’ attitudes and beliefs (Ertmer, 1999; Ertmer, 2005; Ertmer et al., 2012). In 1986, Cuban warned that computers were no different than any other instructional innovation, and that teachers’ beliefs would ultimately determine how they were adopted and implemented. Fullan (2007), a renowned researcher known for his expertise related to education reform, also recognized that teachers’ beliefs are formidable gatekeepers to educational change, and contribute to the high failure rate of reform initiatives. Fullan asserted that all effective reform initiatives require an understanding of teachers' experiences and skill in building their capacity for change.

Like Cuban, Fullan (2016) discouraged educational leaders from using technology as a driver for system-wide gains in student achievement. Instead, Fullan encouraged leaders to embrace pedagogy as a vehicle for improvement. Technology integration researchers recognized that the provision of technology alone cannot improve teaching or learning and urged leaders to shift their focus from the provision of devices to promoting effective digital pedagogy (Ertmer & Ottenbreit-Leftwich; Ertmer et al., 2012; Heath, 2019; Hew & Brush, 2007).

First-order Barriers to Technology Integration

Researchers described first-order barriers to technology integration as extrinsic obstacles, generally described in terms of the inadequate provision of resources, including equipment, time, training, and administrative support (Ertmer, 1999, 2005; Ertmer et al., 2012; Ertmer & Ottenbreit-Leftwich, 2013). Early integration efforts focused on the elimination of first-order barriers related to the provision of equipment and infrastructure, based on the assumption that the provision of resources would naturally be followed by integration (Ertmer, 1999). As stated previously, researchers came to understand that the mere provision of devices did not typically translate into uptake or effective implementation. However, authors recognized that the elimination of first-order barriers was one of the important pre-requisite contextual factors to teachers' adoption of student-centered, technology-enabled instruction, as teachers must perceive that external factors will not impede their efforts before they are willing to change their practice (Ertmer & Ottenbreit-Leftwich, 2013). Hew and Brush (2007) reported that a lack of resources (e.g., access to devices, time, and technical support) was the most common technology integration barrier found in the literature. However, other researchers reported that much progress has been made toward addressing first-order barriers related to access (e.g., access to devices, the internet, and professional develop opportunities) (Ertmer & Ottenbreit-Leftwich, 2013).

While access to devices is reported as the most common first-order barrier, a lack of vision for technology integration and the adversarial attitudes of school leaders can also pose a significant external obstacle to meaningful technology integration. Teachers report having to work around administrators, rather than working with them, as an important factor in their willingness to change their practice (Ertmer & Ottenbreit-Leftwich, 2013).

Second-Order Barriers to Technology Integration

Ertmer (1999) described second-order barriers to technology integration as being intrinsic, or personal, to teachers and are important impediments to fundamental change. These barriers were described as being less tangible and include beliefs about teaching, computers, established classroom practices, and an unwillingness to change. Pedagogical beliefs were found to be the most significant barriers to high-level technology use, even when teachers had ready access to technology (Ertmer, 2005).

Fear and anxiety related to technology were also found to be important second-order barriers to effective technology integration. Ertmer (1999) listed several fears of teachers related to technology integration, including fears about what to if technology fails, not understanding software, and not being able to meet curricular demands. Donavan et al. (2007) reported that teachers attempting to integrate one-to-one technology into their classroom expressed discomfort in using laptops for instructional purposes and harbored anxiety about classroom management in one-to-one environments. The authors reported that teachers with fears related to their technological proficiency rarely used laptops during initial stages of one-to-one programs, and when they did use them, they did not use them in innovative ways, but instead they only used devices for low-level activities such as word processing and teacher-centered presentations.

Computer-Efficacy and Its Sources

CSE is a construct grounded in social cognitive theory and is largely based on Bandura's (1977) construct of self-efficacy. Compeau and Higgins (1995) stated that CSE "represents an individual's perception of his or her ability to use computers to accomplish a task" (p. 191). Topkaya (2010) noted that the construct of CSE has been applied to numerous contexts, including business and education. Educational researchers have studied the CSE of students, pre-service teachers, and practicing teachers (Abdullah & Mustafa, 2019; Celik & Yesilyurt, 2013; Paraskeva et al., 2008; Topkaya, 2010; Wang et al., 2014). CSE proved to be a useful framework for understanding the uptake and use of computers for instruction, as the acceptance and application of computers is "largely determined by beliefs, perceptions, and attitudes of teachers" (Topkaya, 2010, p. 145). Researchers found that teachers' perception of their CSE affected the extent to which they used technology, and the way teachers incorporated computers in their instructional practices (Celik & Yesilyurt, 2013; Paraskeva, 2008; Wang et al., 2014). Paraskeva (2008) asserted that a positive attitude toward computers and strong teacher CSE are basic pre-conditions for meaningful computer-aided education.

Using empirical evidence from social cognitive theory and information systems literature, Compeau and Higgins' (1995) devised a model illustrating four constructs that positively impact CSE: usage, other's use, encouragement, and affect. Each of these constructs are analogous to one of the four major sources of efficacy information proposed by Bandura (1986) (as cited by Compeau & Higgins, 1995). Compeau and Higgins included a fifth construct in their original model, that of support, but the findings of their study revealed that support negatively impacted CSE, thus was not included in the revised model. The authors explained this surprising finding, suggesting that "if individuals can always call on someone to help them when they encounter difficulties, they may never be forced to sort things out for themselves" (p. 203-204). Each construct is next described.

Usage

Compeau and Higgins (1995) based this construct on Bandura's (1986) construct of guided mastery, in which experiences of success were found to be the strongest source of efficacy information. The author's construct of usage established the idea that successful experiences with computers are needed to develop strong computer efficacy. This construct has implications with respect to training, as Compeau and Higgins (1995) recommended hands-on experiences in which people can build confidence along with skill.

Use by Others

Compeau and Higgins (1995) reported a positive relationship between the use of computers by members of an individual's reference group and an individual's CSE. The authors noted that, "The actual behavior of others with respect to technology is a source of information used in forming self-efficacy" (p. 195). The construct of other's use is similar to Bandura's (1977) construct of vicarious experiences, including behavior modeling, in which the observations of others' experiences are used as a source of efficacy information. Compeau and Higgins (1995) advocated for the use of behavior modeling in training to enhance CSE. Wang et al. (2014) observed that the vicarious learning experiences of student teachers had a positive impact on their self-efficacy related to using computers in their teaching. Ertmer and Ottenbreit-Leftwich (2013) suggested that school leaders provide opportunities for teachers to observe each other incorporating computers into their instruction to enhance teacher efficacy related to technology integration.

Encouragement by Others

Compeau and Higgins (1995) found that encouragement from those people to whom an individual looks to for guidance positively influenced CSE, especially if those people were perceived as credible. Encouragement by others is analogous to Bandura's (1977) construct of verbal persuasion in which "people are led, through suggestion, into believing they can cope successfully with what has overwhelmed them in the past" (p. 198). Researchers suggest that specific feedback from supervisors, or a pep talk from supervisors or colleagues, may be useful in countering self-doubt that may arise during occasional setbacks (Tschannen-Moran, 1997). Ertmer (1999) noted that, through ongoing conversations with colleagues during common planning periods, teachers gained access to supportive networks that encouraged them to achieve meaningful technology use.

Affect

In Compeau and Higgins (1995) model, affect associated with strong computer efficacy is analogous to interest in or "liking" computer use and serves as an "important precursor to usage behavior" (p. 196). The authors reported that individuals with higher CSE experienced lower computer anxiety. Donovan et al. (2007) observed that teachers pursuing master's degrees in educational technology were much more comfortable with laptop integration than their peers.

The SAMR Model

The conceptual framework designed for this study includes an adaptation of the substitution, augmentation, modification, and redefinition (SAMR) theoretical framework developed by Puentedura (2006). In 2006, while working with the Maine Technology Initiative, Puentedura developed the model as a tool for evaluating the quality of instruction of educators who were provided one-to-one laptop technology (Romrell et al., 2014). Puentedura's (2006) SAMR model consists of two primary levels, enhancement and transformation. The enhancement level consists of the sublevels of substitution and augmentation. The transformation level consists of the sublevels of modification and redefinition. Hockly (2013) contended that the modification and redefinition levels must be attained to realize the true potential of instructional technology. In the current study, an adaptation of the SAMR model was used as a framework for the identification of transformational instructional practices of teachers in suburban Texas high schools, teachers who are integrating one-to-one laptop computers into their teaching. Because of the complexity of the SAMR model, some researchers utilized only the two major levels of the SAMR model, enhancement and transformation (Geer et al., 2017). The enhancement level consists of the substitution and augmentation sublevels, while the transformation level consists of the modification and redefinition sublevels. To provide clarity about the sublevels, detailed descriptions and examples for each are provided.

Substitution

Visualizing the SAMR model as a ladder, the substitution level comprises its lowest rung. Integrating technology at the substitution level is considered a pedagogical enhancement in which new technologies are used as direct substitutions of older technologies, without functional changes (Puentedura, 2006). Examples of substitution level enhancements include using word processing functions in a laptop in lieu of a typewriter, accessing an online textbook with interactive annotation features for highlighting and note-taking (Puentedura, 2013, 2014b), providing worksheets online rather than printed copies, and referring students to online databases rather than providing hardcopies of documents (Jude et al., 2014).

Augmentation

The next rung up the ladder on the SAMR model is the augmentation level (Puentedura, 2006). At this level, technology is a direct tool substitution, but with functional improvements. Puentedura (2013) classified the cut-and-paste and spell-checking tools of word processing software as augmentation level enhancements, as well as tools to enhance visualization, such as interactive timelines. Romrell and colleagues (2014) depicted an augmentation level activity in which students on a field trip used an online tool to identify fish that placed the fish in their natural habitats, rather than using a printed field guide. Puentedura (2014b) described an augmentation level activity in which students used an online birding guide that not only gave descriptions and visuals of birds, but also provided a journaling tool for students to record the types of birds viewed; the number of birds observed; and the date, location, and weather conditions. As an example of an augmentation level application in mathematics, Puentedura (2013) suggested adaptive computerized drills of real-world scenarios.

Modification

The third rung on the SAMR model is modification. At this level and above, instructional practices are considered transformational. Puentedura (2006) described activities at this level as those in which tasks have been significantly redesigned due to the affordance of the new tool. Examples of instructional technology used at the modification level include video conferencing and online discussions (Jude et al., 2014). Puentedura (2013) classified student presentation projects with narration at the modification level. Utilization of text-to-speech applications was also categorized as a modification level activity (Puentedura, 2014a). Puentedura (2014b) provided an example of a modification level lesson, in which data analysis software was used to collect, organize, and graph data collected from bird watching excursions.

Redefinition

The top level of the SAMR model is redefinition. Puentedura (2006) described this level as one in which the technology affords the creation of tasks that were once inconceivable. Puentedura (2013) classified multi-media student products shared with authentic audiences to be examples at the redefinition level. As an example of a student product at the redefinition level, Puentedura (2014b) described a multimedia video presentation of a student's bird watching data. The presentation included photographs of birds, charts and graphs of collected data, embedded links to the student's data collection tool, recorded sounds of bird calls, and recorded student narration of the student's bird watching experiences.

Studies with SAMR as a Theoretical Framework

Of the studies included in this review of literature, three of the researchers examined instructional practices using the SAMR model as a framework for evaluating changes in instructional practice due to technology integration. No study was conducted to examine grades 9-12 where school-provided, one-to-one laptops were used. One large-scale study of technology integration at a university in Uganda included the SAMR model to examine how technologies were (or were not) transforming instructional practices (Jude et al., 2014). The researchers of the Jude study included all forms of information and communications technologies (ICT), including mobile phones, radio, video, computer labs, and lap-tops. The findings of the mixed-methods study that included four colleges in one university provided insights for evaluating instructional practices through the lens of the SAMR model. Jude and colleagues distributed 600 questionnaires, 150 to each college, with a response rate of 35%. The qualitative phase of the study included focus group discussions, interviews, observations, a project blog, and document analysis. The results of the Ugandan study showed impediments to transformation caused by technical challenges, such as lack of access to devices and slow internet connectivity. The Ugandan study differed from the current research, as the study was conducted in a setting of higher education, devices were not all laptops, and the devices were not necessarily provided by the university.

Romrell et al. (2014) examined ten studies of educators implementing mobile learning (mLearning) devices into their lessons and found that only lessons at the transformation level of the SAMR model capitalized on the unique characteristics of the mobile devices. Romrell et al. stated, "If learning activities involving a mobile device are purposely designed to be personalized, situated, and connected, the resulting mLearning activities have the potential to redefine and transform learning" (p. 9). The first transformative characteristic of mobile devices described by Romrell and colleagues was personalization. These researchers claimed that mobile devices, particularly those owned by students, reflected student preferences and choices, including the types of devices, software, colors, and fonts. They asserted that the personalization of devices led to a familiarity that facilitated more robust utilization. Next, they described mLearning devices as being situated, referring to their portability, which allows them to be taken out of the classroom. The situated characteristic of mobile devices allowed students to learn in real-world contexts. The third transformative characteristic Romrell and colleagues credited to mLearning devices was connectivity, asserting that access to the internet provided instant access to both information and people. This anytime, anywhere access to information and people allowed learning in real-world contexts and created communities of learners.

Finally, Romrell et al. (2014) discussed the need for instructional designers to have a framework to use when attempting to incorporate mLearning devices into their lessons. They suggested the SAMR model because it afforded educators criteria for examining instructional practices to determine if their practices are merely enhancements of traditional, analog practices, or are truly transformative. Laptop computers are one type of mLearning device, thus an adaptation of the SAMR model was an appropriate framework for evaluating instructional practice in the current study.

An Australian study of four schools with grades K-9, implementing a one-to-one iPad® mobile digital device initiative, most closely approximated the objectives of the current study as it focused exclusively on changes in pedagogy using the SAMR model as a framework (Geer et al., 2017). Geer et al. noted the emergence of transformational practices when iPad devices were integrated into the learning environment. Teachers in the study developed lessons that were both authentic and media rich, using applications such as iMovie® and Garage Band® (Apple Inc., Cupertino, CA). Regarding leadership, Geer and colleagues asserted that it was beneficial for administrators to provide teachers time to familiarize themselves and experiment with the iPad devices, in addition to providing formal professional development.

Geer et al. (2017) noted difficulty in categorizing the observed instructional practices into the four levels of the SAMR model (substitution, augmentation, modification, and redefinition). These researchers chose instead to focus on the two primary tiers: enhancement and transformation. In the end, Geer and colleagues concluded that best practices in the field of educational technology have yet to emerge and that further research is needed.

Historical and Predicted Impact of One-to-One Programs

Included in this section are the findings of studies related to the impact of one-to-one programs on teaching and learning during the past three decades. Also included is a discussion of researchers' predictions of changes to the educational system based on the capabilities of one-to-one technology. Finally, a case is made for the need of additional research to clarify what constitutes a best practice when integrating laptops into teaching, and how leaders can support teachers in changing their pedagogy.

Historical Impact on Teaching and Learning

While critics of one-to-one laptop programs, like Cuban (2001) and Weston and Bain (2010), casted doubt on the ability of one-to-one programs to transform teaching and learning, other researchers espoused the benefits of these programs (Cavanaugh et al., 2011; Harris et al., 2013; Keppler et al, 2014; Livingstone, 2010; Penuel, 2006; Shapely et al., 2011; Sung et al., 2016; Zheng et al., 2013). This section examines the benefits to students and teachers as reported in studies of one-to-one mLearning initiatives, including one-to-one laptop programs.

Impact on Teaching

Harris et al. (2016) asserted that teachers using one-to-one laptop computing were at a distinct advantage compared to teachers that were not provided this technology. A study of the first state-wide one-to-one initiative in the US, the MLTI, provided evidence that one-to-one computing allowed teachers to provide work that was more engaging and challenging for students (Berry et al., 2009). Results of a comparison study of the Texas TIP also reported that teachers who provided students with laptops resulted in students engaging in more complex problems and the use of laptops allowed those students to brainstorm solutions to problems in small groups. This was not observed in classrooms that were not afforded laptops (Shapely et al., 2011). Because of the observed differences in one-to-one learning environments and traditional classrooms, especially the reorganization toward small group instruction, Shapely and colleagues concluded that the affordance of technology may be a prerequisite to pedagogical change.

Keppler et al. (2014) also noted a progression away from direct instruction toward more small-group instruction in one-to-one laptop classrooms. Keppler and colleagues, as well as Shapely et al. (2011), reported that the use of one-to-one computers allowed teachers to increase formative assessments of student work, helping to diagnose and respond to student needs, including the need for enrichment. Additional benefits of one-to-one computing, related to teaching, included an increased ability for teachers to design authentic learning experiences (Geer et al., 2017) that dive deeper into topics and instantly disseminate content knowledge (Keppler et al., 2014).

Impact on Learning

Livingstone (2010) outlined the unique characteristics of laptops that positioned them to have a more significant impact on student achievement than previous educational technologies. First, Livingstone asserted that laptop computers combined the educational technologies of the past, including books, television, photography, data bases, and writing tools. Second, the mobile nature of these devices increased students' capacity to learn in a variety of settings, including home, school, work, and the community. Comparatively, research conducted by Zheng et al. (2013) revealed positive effects of one-to-one laptop computer programs on student achievement in English, writing, and mathematics, especially for at-risk students and English language learners. In addition, a meta-analysis conducted by Sung et al. (2016) revealed increased achievement on standardized tests and improved grade point averages, as compared to students without laptops. A meta-analysis by Penuel (2006) discovered the positive effects of mobile learning on both literacy and writing skills. Other researchers reported that the revising and editing capabilities of laptops, opportunities for feedback, and ability to publish to authentic audiences, had positive effects on student writing (Cavanaugh et al., 2011; Keppler et al., 2014; Shapely et al., 2011; Zheng et al., 2013). In a comparative study of iPads used in 4th and 5th grade classrooms, students using iPads were reported to be more collaborative, communicative, and self-reliant (Geer et al., 2017). Russell et al. (2004) reported that students who were allowed to use school laptops at home increased the time they spent at home on academic endeavors. Results of numerous studies revealed increased student engagement in one-to-one learning environments (Baker et al., 1990; Cavanaugh et al., 2011; Keppler et al., 2014; Shapely et al., 2011; Sung et al., 2016). Researchers also noted increased technological proficiency as a benefit for students, especially for economically disadvantaged students (Shapely et al., 2011; Zheng et al., 2013).

Future Impact of One-to-One Computing

In addition to the benefits of one-to-one computing described above, other researchers predicted an increased trend toward a flexible schooling model of blended learning models for K-12 schools. Blended learning typically consists of both online instruction and traditional face-to-face instruction, small-group instruction, or tutoring (Christensen et al., 2013). Christensen et al. predicted that,

> The fundamental role of brick-and-mortar schools will pivot. Schools will focus more, for example, on providing well-kept facilities that students will want to attend with great face-to-face support, high-quality meals, and a range of athletic, musical, and artistic programs and will leverage the internet for instruction. (p. 4)

The authors went on to assert, "We predict that hybrid schools, which combine existing schools with new classroom models, will be the dominant model of schooling in the United States in the future" (p. 4).

Learning management systems (LMSs), such as Blackboard™ (Blackboard Inc., Reston, VA) and Canvas™ (Instructure, Thoma Bravo, LLC, Salt Lake City, UT), are contributing to the trend toward blended learning. These systems provide platforms for organizing digital learning resources (Schaffhauser, 2015). Schaffhauser asserted that LMSs have been used widely in higher education for years, and are expanding into K-12 classrooms with the uptick in student computing. The author listed several features of these programs that make them capable of transforming traditional classrooms, including structured organization of digital learning resources, enhanced sharing of resources, intuitive interfaces similar to social media, collaboration platforms for discussion, and responsive analytic capabilities that can help drive instruction. As capabilities of LMS and other programs improve, transformational instructional models such as blended learning may become common, increasing flexibility in both teaching and learning.

Critics and Criticism of Studies

Despite the many benefits to teaching and learning reported by researchers, the positive impact of these programs on student achievement has not reached expected levels (Cuban, 2001; Weston & Bain, 2010). Weston and Bain posited that one-to-one laptop computing will have no more of an effect on education than technological innovations of the past; for example, they claimed blackboards were replaced by white boards, which eventually gave way to smart boards, while the process of instruction remained substantially unchanged. Weston and Bain contended one-to-one laptop programs are merely expensive and labor-intensive innovations in a long history of the failure of technology to transform education, and that the provision of these devices does nothing to address the activities involved with teaching and learning. As evidence for their position, Weston and Bain called attention to the failure of the Texas TIP program to meet the expectations of its advocates, in that it produced only marginal increases in student achievement on the state's standardized tests. Zheng et al. (2013) concluded that there was little evidence that one-to-one laptop computing programs had narrowed the achievement gaps between advantaged and disadvantaged students.

Other researchers criticized the current body of research. Penuel (2006) called attention to the lack of large-scale experimental studies that included well-matched comparison groups. Sung et al. (2015) noted that many studies were conducted in the initial phases of one-to-one initiatives rather than in later stages of mature programs. Studies in this review of literature were found to be in the initial implementation stages of programs with novice users being the subjects (Chen et al., 2009; Geer et al., 2017; Russell et al., 2004). Both the Florida and Texas studies were conducted in the early stages of the implementation process with the Florida study being a one-year study and the Texas study conducted over two years (Cavanaugh et al., 2011; Shapely et al., 2011). As these studies are two of the largest included in this review, it is clear that more research is needed to understand the impact of one-to-one programs on teacher pedagogy and student achievement.

The Need for Change in Pedagogy

The lack-luster student achievement results reported in these studies have been connected to a lack of understanding of the best uses of these devices. Researchers contend that the mere provision of these devices will not necessarily lead to changes in teacher practice (Ertmer et al., 2012; Wang et al., 2004; Zheng et al., 2013) and that additional research is needed to help understand which practices are best practices when it comes to technology integration (Geer et al., 2017; Sung et al., 2015). Other researchers lamented the scarcity of research about how to specifically implement technology at transformational levels, or in specific content areas (Howard et al., 2014; Jude et al., 2014). The findings of the studies in Florida and Texas provided only surface level examinations of instructional practices. The findings of both studies revealed increases in student-centered activities (Cavanaugh et al., 2011; Shapely et al., 2011), but neither study that examined uses of laptop technology used a theoretical framework to assess the extent to which these programs had transformed instruction.

The Need for Research Related to Leadership

Several studies included in this review reported supportive conditions of leadership that helped teachers have successful (though not necessarily transformational) experiences when integrating technology into their lessons. These conditions included time to learn how to use devices, on-going professional learning opportunities, instructional coaching, modeling, and access to technology integration experts (Cavanaugh et al., 2011; Chen et al., 2009; Geer et al. 2017; Granger, 2002; Hull & Duch, 2019; Keppler, 2014; Harris et al., 2016; Russell, 2004; Zheng et al., 2013). While the lessons for leadership presented in these studies are helpful, educational leaders need more help from the educational leadership community in knowing how to support teachers in changing their pedagogy in one-to-one learning environments. McLeod et al. (2015) criticized the educational research community for its slow response in helping educational leaders understand how to maximize the potential of these programs through effective classroom implementation.

The call for additional research to help administrators is urgent, as Machado et al. (2015) asserted that the role of the principal is especially critical for changing classroom practices with technology. Based on a review of literature about the role of educational leadership in technology integration, Richardson et al. (2012) concluded that there was a lack of research related to the standards set forth by ISTE (2009) to help leaders support the appropriate use of technology, understand how technology should be used in various educational contexts, or lead purposeful change.

Summary

For the past 100 years, technology played a central role in education. In the early 20th century, radio and film were integrated into classrooms. By the 1950s, television made the scene, and by the 1980s, computers began being incorporated into classrooms. Radio, film, and television clearly did not bring about meaningful changes to education. However, hope still exists that one-to-one computing will serve as a catalyst for improved instructional practices, and ultimately, increased student achievement.

If the potential for one-to-one computing is to be realized, changes in instructional practices must accompany the provision of these devices. Without changes in pedagogy, one-to-one computing will have no more of an impact on teaching and learning than did radio, film, or television. For change to occur, researchers must paint a clearer picture of the best practices for implementing one-to-one computing into classrooms. Additionally, the educational leadership research community must seek to help administrators know how to effectively lower barriers to technology integration and facilitate strong CSE among teachers, as these are pre-requisite conditions for the emergence of transformation digital pedagogies. This review of literature highlights the gaps in research related to pedagogy in one-to-one learning environments, and the need for additional research about how leaders can facilitate changes in instructional practice. Chapter 3 details the research methods for the current mixed-methods case study aimed at addressing these gaps.

CHAPTER 3

METHODOLOGY

This chapter presents the research design utilized to identify the leadership supports that lead to high teacher computer self-efficacy (CSE) and transformational levels of digital pedagogy in one-to-one learning environments. This chapter includes a discussion of the research design, participants, sampling techniques, data collection tools and strategies, plans for data analysis, trustworthiness, reflexivity, and limitations. The purpose of this study was to explore the extent to which teachers in one-to-one learning environments incorporate transformational pedagogy, according to an adaptation of the substitution, augmentation, modification, and redefinition (SAMR) model (Puentedura, 2006), and to identify supports school leaders provide that promote high CSE and transformational digital pedagogy. The following research questions (RQs) guided the study:

1. What are the levels of teachers' perceived computer self-efficacy for technology integration in schools with mature one-to-one laptop programs?
2. To what extent does computer self-efficacy predict teacher's ability to incorporate transformational levels of digital pedagogy in one-to-one learning environments?
3. According to teachers' perceptions, what supports do leaders in schools with mature one-to-one programs employ to increase teachers' computer self-efficacy related to digital pedagogy?

Research Design

The literature reviewed in Chapter 2 revealed a lack of concrete examples of effective leadership in schools with one-to-one laptop programs. While researchers identified barriers to high levels of technology integration (Ertmer, 1999; Hull & Duch, 2019) and urged leaders to shift their focus from the provision of devices to promoting effective digital pedagogy (Heath, 2019), the educational research community was criticized for its slow response in helping leaders understand how to effectively confront the many challenges associated with one-to-one laptop initiatives (McLeod et al., 2015). Therefore, the current study was designed to help paint a more complete picture of the leadership supports that may lead to transformational digital pedagogy in one-to-one learning environments and to examine the level of teacher self-efficacy for integrating one-to-one technology.

A mixed-methods case study was selected to address the research questions. Yin (2018) suggested that case study research is appropriate for studying a contemporary phenomenon, or case, especially when the researcher has little or no control over behavioral events. (Little did I know at the time the study was designed just what impacting events would occur during data collection.) According to Creswell and Poth (2018), a case study approach is appropriate when the research objective is to “develop an in-depth description and analysis of a case” and the research problem requires the researcher to “provide an in-depth understanding of a case” (p. 67). To address the first research question, a quantitative survey, developed by Wang et al. (2004), was used to determine the levels of teachers’ perceived CSE for technology integration in schools with mature one-to-one laptop programs. To determine the extent to which CSE predicts teachers’ ability to incorporate transformational levels of digital pedagogy in one-to-one learning environments (RQ2), an explanatory approach was more appropriate because the goal was to understand how transformative practices are fostered. Hodkinson and Hodkinson (2001) asserted that causal relationships can be established with case studies, due to their depth and complexity, similar to the way causal relationships are established with statistical correlation. An explanatory approach was needed to examine and compare the extent to which teachers with high and low levels of CSE employ transformational digital pedagogies in one-to-one learning environments. Hesse-Biber (2017) asserted that explanations go further than descriptions, stating, "To explain, on the other hand, is to account for what happened, or for how things proceeded" (p. 22).

A descriptive case study was especially appropriate for the third research question as the purpose was to identify and describe the supports provided by school leaders that lead to digital pedagogies in one-to-one laptop environments. Descriptive case studies are useful when it is necessary to provide rich descriptions of a social phenomenon in "its natural setting, recognizing its complexity and its context" (Hesse-Biber, 2017, p. 148). Table 1 summarizes the research design.

Table 1

Research Design: Mixed-methods Explanatory/Descriptive Case Study

Type	Description
Site Selection Criteria	• District implementing one-to-one laptop program at the high school level • Mature program with at least 4 years of consecutive implementation
Participant Selection Criteria	English language arts, social studies, and science teachers implementing one-to-one computing into their lessons in Grades 9-12
Methods/Tools for Data Collection	Quantitative survey of teachers; in-depth, face-to-face, semi-structured and focus-group interviews of teachers; documents provided by teachers; recorded interviews with *VoiceRecord Pro*© app; transcription of interviews with time stamps by *TranscribeMe.com*, self-designed spreadsheets for analyzing interview data; and *SPSS* software for quantitative analysis

Population and Sample

This section describes the context of the research site, the sampling universe, and the process for selecting participants. Included is a description of the research site and its one-to-one implementation. A detailed description of the sampling technique and the participant sampling process is also provided.

Context of the Research Site

To protect the confidentiality of the proposed school district, a pseudonym was used, that of High Tech Independent School District (HTISD). HTISD is a large, suburban school district in Texas with a student population of approximately 25,000. The district consists of one early childhood education center, 20 elementary schools, five middle schools, three high schools, and four alternative campuses. This case study focused on the three high school campuses. Each campus implemented the district's one-to-one program in the 2014-2015 school year. Deployment of MacBook Air® laptop computers (Apple Inc., Cupertino, CA) began in the fall of 2014 with all faculty members and ninth-grade students at the three high schools. In each successive year, the district provided laptops to the new class of ninth-grade students. By the 2017-2018 school year, virtually all high school faculty members and students had year-round access to district-provided devices for both school and home use.

To protect the confidentiality of the high schools participating in the study, each was given a pseudonym: Star High School (SHS), Hill High School (HHS), and Valley High School (VHS). According to the Texas Education Agency (2019), SHS is the smallest high school in the district, with an enrollment of approximately 2000 students. The student population there is diverse, with African American students making up approximately 20% of student enrollment, Hispanic students about 25%, and White students about half. The remainder of the student body is comprised of Asian students and students of mixed races. Slightly less than 30% of the student body is classified as economically disadvantaged and less than 3% are classified as being Limited English Proficient (LEP).

VHS is the oldest and largest of the high schools in the district. VHS also is a diverse high school within HTISD with White students making up the majority of the student population at just under 50%, followed by Hispanics for about 30%, African American students comprising approximately 15%, and Asian students and students of mixed race comprising the remainder of the student population. SHS has the highest rate of economically disadvantaged students in HTISD, at a little over 30%. Slightly more than 5% of the VHS student population is classified as LEP.

HHS is the second largest of the high schools in HTISD, with a student population of almost 3000 students. HHS is the least diverse of the high schools in the district with White students comprising approximately 65% of the student population, followed by Hispanic students at just under 20%, and African Americans at less than 10%. The final 6% is comprised of Asian students and students of two or more races. HHS also has the fewest number of economically disadvantaged students in the district at about 15%. LEP students make up slightly more than 3% of the student body.

Population

Robinson (2013) defined the sampling universe as "the totality of persons from which cases may legitimately be sampled…" (p. 26). The sampling universe for the current study included high school teachers in the north Texas region. Through purposive sampling, participants comprised a set of teachers from HTISD's three high schools, teachers who were the most qualified to provide insights related to the research questions. The campus websites were mined to compile an initial list of potential participants.

Sampling Technique

For purposive sampling, 177 core-subject teachers in English language arts (ELA), social studies (SS), and science grades 9-12 at HTISD's three high schools were invited to participate in a Likert-scale survey to assess their perceived CSE for technology integration, as ELA, SS, and science teachers are predicted to have the highest levels of laptop integration in their lessons Mathematics teachers were not included, as the nature of their subject may inhibit technology integration. Elective teachers were not chosen for participation due to the logistics of the district one-to-one laptop implementation. Because teachers in elective classrooms tend to have students from multiple grades, students in elective classes may not have had universal access to devices until the fourth year of implementation.

The final question of the survey asked if the participant teacher was willing to participate in a follow-up individual or focus group interview; of the 62 useable responses to the survey, 34 teachers agreed. The mean CSE score of each survey respondent willing to participate in a follow-up interview were ranked from lowest to highest CSE score. The four teachers with the lowest CSE scores and the four with the highest CSE scores were sent solicitation emails to participate virtually in individual interviews related to the supports they received during the district's one-to-one implementation (RQ3). Teachers were given 72 hours to respond. All four participants with the highest CSE mean score responded in the affirmative within the allotted time. Two of the four teachers with the lowest CSE mean score responded in the affirmative within the 72 hours provided for a response. To reach the desired number of eight individual interview participants, two additional solicitation emails were sent to participants with the next lowest CSE mean scores. These two teachers agreed to participate, resulting in four teachers with reactively low CSE means and four with relatively high CSE means for individual interviews.

After the individual interview participants were secured, the 24 participants not solicited for individual interviews were sent email invitations to participate in one of two focus group interviews focused on their digital pedagogy (RQ3). These survey participants were given 72 hours to respond. (See Appendix B for all documents related to focus group interviews.) The CSE scores of these participants were used to divide participants into two groups, those with higher CSE scores and those with lower. Based on an appropriate cut score, 13 survey participants with lower CSE scores were invited to participate in the first focus group interview, and 11 with higher CSE scores were invited to participate in the second focus group interview. The goal was to secure 5-7 participants in each focus group interview. Four participants from each group responded within the allotted time and agreed to participate in the virtual focus group interview at the agreed upon times. Table 2 summarizes the breakdown of participants and the data collection strategy for each.

Table 2

Participant Types, Numbers, Data Collection Strategies, and Alignment to Research Questions

Type of Participant	*n*	Data Collection Strategies	Research Question
ELA, SS, and science teachers	177	Survey	1
Teachers with high efficacy	4	Semi-structured interviews	2
	5	Focus group interview	3
Teachers with low efficacy	4	Semi-structured interviews	2
	5	Focus group interview	3

Note: ELA refers to English language arts and SS refers to social studies.

I received a request from one potential focus group participant in the high CSE group for a date alternate to the one scheduled. Because there was little difference between the highest CSE score of the first focus group pool (relatively low CSE scores) and the lowest score of the second focus group pool (relatively high CSE scores), the request was honored. This resulted in five participants for the first focus group. One survey participant who did not responded to the interview invitation in time to be included reached out and offered to participate in a focus group interview. To respect the participant's willingness to participate beyond the survey, and to reach the target number for the second focus group, that participant was allowed to join the second focus group.

Data Collection Tools and Strategies

In order to triangulate data, three separate data collection tools were utilized: a quantitative survey; a face-to-face, semi-structured interview protocol; and a focus group interview protocol. All participants were assured that their participation was voluntary, that their confidentiality would be protected, and that there would be no consequences for opting out at any point during the study.

The quantitative and qualitative phases of the study took place in the fall semester of 2020. The study began with the quantitative phase, with solicitation emails sent to ELA, SS, and science teachers, inviting them to participate in an online CSE survey. Informed consent was included in the first part of the online surrey. Once survey results were analyzed, solicitation emails were sent to survey participants that met the selection criteria of having high or low CSE scores and who indicated in the survey their willingness to participate in individual or focus group interviews. Informed consent forms were sent with the solicitation emails then were reviewed with participants at the beginning of the individual and focus group interviews.

During the quantitative phase of the study, a quantitative Likert-scale survey was used to determine the perceived self-efficacy for technology integration of ELA, SS, and science teachers at the three high schools (RQ1). Teachers were informed that there would be no consequences if they declined to participate, and if they choose to participate, they could opt out at any time after they began the survey. (See Appendix A for all survey documents.) The CSE for technology integration survey instrument consisted of 16 survey questions developed by Wang et al. (2004) to measure efficacy related to "computer technology capabilities and strategies" (p. 235). The lead author who developed the instrument granted permission for the instrument to be used in this study. Participants were asked to rate their levels of agreement from

1, s*trongly disagree*; 2, *disagree*; 3, *neither agree nor disagree*; 4, *agree*; to 5, *strongly agree*. Survey data were imported into the SPSS software for statistical analysis. Typically, responses for neither agree nor disagree would be excluded in the data set. However, since this survey was designed by other researchers, the data were analyzed as designed and these data points were included in the analysis.

Both content and construct validity and instrument reliability were established for the survey (Wang et al., 2004). To establish content validity, the lead author assembled a panel of six content experts in the area of self-efficacy who provided feedback for each of the items developed for the instrument. Feedback obtained from the panel of experts was used by Wang and colleagues to revise the instrument. After the revision process, the authors were confident the instrument had content validity.

Wang and colleagues used empirical evidence to establish construct validity and reliability of the instrument. The authors conducted an exploratory factor analysis on the 21 items of the original instrument to determine if the items measured meaningful constructs. The factor analysis revealed 16 items suited to measure teachers' efficacy for using computer technology in innovative and strategic ways. Wang and colleagues conducted a second factor analysis of the remaining 16 items that provided additional evidence that the instrument had construct validity. The Cronbach alpha coefficient calculated from these data was .96, which indicated to the authors that the instrument was highly reliable. Because they were able to establish content and construct validity, and the high reliability of the instrument, the authors concluded the instrument held "promise for its use in further research" (Wang et al., 2004, p. 236).

An individual, semi-structured interview protocol was developed to identify supports that promote teachers' CSE related to digital pedagogy (RQ3). The interview protocol also was designed to determine the extent to which CSE predicts the teachers' incorporation of digital pedagogy (RQ2). Semi-structured interviews were chosen because they can be aligned to specific research questions and still allow conversations to flow naturally (Hesse-Biber, 2017). Additionally, Hesse-Biber contended that semi-structured interviews provide participants the latitude and freedom needed to share what they deem important. Yin (2018) recommended that shorter case study interviews, those with a duration of about an hour, more closely follow an interview protocol and probes. Yin contended that even while adhering more closely to the interview protocol, the interview can still remain open-ended and conversational. (See Appendix B for all documents related to the individual interviews.)

A focus group interview protocol was developed to measure the extent to which CSE predicts teachers' ability to incorporate transformational levels of digital pedagogy into their lessons (RQ3). Focus groups were appropriate for this phase as they yield descriptive, process-oriented data from multiple participants at once, giving both depth and breadth to the subject (Hesse-Biber, 2017). Additionally, Punch and Oancea (2014) suggested that, "Educational programs are frequently evaluated through focus group research in order to understand their benefits and aid in strengthening them" (p. 150). Teachers with contrasting levels of efficacy (high vs. low) were interviewed in separate focus groups to establish a basis for comparison in the analysis phase of the study. One focus group consisted of teachers with the highest perceived levels of CSE; the other consisted of teachers with the lowest CSE. Twenty-four campus teachers with high and low levels of CSE were asked to participate in the two focus group interviews. Five participants were secured for each of the focus group interviews. See Appendix C for all focus group interview documents.)

A two-step field test process was used to vet the focus-group and semi-structured interview protocols. First, I asked teachers not participating in the study to review the draft questions to see if they made sense, contained bias, or were leading. After the first round of vetting, I refined the questions and asked colleagues that met the criteria to be participants of the study (yet were not participants) to review them again to determine if they believed the questions would yield data related to the research questions. After refinements were made, members of my dissertation committee provided feedback before protocols were finalized.

With the participants' permission, interviews were recorded using the VoiceRecord Pro™ application (Dayana Networks, Cocquilam, BC) which allows electronic files of interviews to be saved using the Google Doc™ word processing program (Apple Inc., Cupertino, CA); interview recordings were secure using a password protected laptop computer. Electronic files of the interviews were transcribed using the transcription service TranscribeMe!™ (TranscribeMe Inc., Oakland, CA) which produces time-stamped transcripts. Participants were informed that TranscribeMe! has a process for keeping client files confidential. I verified the accuracy of each transcript by listening to each recording while reading the transcript.

Data Analysis Strategies

The quantitative survey data were analyzed using descriptive statistics to examine the mean, median, mode, variance, and SD. Each survey question was evaluated to draw conclusions related to the CSE of each teacher. Participants were ranked from the highest to the lowest level of CSE, according to their mean CSE scores.

Qualitative data were analyzed using a series of researcher-designed spreadsheets. A priori codes were used for deductive analysis of interview data, in addition to descriptive and in vivo codes and themes. Multiple readings of data were necessary to develop descriptive and in vivo codes. To deductively analyze data related to RQ2, the four levels of the SAMR (2006) model were used as a priori codes (substitution, augmentation, modification, and redefinition). To deductively analyze all interview data related RQ3, the five ISTE (2009) standards for administrators were used as a priori codes (visionary leadership, digital-age learning culture, excellence in professional practice, and digital citizenship). Descriptive codes and in vivo codes were developed during an inductive analysis of interview data for RQ2 and RQ3. Descriptive codes consisted of short words and phrases to thematically describe patterns within the data, as suggested by Saldana (2009). In vivo coding, using words or phrases of participants that capture crucial points or meanings, were used when appropriate, as suggested by Hesse-Biber (2017). Once codes were established, they were codified by systematically arranging them into groups and categories based on shared characteristics, according to Saldana's recommendations (2009). As recommended by Saldana, codes were grouped into categories, then categories were subsequently grouped into subcategories, ultimately developing salient themes to explain the relevance of the data to the research questions. As recommended by Creswell and Posh (2018), the analysis of data is represented in Chapter 4 by figures, tables, and a discussion.

Establishing Trust

Lincoln and Guba (1985) outlined four factors qualitative researchers must consider for establishing trustworthiness: credibility, transferability, dependability, and confirmability. The authors described credibility as confidence in the truth of the researcher's findings and they recommended several techniques for establishing credibility, including prolonged engagement, triangulation, peer debriefing, and member checking. Lincoln and Guba explained that, as a part of prolonged engagement, researchers must spend sufficient time in the field to speak with a range of people, develop relationships and rapport with participants, and understand the context of the situation under study. Being an insider of the proposed district had its challenges and ethical considerations, but it did accelerate the building of relationships and understanding of the context of the program being studied. Because data were collected during a short timeframe in the spring 2020 semester, it was helpful to have a head start in building rapport with participants.

To gain a multitude of perspectives, 18 participants with varying levels of CSE were interviewed in individual sessions or in a focus group. During interviews, participants were asked to provide relevant documents to substantiate their accounts. Only two participants provided documents as examples of their digital pedagogy and a brief description of those documents is included in the findings, but only as supportive data. According to Creswell and Poth (2018), "When qualitative researchers locate evidence to document a code or theme in different sources of data, they are triangulating information and providing validity to their findings" (p. 259). To find common codes and themes, triangulation in the current study consisted of reviewing the quantitative survey data, as well as the individual interview and focus group interview data of teachers with high and low levels of CSE. Lincoln and Guba (1985) explained that comparing data from people with different points of view is one way to triangulate sources. In the current study, a variety of points of view of teachers with both high and low CSE were sought.

Member checking occurred during the data collection phase. Following individual interviews, I emailed each participant a summary of my interpretation of the interview so they could determine if I accurately captured their ideas, as recommended by Hesse-Biber (2017). Debriefing occurred throughout the analysis process as the co-chair of the committee was called upon regularly to review my analysis of data to determine if it was coherent and without bias. Committee members' review of the findings also gave credibility and dependability to the study, which Lincoln and Guba (1985) described as being critical components of trustworthiness.

The final component of trustworthiness, according to Lincoln and Guba (1985), was transferability, which the authors described as the applicability of the findings in other contexts. The technique recommended for establishing transferability is using thick descriptions, as described by Geertz (1973), with sufficient details to allow readers to determine if the conclusions made by the researcher are transferrable to other situations. The case study approach lends itself well to transferability, as a case study "aims to build understanding by addressing research questions and triangulating thick descriptions with interpretations of those descriptions in an ongoing iterative process" (Hesse-Biber, 2017, p. 221).

Reflexivity

Qualitative research requires reflexivity by researchers about their role in the study and how their personal background, attitudes, and experiences can shape their interpretations and the meanings they ascribe to data (Creswell & Creswell, 2018; Hesse-Biber, 2017). As an administrator at one of the high schools included in the study, my primary responsibilities revolved around curriculum, instruction, and professional learning but not as an evaluator of teachers invited to participate. Prior to becoming an administrator, I spent 20 years as a classroom teacher and 2 years as a department chair and instructional coach. During that time, my experience in implementing classroom technology met with limited success. Although I recognized the potential of technology integration to improve lesson designs, my experiences with technology were often frustrating due to limited access to devices (e.g., computer carts or computer labs) and limited internet connectivity. As a classroom teacher, one-to-one technology and robust internet access was not available to me.

During my first year as an administrator in the studied district, the district's one-to-one program was implemented. The problems of access and connectivity were systematically eliminated as all students and teachers were provided devices for both school and home use and the broadband systems were upgraded. As a result, I found myself in the position of having to support teachers in changing their pedagogy in the one-to-one learning environments, with little experience of my own to know how to help. Personally, this is a true problem of practice, and provided the motivation to make this the topic of study for my dissertation research.

Certain advantages and disadvantages accompany insider research. Punch and Oancea (2014) asserted that insiders have an advantage in that they bring a greater understanding of the context of the situation but may lack objectivity. Conversely, the authors contended that outsiders may bring more objectivity to a situation, but less understanding of the context. Ultimately, Punch and Oancea concluded that "There is no such thing as a 'position-free' project. Even the (supposedly) detached objective external researcher occupies a position with respect to research" (p. 50). The authors explained that careful scrutiny of the researcher's position allows the researcher to minimize the weakness of their position and maximize the advantages. Creswell and Creswell (2018) listed two disadvantages of studying in your own organization. First, they warned of a compromised ability to disclose unflattering information that may be brought to light while gathering data. Second, the authors cautioned researchers to be aware of imbalances in power between researchers and participants.

To minimize bias and ethical breaches, Coghlan and Brannick (2005) recommended researchers take measures to understand their own presuppositions, a process the authors refer to as epistemic reflexivity. Punch and Oancea (2014) recommended researchers think deeply about the concept of beneficence, which they described as foreseeable harms and benefits. Additionally, the authors recommended that researchers "bracket (or suspend) preconceptions about topics under discussion" (p. 147). To build reflexivity into the research process, per the recommendation of Coughlan and Brannick (2005), I journaled throughout the research process. These authors promoted journaling as a method of critiquing your own pre-understanding, being able to probe as deeply as an outsider, and maintaining good faith with participants. The journaling process was important, as Yin (2018) explained that being sensitive to the fact that both the interviewer and interviewee can both unknowingly influence each other's responses and line of questioning. Journaling occurred after each interview to review how I conducted the interview to ensure the interviewees' accounts were true accounts, free of my subjectivity or bias.

As an administrator in the district, I must be constantly aware of potential power differentials when working with teachers. This concern resulted in one of the delimitations of not conducting classroom observations. To avoid the perception that my role in the research was in any way evaluative in nature, I worked diligently to maintain relationships with participants and help them understand that the goal of the research was to help better understand how to support changes in pedagogy in one-to-one environments, and not to make evaluative judgments. I constantly drew upon my own failed experiences as a classroom teacher struggling to implement technology in my classroom, to maintain an empathetic spirit.

Limitations

Hesse-Biber (2017) advised listing the limitations of a study to create trust with the reader, which in turn increases the validity of the study. Simon and Goes (2013) described limitations as weaknesses of the study that are the result of a particular method and thus out of an author's control. One of the limitations of this study is the generalizability of the findings. It is impossible to know to what extent the experiences of the participants of this study are similar or different from other teachers in school systems with one-to-one programs. While the district studied is demographically diverse, it is located in an area with high property tax valuations, allowing the school to afford to fully support a one-to-one initiative at all of its high schools. School systems in rural locations or in locations with fewer financial resources may not be able to support robust one-to-one programs.

Another limitation of the current study is researcher bias. Hodkinson, P. and Hodkinson, H. (2001) asserted that interpretations of data collected during case studies are constructions of the researcher and cannot be completely objective. The authors recommended that researchers be completely transparent about their judgments and present adequate evidence to support their conclusions.

Summary

This chapter includes descriptions of the research design, participants, sampling techniques, data collection tools, data collection strategies, and data analysis techniques. Also included are discussions of trust, reflexivity, and the limitations of the study. This mixed-methods case study was designed to explore how school leaders can support changes in pedagogy in one-to-one learning environments. The participants of the study were teachers in three high schools in a large, suburban district in Texas. Purposeful sampling was the primary sampling method to ensure participants met the criteria set for data collection. Data for the study were collected through a quantitative survey, individual semi-structured interviews, and focus group interviews. Chapter 4 includes an analysis of the collected data.

CHAPTER 4

PRESENTATION OF FINDINGS

The purpose of this study was to discover, from the perspective of teachers, which supports promote teachers' computer self-efficacy (CSE) (Compeau & Higgins, 1995) for integrating laptop technology into their lessons. By examining the lived experiences of teachers with various levels of CSE in a school district with a mature one-to-one laptop program, the study was designed to discover if high CSE for technology integration serves as a pre-requisite condition for the emergence of transformational digital pedagogy.

A mixed-method case study research design was employed to investigate teachers' perceptions of their own CSE, the ways teachers incorporated technology into their instruction, and their perceptions of the supports provided by school leaders. The study was designed to determine which supports leaders can provide teachers to promote high levels of CSE for technology integration and transformational levels of digital pedagogy. The quantitative phase of the study consisted of a survey developed by Wang et al. (2004) to measure a single factor related to CSE, "computer technology capabilities and strategies" (p. 235). The qualitative phase consisted of eight individual semi-structured interviews and two focus group interviews conducted via the video conferencing application, Zoom™ (Zoom Video Communications, Inc., San Jose, CA). Teachers' accounts of their use of one-to-one laptop technology were analyzed based on Puentedura's (2006) substitution, augmentation, modification and redefinition (SAMR) model for evaluating digital pedagogy. Teachers' perceptions of supports provided by leaders were analyzed based on the International Society for Technology in Education (ISTE) (2009) leadership standards for administrators.

The research findings reveal that the purpose of the study was achieved, which was to investigate the following research questions:

1. What are the levels of teachers' perceived computer self-efficacy for technology integration in schools with mature one-to-one laptop programs?
2. To what extent does computer self-efficacy predict teachers' ability to incorporate transformational levels of digital pedagogy in one-to-one learning environments?
3. According to teachers' perceptions, what supports do leaders in schools with mature one-to-one programs employ to increase teachers' computer self-efficacy related to digital pedagogy?

This chapter includes the quantitative and qualitative data analyses related to the research questions. The organization and presentation of data in this chapter support the purpose of the study and data are organized according to the research questions they support. Individual interview protocol items that were designed to answer RQ2 and the focus group interview protocol items that were designed to answer RQ3 were unexpectedly combined as all interview types yielded data related both to RQ2 and RQ3. This is made clear in Chapter 5, when the qualitative findings are discussed.

Quantitative Findings: Research Question 1

What are the levels of teachers' perceived CSE for technology integration in schools with mature one-to-one laptop programs?

The first research question was designed to ascertain teachers' perceived CSE for technology integration in a school with a mature one-to-one laptop program. Using Qualtrics™ survey software (Qualtrics Inc., Seattle Washington), quantitative data were gathered from a 16-item, five-point Likert scale online survey developed by Wang et al. (2004), designed to measure teachers' CSE for using technology in innovative and strategic ways. Authors of the survey employed an exploratory factor analysis of the original 21-item instrument. The authors' analysis revealed that 16 of the items are appropriate for measuring teachers' efficacy for using computers in innovative and strategic ways. Their second factor analysis provided evidence of the instrument's construct validity with a Cronbach alpha of 0.96. Permission was granted to use this survey.

Invitations to participate in the survey were extended via email to 177 selected teachers in the studied school district, including 53 English language arts (ELA) teachers, 56 science teachers, and 68 social studies (SS) teachers in the three district high schools. Mathematics teachers were not included since typically there is little computer technology integration in those classes. Each participating teacher was given 7 days to respond to the survey with a reminder email sent on the 4th day the survey was available. The overall response rate of the survey was 36%, with 63 teachers completing the survey. All completed surveys were deemed usable but one, as one respondent's answers were eliminated from the data set based on comments made to the researcher in an email. Based on those comments, I determined that the respondent had not answered honestly, but answered in a manner perceived to be of help to me as the researcher. Eliminating this participant's survey results reduced the usable response rate to 35%. This response rate was acceptable as response rates between 20-25% are considered fairly high for studies with small samples (Fosnacht, et al., 2017).

Each survey respondent rated their agreement or disagreement with each survey item based on the following choices: (5) *strongly agree,* (4) *agree,* (3) *neither agree nor disagree,* (2) *disagree*, and (1) *strongly disagree.* Version 26 of the Statistical Package for the Social Sciences (SPSS)^{TM} (IBM Inc., Armonk, NY) was utilized to generate the descriptive statistics of minimum value, maximum value, mean, standard deviation (SD), and variance of the perceived CSE for one-to-one technology integration of all participants together, as well as for teachers in the three individual subjects and the three campuses. Table 3 provides a summary of the descriptive statistics of all participants.

Table 3

Summary of Descriptive Statistics for All Survey Participants

Campuses	Number of Useable Surveys	Percent of Useable Surveys	Minimum CSE	Maximum CSE	Mean CSE	SD
SHS, HHS, & VHS	62	100%	1.88	5.00	4.05	0.626

Based on the 5.0 Likert scale, in the year of the study, the seventh year of HTISD's one-to-one laptop initiative, the district's overall CSE mean score of survey participants (n = 62) was 4.05, with a SD of 0.626. Of the 62 survey respondents, 50 posted average CSE scores within one SD of the district mean, while another 5 respondents posted a CSE one SD above the district mean. Only 7 participants posted CSE scores more than 1 SD below the district mean, with 3 posting scores 3 SDs below the district mean. Mean CSE scores for individual participants ranged from 1.88 to 5.00. Table 4 displays the descriptive statistics for the participants at each respective high school campus.

Table 4

Summary of Descriptive Statistics for Survey Participants per Campus

Campus	Number of Useable Surveys	Percent of Useable Surveys	Minimum CSE Score	Maximum CSE Score	Mean CSE Score	SD	Variance
SHS	43	69.35%	3.06	5.00	4.16	0.4870	0.238
HHS	13	20.97%	1.88	4.75	3.70	.0862	0.743
VHS	6	9.68%	2.69	5.00	4.02	.0755	0.570

Participation rates on the survey varied widely among the three high schools, as did the mean CSE scores for each school. The mean for survey participants at SHS (n = 43) was 4.16, slightly higher than the mean CSE score for the entire district (4.05). SHS also had the lowest variation in CSE scores, with a minimum CSE of 3.06 and a maximum CSE of 5.00; these fell within 2 SDs of the mean CSE score for the district. The mean CSE score for VHS survey participants (*n* = 6) was 4.02, nearly matching the district's overall mean CSE score (4.05). The maximum score for VHS was within 2 SDs of the district score, while the minimum score was 3 SDs below the mean. (The notably low response rate for VHS is discussed in Chapter 5). HHS (*n* = 13) had the lowest mean CSE score for survey participants at 3.70, and the greatest variance, 0.743. Like VHS, HHS's maximum mean CSE score (5.00) fell within 2 SDs above the mean, while the minimum CSE score (1.88) fell 3 SDs below the mean. Although participation rates and the variance of the mean CSE scores for the three high schools differed, the mean CSE score for each of the three high schools all fell within 1 SD of the district mean. Participation rates also varied according to subject taught with 22 ELA teachers, 14 SS teachers, and 26 science teachers completing the survey. Table 5 shows descriptive statistics for subject area participants.

Table 5

Summary of Descriptive Statistics of Survey Participants per Subject

Subject	Number of Useable Surveys	Percent of Useable Surveys	Minimum CSE Score	Maximum CSE Score	Mean CSE Score	SD	Variance
ELA	22	35.48%	3.06	4.88	4.17	0.494	0.244
SS	14	22.58%	3.38	5.00	4.16	0.451	0.203
Science	26	41.94%	1.88	5.00	3.91	0.701	0.609

Among the three subject areas, ELA and SS showed very similar mean CSE scores at 4.17 and 4.16, respectively, both falling above the district mean CSE score of 4.05. The mean CSE for science teachers (n=26) was 3.91, falling below the district mean. Science teachers also had the greatest variance at 0.609 when compared to ELA and SS with variances of 0.244 and

0.233, respectively. Two outlier means in the science survey responses were retained in the data because the insights of both of those science teachers were considered valuable and both were invited to participate in the individual interviews. While the minimum CSE scores for ELA (3.06) and SS (3.38) fell within 2 SDs of the mean, the minimum score for science (1.88) was 3 SDs below the mean. Despite the differences in the variation of the means for participants from these three subject areas, the mean CSE for teachers in all three subjects fell within 1 SD of the district mean CSE score.

Survey results were loaded into the SPSS software to yield descriptive statistics for each of the survey items, including mean CSE scores, SD, variance, median, and mode. Table 6 summarizes the descriptive statistics, including the SD, median, mode, and variance, as well as the percentages of responses of ratings 1 or 2, 3, and 4 or 5 for all survey items that posted mean CSE scores above the district mean of 4.05. Survey items are listed in descending order, according to mean CSE for each item.

Results included in Table 6 reveal a relatively high degree of CSE across respondents, as evidenced by 10 of the 16 survey items netting a mean of at least 4.06 out of the possible 5.0 scale, with rankings slightly above the district's CSE mean score of 4.05. One example of high CSE levels among survey participants was evidenced in the results of Item 2 (how confident teachers felt about having the skills necessary to use the computer for instruction) that had a mean CSE score of 4.50 with 96.8% of participants responding with a 4 or a 5 rating. Item 12 also provided evidence for high levels of efficacy for technology integration with a mean score of 4.48, with 96.8% of participants responding with a 4 or a 5 rating. These data provide evidence that the majority of teachers who participated in the study feel confident they can regularly incorporate technology into their lessons when appropriate.

Table 6

Descriptive Statistics and Answer Percentages Ranked for Survey Items Above the District CSE Mean

Item	Statement	Mean CSE Score	Median	Mode	Std Dev	Var	% Rating 1, 2	% Rating 3	% Rating 4, 5
2	I feel confident that I have the skills necessary to use the computer for instruction.	4.50	5.0	5.0	0.695	0.484	3.2%	1.6%	96.9%
12	I feel confident I can regularly incorporate technology into my lessons when appropriate.	4.48	5.0	5.0	0.671	0.451	3.2%	0%	96.8%
3	I feel confident that I can successfully teach relevant subject content with appropriate use of technology.	4.37	4.5	5	0.794	0.631	0%	6.5%	93.5%
11	I feel confident that I can provide individual feedback to students during technology use.	4.26	4.0	4.0	0.840	0.555	4.8%	3.2%	92%
14	I feel confident about assigning and grading technology-based projects.	4.21	4.0	4.0	0.813	0.660	1.6%	9.7%	88.7%
10	I feel confident that I can consistently use educational technology in effective ways.	4.18	4.0	4.0	0.840	0.706	8.1%	3.2%	88.7%
13	I feel confident about selecting appropriate technology for instruction based on curriculum standards.	4.08	4.00	4.00	0.836	0.698	6.5%	6.5%	87%
1	I feel confident that I understand computer capabilities well enough to maximize them in my classroom.	4.06	4.0	4.0	0.885	0.783	8.1%	6.5%	85.5%
9	I feel confident that I can mentor students in appropriate uses of technology.	4.06	4.0	4.0	0.903	0.815	9.7%	8.1%	82.2%
16	I feel confident about using technology resources (such as spreadsheets, electronic portfolios, etc.).	4.06	4.0	4.0	0.956	0.914	13.7%	8.1%	78.2%

Note. *N* = 62 district ELA, SS, and science teachers.

Results of two other survey items revealed evidence of particularly high CSE for technology integration among HTISD's teachers with 93.5% of participants responding with a 4 or a 5 on both items. Survey Item 3 had a mean CSE score of 4.37, revealing that teachers felt confident they could successfully teach relevant subject content with appropriate use of technology. Survey Item 11 had a mean CSE score of 4.26, demonstrating that teachers were confident they could provide individual feedback to students during technology use.

The analysis also revealed two survey items showing fairly high CSE means with 88.7% of teachers responding with a 4 or a 5 rating. Item 14 measured teachers' level of confidence for assigning and grading technology-based projects; responses to this item resulted in the fifth highest mean of 4.21. Among participants who did not score this item as a 4 or a 5, 9.7% scored the item a 3, suggesting ambivalence among some staff members in this area. Item 10 measured teachers' perceptions of their ability to consistently use technology in effective ways. Respondents who indicated a 1 or a 2 (8.1%) revealed that they do not feel confident in their ability to implement technology effectively on a consistent basis.

Four survey items (13, 1, 9 and 16) posted mean CSE scores above the district mean of 4.05, but the margins were slight and the variance among participants increased, compared to the variance overall among participants in the survey. A fairly large number of teachers expressed confidence in their ability to select appropriate technology for instruction based on curriculum requirements, as measured by Item 13, which had a calculated mean CSE score of 4.08, with 87% of participants responding with a 4 or a 5 rating. The first item of the survey sought to determine teachers' level of confidence regarding their understanding of computer capabilities and their ability to maximize those capabilities in their classroom. While 85.5% responded with a 4 or 5, with the item showing a mean CSE score of 4.06, the variance among participants for this metric was 0.783. Among the respondents, 8.1% responded with a 1 or a 2, indicating they consider this to be an area of weakness. An additional 6.5% responded with a 3, indicating that they did not feel this was an area of weakness, but neither did that score reveal absolute confidence in this area. Items 9 and 16 also had mean CSE scores of 4.06 and posted variances among participants of 0.815 and 0.914, respectively. Item 9 assessed teachers' perceived level of confidence in their ability to mentor students in appropriate uses of technology. While 82.2% of participants rated this item with a 4 or 5, 6.5% answered with a 3, and 8.1% answered with a 1 or 2. Item 16, which measured teachers' level of confidence for using technology resources such as spreadsheets and electronic portfolios, posted the lowest percentage of teachers rating this item with a 4 or a 5 among all items that were scored above the district's mean CSE score of 4.05. While 78.2% of teachers posted a 4 or 5 for this survey item, 8.1% responded with a 3, and 13.7% rated the item with a 1 or 2.

Analysis of the data for these four survey items revealed that the majority of teachers in HTISD possess a relatively high degree of confidence for technology integration related to selecting technology based on curriculum requirements, understanding computer capabilities, mentoring students regarding the appropriate use of technology, and using a variety of technology resources. However, the data suggest that many teachers do not necessarily consider these aspects as strengths, while a significant number of teachers consider them weaknesses.

In summary, the 10 items discussed thus far all showed means greater than the district mean of 4.05 indicating that teachers expressed a high degree of confidence in the specific areas these items measured. The remaining six survey items had mean scores below the district mean of 4.06. Table 7 ranks these items from high to low mean CSE; also shown are the other descriptive statistics and percentages of response categories associated with these items.

Table 7

Descriptive Statistics and Answer Percentages Ranked for Survey Items Below the District CSE Mean

Item	Statement	Mean CSE Score	Median	Mode	Std Dev	Var	% Rating 1, 2	% Rating 3	% Rating 4, 5
5	I feel confident that I can use correct terminology when directing students' computer use.	3.98	4.0	4.0	0.799	0.639	4.8%	17.7%	77.5%
8	I feel confident that I can effectively motivate my students to participate in technology-based projects.	3.98	4.0	4.0	0.878	0.770	8.1%	14.5%	77.4%
4	I feel confident in my ability to evaluate software for teaching and learning.	3.85	4.0	4.0	1.037	1.077	11.3%	12.9%	75.8%
15	I feel confident I can be responsive to my students' needs during computer use.	3.79	4.0	4.0	0.926	0.857	9.7%	6.2%	84.1%
7	I feel confident I can effectively monitor students' computer use for project development in my classroom.	3.48	4.0	4.0	1.036	1.074	24.2%	14.5%	61.3%
6	I feel confident I can help students when they have difficulty with the computer.	3.48	4.0	4.0	1.036	1.073	24.1%	11.3%	64.3%

Note. N = 62 district ELA, SS, and science teachers

Although all of these 6 items were within one SD of the district's mean, and the majority of participants in the survey responded with a 4 or a 5 for all of these items, there was a large degree of variance on these survey items among teachers on these survey items. Items 5 and 8 both posted mean CSE scores of 3.98. Item 5 measured teachers' confidence in their ability to use correct terminology when directing students' computer use, with 77.5% of respondents posting a 4 or a 5. Item 8 measured teachers' confidence in their ability to motivate students during technology-based projects with 77.4% of participants responding with a 4 or a 5. Data revealed that ratings for Items 5 and 8 seem very similar. Only 4.8% of respondents rated Item 5 a 1 or 2, compared to 24.2% on Item 8, indicating that nearly one quarter of participating teachers lack confidence in their ability to motivate students during technology-based projects.

This result is similar to the results for the two items on the survey with the lowest mean CSE scores. Survey Items 6 and 7 both had mean scores of CSE 3.48 with more than 24% of survey participants responding with a 1 or a 2. This indicates that nearly one-quarter of the teachers expressed they had little confidence that they could help students having difficulty with their computer (Item 6) or effectively monitoring computer use (Item 7). Curiously, while Item 15, which tapped into teachers' levels of confidence for responding to students during computer use, faired higher than Item 6, only 64.6% of respondents rated Item 15 with a 4 or a 5, regarding their confidence for helping students having difficulty using their computer, but 84.1% rated their level of confidence to be responsive to students' needs during computer use as a 4 or a 5 with less than 10% responding with a 1 or a 2.

The final survey item to discuss is Item 4 which revealed the degree to which teachers felt confident in their ability to evaluate software for teaching and learning. The mean CSE score for this item was 3.85 with 75.8% of teachers scoring themselves with a 4 or a 5, 12.9% scoring a 3, and the remaining 11.3% scoring a 1 or a 2. This finding reveals that more than three-quarters of the teachers felt confident they can evaluate software for teaching and learning, but the remaining quarter were only moderately confident or not confident at all.

Overall, the mean CSE score for each individual survey item fell within 1 SD above or below the overall district CSE mean of 4.05. Additionally, all means and modes for individual survey Items were either 4 or 5. The majority of survey participants rated a 4 or 5 on all survey items, with percentages of 4 and 5 ranging from a low of 61.3% to a high of 96.8%.

Qualitative Findings

Before presenting findings for Research Questions 2 and 3, it is important to understand how the qualitative process worked and the unusual context at the time in which qualitative data were obtained.

The Qualitative Data Analysis Process

The qualitative phase of the data analysis process began with a review of all transcripts from the two focus group interviews and the eight, semi-structured individual interviews. All individual and focus group interviews were digitally recorded using the VoiceRecord Pro© application (Dayana Networks, Cocquilam, BC) and subsequently transcribed with time stamps using the transcription service TranscribeMe.com™ (TranscribeMe Inc., Oakland, CA). Each transcript then was reviewed for accuracy while listening to the recording of the respective interview. Word repetitions and fill words such as "you know," "like," and "I mean," as well as nonsensical words such as "hmm," were edited from the transcripts. After that transcript cleaning process, member checking was accomplished by providing a summary of each individual interview transcript to the pertinent interview participants and a summary of each focus group transcript to one participant from each focus group. All participants approved of the summaries with no feedback for correction or improvement. For the purposes of confidentiality and objective analysis, each interview participant was assigned a gender-neutral first name.

The Context at the Time of Data Gathering and Unexpected Findings

The focus group interview protocol was designed to obtain data related to the second research question: To what extent does CSE predict teachers' ability to incorporate transformational levels of digital pedagogy in one-to-one learning environments? The protocol developed for the semi-structured interviews was designed to extract data related to the third research question: According to teachers' perceptions, what supports do leaders in schools with mature one-to-one programs employ to increase teachers' CSE related to digital pedagogy? However, during the initial reading of the transcripts for both focus group and individual interviews it became clear that both types of interviews produced a significant amount of data related to both RQ2 and RQ3. This finding was a surprise as field testing of the interview protocols produced sample data aligned more tightly to the research questions they were designed to explore. Yet, early in the data analysis process, it became apparent that the way qualitative data responded to both research questions was the result of changed dynamics caused by the move to virtual and hybrid learning models due to the COVID-19 pandemic. More precisely, during the initial readings of all interview transcripts, it became apparent that focus group participants were readily giving accounts of the supports they received during virtual learning, yet during individual interviews, participants were readily giving accounts of lessons they had been implementing during virtual and hybrid learning. Consequently, the descriptions of the lived experiences shared by all focus group and individual interview participants are included in the analysis related to both RQ2 and RQ3.

To further provide context for the qualitative data analysis, it is important to understand that both individual interview and focus group protocols designed for this study were finalized in February of 2020, prior to the closure of all HTISD campuses for the remainder of the school year due to the COVID-19 pandemic. During the final quarter of that school year (2019-2020), all face-to-face learning ceased in the district, and very suddenly, teachers were forced to deliver all instruction virtually with both students and teachers working from home. Additionally, for the first three weeks of the 2020-2021 school year, all instruction in HTISD continued to be delivered virtually, although teachers were given the option of working from their classrooms or their homes. During the fourth week of instruction, the district implemented a hybrid learning model in which students were given a choice of learning virtually via the Zoom video conferencing application or face-to-face in a classroom setting. Approximately 30% of the students in HTISD chose to learn virtually from home. Teachers in HTISD were expected to deliver instruction to their students synchronously, meaning they were teaching their face-to-face classes as well as students who were attending via the Zoom video conferencing application at the same time. These events were not anticipated and not considered when the research questions were developed or when the interview protocols were designed, and field tested. These events had a marked impact on how teachers in the three high schools in HTISD were using technology when data for this study were being collected. References to the "pandemic" and "COVID" were ubiquitous in the interview transcripts.

Focus Group and Individual Interview Participants

Of the 62 usable surveys, 34 participants responded "yes" to the final survey question as to whether they would be willing to participate in either an individual or focus group interview. Of the 34 "yes" respondents, the four respondents with the lowest CSE scores (1.88-3.06) were invited via email to participate in individual interviews (Appendix C). Two of the four accepted, while two did not respond within the 72 hours allotted for a response. Two additional participants having the next lowest scores (3.13, 3.44) then were invited to participate in the individual interviews and both agreed to participate. The four respondents with the highest CSE scores (4.75-4.94) were also invited to participate in individual interviews and all accepted. Table 8 summarizes the characteristics of the eight individual interview participants.

Table 8

Characteristics of Individual Interview Participants

Participant	School	Subject Taught	Mean CSE Score	SDs from District CSE Mean (4.06)
Alex	VHS	Science	1.88	3 SDs below
Blake	SHS	ELA	2.81	2 SDs below
Drew	SHS	Science	3.13	2 SDs below
Taylor*	SHS	ELA	3.44	Within 1 SD
Jordan	SHS	ELA	4.75	2 SDs above
Robin	SHS	SS	4.81	2 SDs above
Sidney	SHS	ELA	4.88	2 SDs above
Casey	SHS	Science	4.94	2 SDs above

Note. *This person would have been invited for the focus group interview as well if other teachers with lower CSE scores had responded in time for an individual interview.

Once the individual interview participants were secured, 24 participants were selected and invited to participate in focus group interviews. Email invitations for the first focus group were sent to 13 survey participants with lower CSE scores ranging from 3.44 to 4.19. Four survey participants posted CSE scores of 4.19, while the next highest mean CSE score was 4.25, thus scores of 4.19 and 4.25 were used to determine which participants were considered to have relatively low scores and which were considered to have relatively high scores. For the second focus group interview, email invitations were sent to the 11 survey participants with higher CSE scores, ranging from 4.25 to 4.6. I received a request from one potential focus group participant for a date alternate to the one scheduled, and I deemed it appropriate to schedule that participant in the other focus group as there was little difference in the highest CSE of the first focus group pool (4.19) and the lowest score of the second focus group pool (4.25). One survey participant who had not responded to an interview invitation in time to be granted an individual interview reached out and offered to participate in a focus group interview. That participant was allowed to join the second focus group to respect the participant's willingness to participate beyond the survey, and to reach the target number of participants set during the design of the study. The target for participation in each focus group interview was five to seven participants in each. This target number was achieved as there were exactly five participants in each focus group.

Table 9

Characteristics of Focus Group Participants

Participant	Focus Group	School	Subject Taught	Mean CSE Score	SDs from District CSE Mean (4.06)
Corey	1	SHS	Science	3.56	Within 1 SD
Joe	1	SHS	Science	3.81	Within 1 SD
Quinn	1	SHS	Science	4.06	Within 1 SD
Lane	1	SHS	Science	4.06	Within 1 SD
Dallas	1	SHS	ELA	4.31	Within 1 SD
Sunny*	2	SHS	ELA	3.06	2 SDs Below
Frankie**	2	SHS	Science	3.94	Within1 SD
Tony	2	SHS	Science	4.19	Within1 SD
Darby	2	SHS	ELA	4.4	Within1 SD
Sam	2	SHS	ELA	4.4	Within1 SD

Note: * = Participant with lower CSE score, originally invited to individual interview. ** = Participant with relatively lower CSE score, originally invited to participate in focus group.

Although the context in which the data were collected was very different than when the study was designed, the data collected through both individual interviews and focus groups were aligned to both RQ2 and RQ3. Table 9 summarizes the characteristics of the focus group participants.

The following sections present the qualitative data related to RQ2 and RQ3. Data presented for RQ2 relates to teachers' digital pedagogy, while data for RQ3 relates to leadership supports.

Research Question 2

> *To what extent does CSE predict teachers' ability to incorporate transformational levels of digital pedagogy in one-to-one learning environments?*

The second research question was designed to determine the extent to which CSE predicts teachers' ability to incorporate transformational levels of digital pedagogy in one-to-one learning environments. To better understand how data addressing this research question were analyzed, the four levels of the SAMR model were reported in two categories, transformation and enhancement. As explained by Puentedura (2006), transformative pedagogy is divided into two upper levels of the SAMR model: redefinition and modification. Enhancement pedagogy is divided into the two lower levels: augmentation and substitution. Findings are reported according to the four SAMR levels, as a priori codes: redefinition and modification (in the category of transformation), and augmentation and substitution (in the category of modification). Although the enhancement codes of augmentation and substitution were not transformational, it was important to recognize and identify those codes in the findings, as they can show how teachers might be progressing toward transformational pedagogy. Through the process of transcript analysis, it was important to consider all four levels to find out which teacher accounts were truly transformational.

Inductive analysis consisted of several iterations of descriptive and in vivo coding to ascertain how teachers in HTISD were incorporating one-to-one technology into their lessons.

As suggested by Saldana (2009), descriptive codes, participants' short words and phrases, were grouped thematically to describe similar types of technology integration used by teachers. In vivo coding, described by Hesse-Biber (2017) as using words and phrases of participants, was used to determine the types of software applications teachers incorporated into their instruction. Once the types of technology use were determined, they were deductively categorized using a priori coding based on the four levels of the SAMR model (Puentedura, 2006), under enhancement (substitution and augmentation) and under transformational (modification and redefinition). The following sections present the findings related to teachers' use of technology at both the enhancement and transformational levels.

Enhancements SAMR Category

Digital pedagogies that Puentedura (2006) classified as enhancements include both the substitution and augmentation levels of the SAMR model. At the enhancement level, students primarily use technology for consumption rather than creation (Marlatt, 2019).

Substitution level a priori code. At the substitution level, technology acts as a direct tool substitute with no functional change (Puentedura, 2006). Data revealed that all focus group and individual interview participants incorporated one-to-one laptop technology at the substitution level of the SAMR model. Table 10 summarizes the types of technology integration utilized by teachers at the substitution level, as determined by descriptive and a priori coding.

The most common technology tool used for the substitution level technology integration was the Canvas™ learning management system (LMS) (Instructure, Thoma Bravo, LLC, Salt Lake City, Utah). To post assignments, teachers also used digital textbooks included in a LMS. All participants of focus groups and individual interviews reported posting agendas, calendars, or assignments into an LMS. Additionally, teachers shared that students were expected to submit their completed assignments via the LMS. Descriptions of these types of technology integration were coded as substitution level activities because they took the place of teachers posting agendas on their boards in the classroom or handing out and collecting paper assignments.

Table 10

Enhancement Levels of Technology Integration at Substitution Level

Types of Technology Integration Employed by Teachers	CSE Score Range
Agendas/Assignments/Calendars posted in a learning management system (18)	1.88 – 4.94
Accessing digital data base (1)	4.94
Videos clips to reinforce concepts (3)	3.13 – 4.94

During the first focus group interview, Frankie alluded to the necessity of teachers using the Canvas LMS for disseminating and collecting papers to avoid transmission of the COVID-19 virus. Frankie stated, “We’re basically paperless at this point. Our book is online, so students read the chapters of the book online. All of my assignments are in Canvas; they submit them on Canvas.” Casey, a science teacher at SHS, also described using the features of the Canvas LMS for this purpose. Casey stated, “We use Canvas to disseminate our daily agenda with all the content we are going to be teaching.” Tony, an ELA teacher at SHS, reported, “All of our assignments, or at least our initial introduction to the assignments, are loaded into Canvas.” Blake, another ELA teacher at SHS, elaborated during an individual interview, stating:

> My daily presentations are available for kids. I think as low as that may be on the creativity level, having them available for kids all the time through Canvas is invaluable, especially when a kid is absent. They can go and find what they need. You can hyperlink documents so everything is there for them and they don’t have to wait for you to hand them a handout.

Another example of a substitution level activity described by an HTISD teacher is the use of online databases. Casey described a lesson in which students went online to search databases about elevation that are available through the Texas Parks and Wildlife website. Students used data they gleaned from these databases to create topographic maps of five different state parks.

Three science teachers at SHS referenced using traditional video clips to help students understand science concepts. During their individual interviews, Drew and Casey reported using video clips found on the YouTube™ video-sharing platform (Google Inc., San Bruno, CA). During a focus group interview, Corey, also a science teacher at SHS, described the usefulness of the animated video clips in an online textbook:

> It would have taken me an entire class to just explain that one concept in depth like the book did with the nice simulations of throwing things in a garbage wastebasket. They [the digital textbook] had another one [animated video] that followed up explaining how to estimate to one digit. It would have taken me another class to explain all of that in the depth they did in just a few minutes...that's the reason we were adopting the book.

While it is noteworthy that all teachers participating in the study referenced their use of Canvas for posting agendas and assignments, data also revealed that there were teachers who did not use HTISD's LMS prior to having to move to a virtual learning environment as a result of the school closure due to the COVID-19 pandemic during the last quarter of the 2019-2020 school year. During an individual interview, Robin, a social studies teacher at SHS, shared an experience of helping a senior social studies team of teachers learn to use the Canvas LMS to disseminate lessons virtually: "The senior team is the most reluctant…they have had technology the least amount of time, so they are just learning Canvas really during the pandemic."

Data revealed that all teachers in HTISD were able to use the district-provided laptop technology at the substitution level of the Puentedura's (2006) SAMR model. The data suggest that all teachers in HTISD likely use the Canvas LMS for posting agendas and assignments. Although the substitution level does not represent transformational pedagogy, successes with digital technology at this level may contribute to increased CSE for a large number of HTISD teachers.

- *Augmentation level a prior code*. Augmentation level activities are those activities in which technology acts as a direct tool substitute but with functional improvements (Puentedura, 2006). HTISD teachers provided several examples of lessons where they had directly substituted traditional classroom activities using digital functions of a variety of software applications, including word processing functions of the Google Docs™ web-based word processing program, the graphing functions of the Google Sheets™ web-based spreadsheet program, the screen manipulation functions in the Google Slides™ web-based presentation program (Google LLC, Mountain View, CA), the Hyperlink™ functions (Verity Inc., Santa Clara, CA) within the Google Docs application, and adaptive functions in online quiz games. Grading functions included in the district's LMS that made providing feedback to students more effective were also described by teachers. Descriptions of lessons that included software applications with these types of functions were classified at the augmentation level. Table 11 summarizes the technology integration strategies of HTISD's teachers at the augmentation level.

Table 11

Examples of Technology Integration at the Augmentation Level

Types of Technology Integration Employed by Teachers	CSE Score Range
Word processing features for lab reports, essays, and research papers (6)	1.8 – 4.31
Graphing lab data with web-based presentation program (2)	3.13 – 4.19
Hyperlink features used in documents and presentations (3)	2.81 – 3.96
Adaptive quizzes, competitive quiz games, digital flashcards for interactive content review (5)	1.88 – 4.94
Drag and drop features of web-based presentation programs lieu of hands-on manipulatives (2)	3.8 – 4.1
Digital one-pager including visuals/graphics (student product) (1)	4.75
Grading functions of LMS for improved and more expedient feedback to students (8)	3.06 – 4.88

Six teachers referenced students using the word processing features of the Google Docs web-based word-processing program to write lab reports and essays. Alex and Frankie, both science teachers, reported that students used the Google Docs word processing program to write formal lab reports. Alex, a science teacher at HHS, also shared that prior to the one-to-one initiative, "the only thing that I had ever had my students use a computer for was writing up a research paper." Blake, Taylor, and Sunny all reported having students type essays for their English classes using the Google Docs web-based word-processing program. Curiously, Dallas, an ELA teacher with one of the highest CSE scores, reported scaling back on the use of some of the more elaborate technology integration strategies during hybrid learning in the fall of 2020, opting instead for simpler strategies. She explained:

> The front loading of these things is too complicated and I don't have time to front load so much. With the change in format [referring to the Hybrid teaching model], my kids generally are doing assignments in Canvas by making a copy of Google Docs…for me it's just easier; we're writing essays and outlines.

These examples of technology integration were all coded at the augmentation level since using word processing features such as spell-check and cut-and-paste features are enhanced word processing features (Puentedura, 2013, 2014 b).

Another example of an augmentation level activity was described by Casey who said, "We recently did a graphing activity…they had to use the Google Sheets in order to make a chart and then make a line of best fit." This activity was coded as an augmentation level enhancement because the graphing features in the Google Sheets web-based spreadsheet program the and the Google Slides web-based presentation program are similar to the enhancement features of cut-and-paste and spell-check in the Google Docs word-processing program.

Acting on an idea suggested by HTISD's secondary ELA coordinator, Sunny described an augmentation level poetry activity in which the parts of the lesson (instructions, videos, and assignments) were hyperlinked into a Google Doc to create a HyperDoc. Sunny explained:

> Every Friday I do Poetry Fridays with something called a HyperDoc, which is a Google Doc you build. Each child downloads one on a particular topic. The student has the poem and the poem is read to him by the poet. Then he hears the actual professor explicate that poem in a different stage of the product. Then he gets to choose four or five poems that he can read and gets to explicate that poem in the final step of the HyperDoc…it's amazing how we just link everything and the kids have access to it.

Sunny reported being pleased both with the format of the lesson and because the lessons could be implemented asynchronously during virtual learning. Sunny's description supported a determination that this type of technology integration constituted an augmentation level activity.

Sam, another ELA teacher at SHS, described how having access to MacBook Air® laptop computer (Apple Inc., Cupertino, CA) and the Canvas LMS enabled students to have choice in a lesson. Rather than showing a single movie trailer to a whole class simultaneously, Sam posted links to multiple movie trailers in a Canvas module and allowed students to choose the trailers they wanted to view during independent practice. Sam shared:

> I was teaching explicit and implicit meaning, and one of the things I would not have been able to if I didn't have one-to-one [technology] was provide multiple movie trailers for this activity. I modeled one movie trailer, and then gave them three separate ones to pick from for their independent practice. It gave them the power to choose. Had I not had one-to-one integration, I would have had to show it as a whole class presentation and everybody would have had to use the same material, and we would not have had any versatility in the lesson.

Although movie clips were coded as substitution level activities above, the use of movie trailers described by Sam was coded at the augmentation level because the ability to post a variety of links to different movie trailers within the teacher's Canvas module provided enhanced functionality that enabled students to have choice.

Five teachers reported using online quizzing games such as Kahoot!™ (Kahoot! AS, Oslo, Norway), Quizlet™ (Andrew Sutherland, San Francisco, CA), and Quizizz™ (Quizziz Inc., Santa Monica, CA). Alex, a science teacher at HHS, stated, "We do the standard things with computers in my class. We use the Canvas platform and things like EdPuzzle and Kahoot!." Joe and Lane also reported using the Kahoot! application, a competitive learning game application. Corey reported adding practice quizzes and flashcards found in the Quizlet application into Canvas unit modules. Corey explained, "Kids want me to put up flashcards and any other types of self-tutorials." Casey praised the benefits of using the game application Quizziz, stating:

> The biggest win is using a review game on this website called Quizziz where the questions repeat themselves, and it's a game you're playing. The fact that it is competitive and they have the ability to repeat the questions they struggled with at the time, but when they see it again, they're able to get it…The idea is you've repeated it five times or so. Your cognitive switch gets faster, faster, faster.

These descriptions of using quiz games were coded at the augmentation level because they were substitutions of analog review games played in traditional classrooms, but the applications provided additional functions, including automatic repetition of missed questions, the ability for students to use the function as a whole class or as an individual practice assignment, score keeping functions for an element of competition, and data collection capabilities.

In the fall of 2020, safety precautions imposed due to COVID-19 prohibited students from sharing classroom materials, which made the use of traditional hands-on manipulatives like card sorts impractical. Joe and Lane, both science teachers at SHS, described augmentation level strategies in which they replaced their traditional card sort activities with digital sorting activities using drag and drop functions available in the Google Slides web-based presentation program. They explained that an instructional coach created an instructional video for the science department to show teachers how to create digital replacements for traditional hands-on activities. Joe proudly proclaimed, "I've gotten pretty good at creating Google Slides with names you can manipulate…kids can flip cards and move cards around on the Google Slides; we can drag and drop."

Jordan, an ELA teacher at SHS, shared an augmentation level activity in which a traditional vocabulary assignment for English language learners was redesigned to be more visually rich using the Pages® (Apple Inc., Cupertino, CA) application. Jordan shared:

> I went to an instructional coaches' meeting last week and they were talking about tools you can use when the Wi-Fi is down, how to use your MacBook, specifically; and one of the programs they talked about, which was a Mac program I had never seen called Pages. You can create files and do all sorts of stuff with it like edit text and images. So, I took that and we did a vocabulary one-pager in my reading class.

In lieu of having students merely define and discuss the meaning of a word, creating the one-pager allowed students to incorporate visuals into the assignment, along with their definition. Students were asked to find images within the Pages application and copy and paste those onto a Pages document. Figure 2 shows a product shared by Jordan, in which a student created a vocabulary one-pager for the word adolescent.

Figure 2

Vocabulary One-Pager Example

While teachers described 23 different augmentation level examples of technology integration, the most popular among the participants was the Canvas SpeedGrader tool (Instructure, Thoma Bravo, LLC, Salt Lake City, Utah). Teachers reported that the application allowed them to grade assignments such as essays and lab reports more quickly, saving them time while allowing students to have better and more expedient feedback. Sunny stated, "I love SpeedGrader! I use a rubric and I click, click, click! It's incredible. You can have 150 essays done in three hours instead of two weeks." Frankie also used the rubric function in the SpeedGrader tool to grade formal lab reports. Frankie expressed appreciating not having to carry home students' lab notebooks, as all the assignments were digital and could be accessed from the district-provided laptop. Additionally, Frankie shared that the SpeedGrader tool enhanced the ability to give feedback to students more efficiently, stating, "I just typed in little comments like, 'You did not differentiate your independent variables, minus five.' So, when they got their lab reports back, there wasn't a lot of discussion because it was all right there on the rubric. It worked quite well."

In the fall of 2020, teachers were allowed to request an iPad® mobile digital device and an Apple Pencil® computer input device (Apple Inc., Cupertino, CA), in addition to the district-provided MacBook Air computer, to help facilitate the hybrid model of simultaneous face-to-face and virtual learning. Tony, Sam, and Sidney all sang the praises of the improved functionality of grading electronically using the iPad mobile digital device and Apple Pencil computer input device. Tony reported, "I'm using SpeedGrader on the iPad rather than on my computer. It's super-fast, faster than on the laptop." Sam explained how the Apple Pencil computer input device and iPad mobile digital device helped to provide feedback for students:

> We've adopted iPad this year in addition to teacher laptops. We have Apple Pencil and we're able to write comments and do mark-ups in the traditional style where we are

> actually writing on papers again instead of just typing comments in the comment box. It's a really cool feature. I have the freedom to circle things, draw things, X things out, and really get physical with the paper.

Sunny also expressed appreciation for being able to give faster feedback to students with the SpeedGrader tool, stating, "I use it for every one of my college-application essays…They [the students] needed feedback right now because they have the turnaround in five days and they have to submit it to the colleges for early admission." Sunny went on to say:

> That's [SpeedGrader tool] the best piece of technology that I've seen come down the pike since we started grading electronically. We are actually going a little backwards with that Pencil; back to the papyrus and the goose feather, but it's fantastic. I just love it.

Sam described an additional grading feature in Canvas LMS where teachers can give video and audio feedback to students. Sunny described using the feature to provide students feedback on their resumes: "…for the resume project I found it more beneficial to do video feedback. For the majority of them, I gave a 20-second video clip because I wanted to give them some reason behind it [the feedback]." Because these enhanced grading features are enhancements of traditional teaching methods due to the improved functionality afforded by the SpeedGrader tool, they were all coded at the augmentation level. Although these augmentation level activities are not considered transformations, successful technology integration at this level may contribute to higher levels of CSE and build the skills needed to try more transformational activities.

Transformation SAMR Category

The transformation category of the SAMR model (Puentedura, 2006) has two levels, modification and redefinition. According to Hockly (2013), the modification and redefinition levels must be reached to realize the true potential of instructional technology. Analysis of the data revealed that all individual interview and focus group participants, except one, provided examples of lessons that had been significantly redesigned at transformational levels. Half of the participants described lessons at the highest level of the SAMR model, that of redefinition. Among the participants that described redefinition level technology integration, all but one had a CSE score above the district mean of 4.05.

- Modification level a priori code. According to Puentedura (2006), activities at this level have been significantly redesigned due to the affordance of a new tool. Puentedura (2013, 2014b) included video conferencing and discussion, online conferencing and discussions, student presentations with narration, and the use of data analysis software. In the current study, teachers' accounts revealed the use of a variety of software applications that allowed them to significantly redesign traditional learning activities. Table 12 summarizes HTISD's teachers' technology integration strategies at the modification level.

Table 12

Examples of Technology Integration at the Modification Level

Types of Technology Integration Employed by Teachers	CSE Score Range
Student produced videos and video discussions (7)	2.81 – 4.94
Synchronous and asynchronous collaborative student work with virtual teacher feedback (6)	2.81 – 4.88
Teacher produced multi-media, interactive presentations (6)	3.13 – 4.94
Student produced digital presentations of research findings (infographics, atomic theory magazine) (6)	3.4 – 4.94
Adaptive vocabulary development programs within digital learning platforms (6)	3.1 – 4.75
Adaptive learning activities and assessments within online textbooks/digital learning platforms (6)	2.81 – 4.75
Interactive video lessons with embedded assessments (5)	1.88 – 4.75
Multimedia digital interactive notebooks (3)	3.06 – 4.88
Interactive, multi-media, differentiated digital lessons with assessment and analysis tools; asynchronous and synchronous options (9)	1.88 – 4.44
Digital lab simulations (2)	1.8 – 4.1

Among teachers integrating technology at the modification level, several shared lessons centered around digital collaboration. Six teachers described lessons in which they used the Flipgrid^{TM} application (Flipgrid Inc., Minneapolis, MN) to facilitate asynchronous video discussions and collaboration. Jordan described using the Flipgrid application, stating:

> Flipgrid is a platform where students can record video or audio recordings. I've used it several times and I love it. It has emojis and stickers, and little fun props that kids can add to their videos to personalize them and have fun with them. They [the students] go online to record their responses to the prompt of the assignment. There's a viewer where other students can go in and view their classmates and watch each other's videos. They can add comments, or respond by recording themselves giving a comment or feedback.

Taylor also reported using the Flipgrid application, explaining:

> We use Flipgrid quite frequently for listening and speaking because they [students] get intimidated with 29 other people in the room. Being able to do it on Flipgrid means that they can redo it until they feel like it is perfect. Now they [the Flipgrid application] have a feature where you can reply via video instead of just a comment. Students can go in and reply like a discussion…it has been a huge way to be able to integrate speaking and listing into all the traditional modes of discussion.

Blake shared an experience in which students created digital book reviews using the Flipgrid application:

> Students recorded a book review related to various literary elements such as character analysis and conflict. Any student in the grade level could watch the book review when deciding on their next choice novel. Students left comments about the review for the reviewer.

Robin shared how she used the Flipgrid application:

> I apply it for kids to show what they learn in different forms, not just writing. It gives them an opportunity to demonstrate their understanding of content. I may embed it into their warm-up…have them read or watch a video and then they would respond to a question orally for me. I think it is good practice for them so moving into a workplace they have been able to present their ideas in a logical and consistent fashion.

Lane reported using the Flipgrid application for students learning virtually from home to present their projects to the students in class. Lane played the videos produced by virtual students in class for the face-to-face learners. Face-to-face students also had access to the Flipgrid presentations and were able to provide feedback to their peers virtually.

In addition to collaborating digitally via video, analysis of data revealed that seven teachers designed lessons to facilitate virtual collaboration using the Google Docs web-based word-processing program or the Google Slides web-based presentation program. Using these two applications, students were able to collaborate both synchronously and asynchronously to produce products and to receive feedback from their teachers. Taylor described having virtual writing conferences with students via the Zoom video conferencing application, and how the features of the Google Docs web-based word processing program improved the ability to provide feedback to students. Taylor shared:

> I pair student groups together or just put me and a student in a group [via the Zoom video conferencing application] and being able to work on a document together in real time, without just pointing here and marking red ink all over a physical copy…If it's digital it retains all of those comments and they choose what to see, or what to focus on, and what not to.

Robin detailed a lesson in which students were required to collaboratively create a Google Slides presentation to contrast the three regions of the original colonies, and how the features of the Google Slides web-based presentation program improved the ability to monitor student work and provide feedback. Robin explained:

> I drop into groups [via the Zoom video conferencing application] and can see their Google Slides*,* and see what they're working on. I can say in the [Zoom] breakout room, "Hey, I really like what you're doing, but you are going to need to rethink this"…But also, as kids were cheating and copying and pasting, I might delete it with a little comment like, "I deleted this because you copied and pasted. I need original thought and collaboration."

In addition to being excited about the collaborative features of the applications previously mentioned, six teachers enthusiastically described several applications that helped them transform how they delivered initial instruction. Three teachers with CSE scores below the district mean reported using the Nearpod™ (Nearpod Apps LLC, CO) application to create engaging and interactive lessons, while three teachers with CSE scores above the district mean reported creating video lessons by recording live lessons using a variety of tools and applications including an iPad mobile digital device, the Zoom video conferencing application, QuickTime Player® software (Apple Inc., Cupertino, CA), Flexile™ (Flexile Software Services Private Limited, Bengalura, Karnataka) and the YouTube online video-sharing platform. Taylor detailed the use of the Nearpod application as an interactive platform:

> It's a little different than a slide show presentation because it will ask them [students] to do activities like matching terms, take a short quiz, or a pull, drag, and drop terms to complete sentences, or even mark-up sentences with revising and editing tools. You can also layer screens so that you can provide them [students] with a mentor text…And, it allows me to see everyone's actions all in real time on one screen so I can address certain student groups, or one at a time individually if I choose. I can also add in things that keep them engaged…I can highlight a student that's done well and use it as an example and then I can put it up so I can take control of their screen and show them as an example and say, "Here's what I love about the student example; here's what we might need to focus on", and give them some more guided input.

Robin described the Nearpod application, stating that the presentation slides have "a lot of cool add-ons" and asserted that the Nearpod application was appropriate for "longer presentations and you are worried about maintaining focus."

Corey, Quinn, and Casey, all science teachers, reported learning how to produce their own video lessons during virtual learning. Quinn stated, "I've tried to do this for years. I've been forced to do it this year. I've finally got it done. It's been huge for me." Quinn went on to described creating video lessons using the recording functions of the Zoom video conferencing application. Quinn explained:

> One thing that has been super helpful was to record lessons by recording Zoom meetings, making a YouTube video of that Zoom and putting it on Canvas. My students seem to love it because they ask me before I'm finished for the day if I'm going to put it in Canvas, and I tell them, "I will post before I leave."

Casey also created videos of daily lessons, but described using a different method. Casey shared:

> I really fell in love with making notes with the iPad and QuickTime Player recordings on my screen as I'm writing on it. I usually do an informal share of the equations and then I stop the video after 8 to 10 minutes, then I start a new video. Kids that want to start solving problems, and don't want to watch the whole note taking [video], they just want to get to the problems; you make separate little clips. It [teaching] becomes a little easier for me because my reteach does not have to solely involve me trying to figure out what they're doing, "Did you go through the notes and watch the video? Okay, now you can come to me." It just takes a digital twist.

Corey described creating videos of lessons in a similar manner to Casey, but used the Flexile application. Corey stated, "Flexile is my new best friend. I love using it through my iPad. I can show notes on the big screen for the class and the students at home. I can use the notes section like a whiteboard." Corey and Quinn described the process for putting the recordings of these lessons into the YouTube video sharing platform and how they shared the links with the students in Canvas LMS. Casey edited the QuickTime Player files and posted them directly into the Canvas LMS.

Darby, an ELA teacher, described two modification level activities in which students created multi-media products. The first was a project called a "MeSearch" in which students researched a possible career. Darby stated, "Ultimately they are going to produce an infographic to represent the information digitally." This project was coded at the modification level due to the graphic design elements needed to synthesize students' research. Darby described another project in which students had to listen to three different audio podcasts and provide an oral review of the podcasts embedded in a slide with visuals using the Google Slides web-based presentation program.

Corey, a science teacher, also described a lesson in which students had to create a digitally rich product. Students were tasked with collaboratively producing an *Atomic Theory Magazine* to summarize their research of atomic theory. Corey explained, "Students had to pick an element form each group [of the periodic table]. They split up the duties...they do their part, and then put it together. They had to organize it themselves."

Sunny and Jordan, both ELAR teachers, described using adaptive vocabulary and grammar development applications. Sunny reported using the Membean™ (Membean Inc., Portland, OR) adaptive vocabulary development program, to help students "up their vocabulary game" prior to taking college entrance exams. Jordan reported using the Quill™ (Empirical Resolution Inc., New York, NY) application provided with the newly adopted online textbook, to help English learners with their vocabulary development. Jordan described the functions in the Quill application that had transformed her grammar instruction, explaining:

> I've used Quill since last school year. Quill is an online grammar structure…you can assign activity packs to your kids. I teach ESL students. So, there is a pre-assessment that you can assign…you can be very specific in what you want to assess…and it gauges, based on their grammar and their ability to write coherently with punctuation, where to start with my kids. I can also do a whole group lesson where I do my teaching portion and we're discussing, for example verbs and how to use verbs in the correct past tense. Then we do practice questions together and I can see what they are typing and choosing on my screen. I can stop and reteach.

Based on the descriptions of these programs and the interactive and novel ways they were used in the classroom, Sunny's and Jordan's descriptions of their use of these programs were coded at the modification level.

Several teachers also expressed enthusiasm for the improved functionality of newly adopted online textbooks. Sam, an ELAR teacher, explained, "It's more than a textbook and I think that's important to note. It's not just a digitized textbook. It's a learning platform; it's got integrated activities and it can evaluate." Corey shared that there are "so many quick little games and animations to help them [students]." Blake described using a new online textbook during virtual learning in the spring of 2020: "My online textbook has a wonderful feature called Blasts; they are current event articles…We really used them a lot when we went to online learning in spring." Blake explained that because the textbook was online, the publisher was able to continuously add new current events to the resource banks. "The textbook is not static, current events continue to be added." Dallas described the layout of assignments included with the online textbook, stating that there are "really cool assignments in our textbook that are laid out almost like Nearpod, nice set up; we are really excited about using our new textbook." When coding these accounts, I determined that the teachers were not referring to mere static, digital copies of traditional textbooks that would constitute a substitution level code. Also, the features described were much more advanced than features such as copy and paste that would warrant coding at the augmentation level. Thus, all references to use of the online textbooks described during the study were coded as modification level activities.

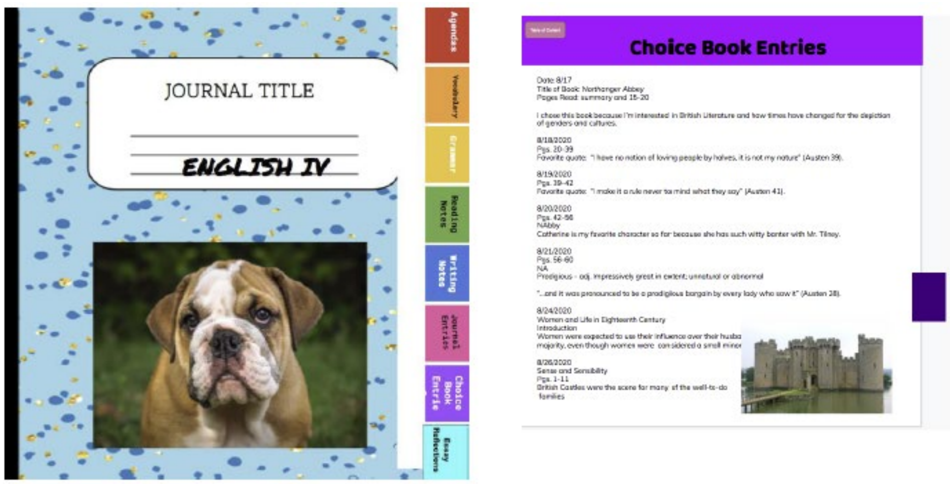
Four teachers reported using the Edpuzzle™ application (Edpuzzle Inc., San Francisco, CA) to edit educational videos to make them interactive and engaging. Corey explained the use of the Edpuzzle application, stating:

> You can download videos from the internet into Edpuzzle and embed questions into the video so they [students] have to stop and answer the questions. It's a self-tutorial. They have to go through, watch the video, and pay attention and answer the questions before they move on, and it grades for them.

Teachers reported using videos edited via the Edpuzzle application, both synchronously and asynchronously. Additionally, teachers explained that the Edpuzzle application included a grading feature that would provide instant feedback to students through the SpeedGrader tool of the Canvas LMS. Simple use of traditional educational videos was previously coded at the substitution level, while using the Canvas LMS to provide a choice of videos for students was coded at the augmentation level. Teachers' descriptions of improved functionality afforded by the Edpuzzle application, including the ability to edit videos, embed assessment items, or have those items graded automatically, necessitated coding the description of these activities at the modification level.

Figure 3

Example of Digital Notebook



Sidney, an ELA teacher at SHS, detailed the use of interactive notebooks created by students using the Google Slides web-based presentation program. Sidney explained that students were provided a template for their digital interactive notebook that was color coded by section. Sidney explained that students were able to personalize their notebooks with images such as "a picture of their dog, or the instrument the play in the band." Sidney also described ways students could manipulate their digital notebook, including choosing their own visuals, taking a picture of their writing and upload that into the notebook, copying and pasting pieces of the teacher's presentation, typing in their own notes into notebook, using textboxes, including digital images, journaling, and adding links to videos. Students were required to make daily entries in their interactive notebooks about the books they were reading and Sidney encouraged students to "include a favorite quote" or "find a picture that depicts the setting of your book of choice and insert an image from a web search." Sidney explained that, "Everyone may have a different image for the day." Because of the diverse functions described regarding the use of the Google Slides web-based presentation program to create digital interactive notebooks, this activity was coded at the modification level. Figure 3 shows a digital notebook artifact shared by Sidney.

Four teachers reported using the Canvas Mastery Paths^{TM} feature (Instructure, Thoma Bravo, LLC, Salt Lake City, UT), which significantly improved their ability to differentiate their lessons. Robin provided a detailed account of a lesson in which the Mastery Paths feature was used to help differentiate lessons in a social studies class. She expressed the need for using the Mastery Paths feature, explaining the class roster make-up had "some super GT kids that are just zooming ahead and some kids that need more teacher face time to get up to speed." Robin detailed how tiered lessons, designed by the teacher, were loaded into the program and that a pre-assessment was used to determine which students received which lessons. Robin elaborated:

> So, assignments open for each group based on their assessments. They [students] don't see what anyone else is doing; they just know what they are doing. Each group is working on things that are targeted specifically for them. The bottom [group] may be at the teacher table with different types of activities like a blackout summary where we gave them articles to read that were really a review of basic information about the Columbian Exchange. The middle group was a more advanced discussion about the economic and political impacts of the Columbian Exchange, and the top group was looking at a super advanced argument about the Columbian Exchange and its impact on local agriculture and population growth. The same topic, but vastly different reading levels. The goal was to keep your top kids engaged with rigorous content while not losing your bottom kids or vice versa.

Because teachers' ability to differentiate lessons was dramatically improved due to the features of the Mastery Paths feature, accounts of using this tool when designing lessons were coded at the modification level.

Lane and Alex both reported using Gizmos^{TM} online lab simulations (ExploreLearning, Charlottesville, VA) to have students perform virtual labs rather than hands-on labs during the fall of 2020 to mitigate the spread of the COVID-19 virus. Alex explained, "Well, in these unprecedented times, I relied a lot on online formats for labs…super complex lab simulations." Alex described how students were able to use the features of the Gizmos simulations, describing a case study about a man with diabetes and how dialysis worked. Alex elaborated, stating:

> The simulation goes all the way down to the level where students watch osmosis occur. They click and choose variables and they have case study handbooks; they have to mess with the pore size of the dialysis tubing and look at the difference between parallel flow and counter current flow to figure out that counter current flow does a better job.

Lane shared an experience in which students used the features of the Gizmos online lab simulations to review graphing skills. Because the features of the Gizmos simulations allowed Lane and Alex to simulate hands-on lab experiences students would have normally been able to have in a classroom setting, including tools for data analysis, these experiences were coded at the modification level.

Another modification level example lesson was shared by Robin, a SS teacher who described a lesson in which students took virtual tours of Jamestown and Plymouth. Robin shared:

> We have a good time comparing and contrasting Jamestown and Plymouth. So, they would take a virtual tour of Jamestown and Plymouth and see the difference in colonial development of the two cities. Kids are actually exploring what it looks like, why they are developing differently and why. Basically, they can guide their way through Jamestown and look at different people in different things, cabins, where the gardens were, how tobacco grew, it's about growing and making money…looking at Puritans; there's a well-developed community, because they brought their families overseas, so you see a church in the middle, and everything moves out from the church.

Robin described another virtual tour, stating:

> We'll be doing a virtual tour of Mount Vernon…we'll actually go to his house, walk inside, and go on a virtual tour of all the rooms in George Washington's house. I really want them to get out of this the wealth of the planter elite; to see how George Washington is really benefitting from slavery and cash cops being grown. All the symbols in the house that represent his status a great military leader, and then as President. They [the students] would be expected to talk about the significance of these findings in terms of a person like George Washington versus an immigrant who comes into Boston.

These accounts, taken together, provide evidence that all but the one teacher incorporated laptop technology at the modification level, thus they were at the transformation level of the SAMR model. It is noteworthy that the teacher who did not share an example of transformational level technology integration was new to the district and had only been teaching in the district for two months when data were collected. The data revealed that low CSE scores did not serve as a barrier to transformational digital pedagogy at the modification level, as teachers with CSE scores well below the district mean proved capable for transformational technology integration.

Redefinition level a priori code. The top, most advanced level of the SAMR model includes activities that would be inconceivable without technology, such as student-produced multi-media video presentations of a student's science field work, including graphs, charts, photographs, and narration that can be shared with an authentic audience, as suggested by Puentedura (2006, 2013). Four teachers that participated in the study described integrating laptop technology at the redefinition level. Table 13 summarizes the technology integration strategies classified at the redefinition level.

Table 13

Examples of Technology Integration at the Redefinition Level

Types of Technology Integration Employed by Teachers	CSE Score Range
Multi-media student presentations including video and audio (3)	3.13 – 4.88
Student produced websites with weekly blogs (1)	4.31

Three teachers described lessons at the redefinition level in which students produced multi-media presentations that included videos. Drew shared that physics students collaboratively produced multi-media slide presentations, including graphs, charts, animations, music, and videos using QuickTime Player software to present the results of a lab project in lieu of a traditional poster board presentation. Regarding the quality of the student products, Drew stated, “They get really creative with their technology.” Sidney described a senior English project in which students created digital senior legacy projects. Sidney stated that seniors “make their movie…compiling all their pictures to show their own little story, from where they were and where they are now.” Sydney explained that students included letters of appreciation to teachers, letters to their first grade selves, pictures of items they would put in a time capsule, theme songs, bucket lists, and commencement addresses. Regarding the final products, Sidney shared, “The way they put them together was so artistic and so crafty; it’s just a different kind of product than what you’re going to have if it’s just paper and pencil.”

Sam described a project in which students produced public service announcements as part of a public speaking unit. Sam said of the lesson:

> It was great because they had the video editing capability on their laptop because the district provides them with Adobe Suite…The products were really top notch…It was a lot more than I was expecting. They went out into their neighborhoods to film them. They wrote the scripts and acted them out.

Dallas described a redefinition level activity in which students created blogs and a website for a project for a “Genius Hour Project.” Dallas explained that each project included an introduction to the project, a presentation of research, advice from an expert, six weekly blogs, digital images of students’ work, and a reflection. The projects were produced using the Google Sites online website-building program and were “supposed to be shared with the world.” Dallas described the Genius Hour project of one student that sought to improve her drawing skills and explained that in order to create the weekly blog, the student:

> …set up her camera on still frame and she would practice her drawing. She would take pictures and come back and speed it up. Her blogs were actually drawing different things, but sped up at a fast, fast pace. That was a cool blog.

Dallas shared the experience of another student who wanted to become a better painter, stating that the student:

> …watched six Bob Ross videos and made six paintings…He interviewed an art teacher [each week] and she gave him tips. Each blog post was a reflection of the different paintings he did. When we did our big presentation where principals, teachers and parents, and everybody could come, he had all of his paintings up and also had his laptop so they could see his video blog.

The accounts provided by these four teachers were all coded at the redefinition level of the SAMR model as they were all multi-media video presentations, which matches the criteria set forth by Puentedura (2006) for the redefinition level.

In summary, RQ2 asked: To what extent does CSE predict teachers' ability to incorporate transformational levels of digital pedagogy in one-to-one learning environments?

The findings of this study suggest that most teachers in HTISD, regardless of their CSE, integrated laptop technology into their lessons at the transformational level of the SAMR model. However, few teachers provided examples of technology integration at the highest level of the SAMR model, and only one of these had a CSE below the district mean. These finding suggest that CSE may not be a barrier to transformational level technology integration, but high levels of CSE may contribute to teachers' ability to integrate technology at the redefinition level. The next section includes findings for RQ3 and teachers' perceptions of the supports they received from school leaders as they integrated laptop technology into their lessons.

Research Question 3

> *According to teachers' perceptions, what supports do leaders in schools with mature one-to-one programs employ to increase teachers' CSE related to digital pedagogy?*

To understand teachers' perceptions of the supports provided by leaders during implementation of the district's one-to-one technology program, the following five a priori codes, based on the 2009 ISTE leadership standards for administrators, were employed: (1) visionary leadership, (2) digital age learning culture, (3) excellence in professional practice, (4) systematic improvement, and (5) digital citizenship. Deductive analysis according to these predetermined codes consisted of several rounds of close reading of individual and focus group interview transcripts. After teachers' accounts were initially categorized according to the ISTE a priori codes, I continued to review data and refine coding. Table 14 summarizes the frequency of teachers' perceptions of support that were categorized according to ISTE a priori codes.

Table 14

Frequency of Teachers' Perceptions of Support Categorized According to ISTE a priori Codes

ISTE Standards as a priori codes for RQ3	# of References
Visionary leadership	47
Digital age learning culture	95
Excellence in professional practice	33
Systematic improvement	206
Digital citizenship	17

Further analysis of the data consisted of inductive coding which revealed emerged themes within each a priori code. After numerous rounds of inductive descriptive and in vivo coding, and consultation with my committee co-chair, I finalized codes within each ISTE a priori code. The following sections report findings for each ISTE a priori code and include emerged themes.

Visionary Leadership a priori Code

According to ISTE (2009), school leaders should "inspire and facilitate among all stakeholders a shared vision of purposeful change that maximizes the use of digital resources to meet and exceed learning goals, support effective instructional practice" (p. 1). Two themes emerged within the data for this code: shared vision and realistic and supportive climate. Teachers expressed excitement for the opportunity the one-to-one initiative provided students, and approval for the district's implementation of the program. Teachers also reported having reasonable amounts of time to acquire the skills needed to integrate technology in ways that supported students' mastery of specific standards. Additionally, teachers recognized the benefits of having a one-to-one technology program prior to the COVID-19 pandemic. Table 15 displays the teacher perceptions related to visionary leadership and the themes that emerged under this a priori code.

Table 15

Development of Emerged Themes within Visionary Leadership a priori Code

Teacher Perceptions Related to Visionary Leadership	Emerged Themes
Teachers' initial perceptions about one-to-one initiative: • Excitement about initiative (8) • Opportunity for students (10) • Teachers' perceptions about one-to-one implementation: • Smart implementation (4) • Worth the work (5)	Shared vision
Teachers' perceptions of expectations for implementation and support: • Integration based on learning standards and student achievement (7) • Realistic time to acquire new skills (5) • Supportive climate (4) • Benefits of having one-to-one technology prior to pandemic (4)	Realistic and supportive climate

- *Shared vision*. Several teachers discussed their perceptions of the district's implementation of a one-to-one technology program, how the program was implemented, and the expectations for use of one-to-one technology in the classroom. Taylor, an ELA teacher, described her reaction to learning of the one-to-one laptop initiative:

> Overjoyed! Simply because technology is something that I feel is imperative for today's children to understand... My teachers had to schedule computer lab time and there was no working outside of class on anything, so it was a huge learning curve for me in college. Learning that there were districts that were one-to-one and then coming here where there were one-to-one devices was revolutionary in my thinking. I was very excited about that.

Blake, an ELA teacher, explained why having students having one-to-one technology is an improvement over the laptop carts:

> I was very pleased because a lot of what we do, especially the writing process, not every kid can write in the moment, on the spot. Sometimes they need to think or mull things

> over a little bit more. We'd like to revise and edit, so having access beyond the school day was helpful, very helpful.

Sidney shared an experience about a senior student that transferred to HTISD from a district without a one-to-one laptop program. "I think it's so cool how HTISD can give our kids that one-to-one opportunity. Now she can take those skills she would never have had into a potential job opportunity." Jordan also shared excitement about the one-to-one program. "Initially, I was excited and I thought, Wow! We have all these new opportunities and doors that can open." These accounts were coded under the a priori code visionary leadership because they provided evidence of teachers' perceptions of the district's vision for the one-to-one laptop program. Inductively, these accounts were coded as a shared vision as they provide evidence that teachers perceive that the one-to-one program had the potential to benefit both teaching and learning.

In addition to teachers expressing their perceptions of need for a one-to-one program, some also expressed apprehension about having to learn how to incorporate technology into their lessons. Jordan shared:

> I was a little apprehensive just because of the resources that were available to me. I was sort of an old school teacher because we used what we had and I was comfortable with those practices and doing everything in a hands-on way and not in a digital way. I had to kind of re-train myself.

Jordan also shared the source of motivation for learning to use the new resources. "I've seen the payoff for some of the programs and tools we have available, so I'm willing to put in the legwork and find out how to use it." Other teachers also shared why they were motivated to learn new skills. Sidney explained: "Quite honestly, I hate going to the copy machine. I can't stand it…So, initially, I really liked one-to-one because I could change and adapt throughout the day and not feel like I had to make all new copies." Sydney elaborated on the importance of mindset in learning new skills: "It's helpful to know, this too you can learn. I think that's the part that helps me acquire new skills, and to know I've got to get on board with this." These accounts were coded under the a priori code visionary leadership because they were considered examples of teachers' buy-in for the district's laptop program. Inductively, these accounts were coded as a shared vision as they provided evidence that teachers perceived a need to learn new skills in order to successfully integrate laptops into their lessons.

Teachers also shared their perceptions of how they were expected to integrate one-to-one technology. Blake shared, "We wanted to make sure that when we used technology it was used in a way that was helping their education. Not just sit and type out papers, but actually be able to research and interact in their lessons." Dallas explained:

> I don't think that there were super high expectations from the outset as to how teachers were going to have students utilize computers in their classrooms. I think that built gradually over time. We are trying to work on meaningful lessons and stick to the TEKS.

Quinn shared a similar perception, stating:

> If it doesn't make sense, I'm not going to use technology for the sake of using technology. If it makes sense, and I feel like they're [the students] going to really gain from it and use it, then, okay, yes, because it is a lot of work to put all that together. I have figured out what works well and what doesn't. I may not use every single thing.

Taylor explained the approach of a subject level team:

> Before COVID, we were utilizing technology when it was necessary and helped enhance the skills that we're working on, but not trying to just do it to do it, but making sure that it actually enhanced whatever lesson it was that we were working with.

These accounts were inductively coded under the theme of realistic and supportive climate as they provide evidence that teachers perceive leaders' expectations for technology integration as reasonable.

- *Realistic and supportive climate.* Casey and Blake both shared perceptions of leaders having realistic expectations regarding the time it takes teachers to learn new digital skills. Casey shared: "We have all of these things…there are 500 million things to choose from, but we've got to just be comfortable with a couple of things and do those well." Blake also shared a perception of being provided time to learn new skills: "Not rushing into things but really giving us time to think through and learn and do has been one of the most amazing things." These teachers' accounts were coded with the visionary leadership a priori code as they provided evidence that teachers shared a similar perception among them that they were to implement digital tools in a way that helped students achieve learning goals. Inductively, they were coded under the theme realistic and supportive climate, as teachers did not perceive that they use technology for technology's sake alone. As Jordan stated, "I did not feel a ton of pressure to use the laptop every day."

A few teachers shared their perceptions of the district's implementation plan in which devices were deployed slowly, one 9th grade cohort of students at a time over four years until all high school students were provided devices. Dallas stated: "I think [HTISD] has done an amazing job…[HTISD] has done a lot of things right." Robin shared:

> I thought it was smart the way they rolled it out to be honest. Everybody wanted it all four years initially, but I think that would have just created a lot of headaches…That helped me with my comfort level because I could watch others as they were trying things out. I was learning gradually while they were experimenting with things. That helped me a lot because my initial reaction to technology was a little bit hesitant.

These accounts were coded with the a priori code visionary leadership as they provided evidence of teachers' positive perceptions about the implementation plan of the district's one-to-one laptop program. Inductively, these accounts were coded within the realistic and supportive climate theme as they provided evidence that the gradual implementation provided time for teachers to learn new skills.

Finally, several teachers expressed gratitude that the district had implemented a one-to-one technology program prior to the COVID-19 pandemic. Teachers also expressed appreciation for the supportive climate administrators created to help relieve stress caused by the moves to virtual and hybrid learning. During a focus group interview, Sam shared:

> I will say, I feel like we were better off being a one-to-one campus when we had the crisis of the 2020 COVID pandemic, and I think that's important to note. I don't think we would be up and running as efficiently as we are without this. For me, it's helped across the board.

Tony added, "[Sam's] right, the learning curve for technology integration into lessons has been extremely steep, but having our foot in the door by having one-to-one already in place was instrumental in getting us moving a little bit faster on this." During an individual interview, Alex shared:

> I cannot even tell you how amazing I feel like the support on my campus has been with all the minor stuff that seems so important in others years. This year has been kind of let it go! We can wear jeans anytime we want. There's flexibility in what we are doing and tremendous support. We have re-looked at things that in a normal year you would have to do. I think there is a very high level of awareness on the part of our administrators on how close we are to drowning; we're just trying to breath. I think they've been tremendously helpful with that.

These teachers' perceptions were coded under the a priori code visionary leadership as they represent buy-in for the district's one-to-one program and the temporary changes in direction due to the COVID-19 pandemic. Inductively, these accounts were coded under the realistic and supportive climate theme. Having an established one-to-one program prior to moving to a virtual or hybrid learning environment and a having realistic and supportive climate was perceived as helpful for teachers.

Digital Age Learning Culture a priori Code

According to ISTE standards (2009), administrators should, "create, promote, and sustain a dynamic digital age learning culture that provides rigorous, relevant, and engaging education for all students" (p. 1). The deductive coding process revealed 72 accounts in which teachers shared their perceptions of learning to use digital tools by collaboration with colleagues. After these accounts were assembled, two themes emerged during inductive analysis: collaboration and encouragement. Table 16 displays the teacher perception phrases related to a digital age learning culture and the themes that emerged under this a priori code.

Table 16

Development of Emerged Codes within Digital Age Learning Culture a priori Code

Teacher Perceptions Related to Digital Age Learning Culture	Emerged Themes
• Inspired by others (5) • Collaboration among teachers: o Teacher teams/PLC (17) o Other teachers (5) • Collaborating with support personnel: o MRS/Technology Integration Specialist (22) o IC (15) o Coordinators (7) o Technical Support (5) • Collaborating with students (3) • Collaborating with learning communities beyond the district (4)	Collaboration
Perceptions of encouragement (12)	Encouragement

- *Collaboration*. Several teachers provided accounts as evidence of a well-established

digital age learning culture. A primary theme that emerged within this a priori code was collaboration. Teachers shared accounts of collaborating with their colleagues across the campus and district, among their subject matter teams and professional learning communities (PLCs), with their students, and with learning organizations beyond the campus. Sidney described how observing how an instructional specialist's personalized laptop inspired a sense of ownership for the district-issued laptop:

> I felt like it [laptop] wasn't really mine. I saw someone else that had a cute little keyboard cover. She was a social studies instructional specialist and she was just the nicest person. She said, "You know, it makes your keys not make noise." And she had a cute little cover, and I said, "Oh, okay, if I'm going to get on board, this is what I need to do." I invested in a keyboard cover…it was Picasso or something. I thought, "I can do this." It made me feel like it was not so delicate. I really thought I was going to damage it because

it was so fine and skinny and cost a lot of money.

Dallas described an experience of being inspired to use a digital collaboration function of the Canvas LMS after seeing other teachers use the function:

> There are a few teachers who have figured out how to do Groups in Canvas a little bit easier, so the next time I'm going to try and do that. That way they [students] can collaborate and build stuff together with me.

Robin explained how the first teacher cohort teaching students with laptops was able to help other teachers learn to integrate technology:

> It was fun for the freshmen teachers to become basically the trailblazers for everybody else. They were the ones teaching everybody. That's not usually the way that works and it put them in a very unique leadership position to help other teams, and so I think they felt pretty valued.

These accounts were coded under the a priori code digital age learning culture because they represent examples of teachers being inspired by other teachers to embrace one-to-one technology. Inductively, these teacher perceptions were coded under collaboration as they provided evidence for a collaborative spirit among district teachers.

Several teachers provided examples of collaborating within their teacher teams or PLCs. Drew described dedicated team time as an important support during teacher in-service: "Time with your groups to talk through planning with technology…It was amazing to be able to sit together with teachers and walk through and solve problems." Alex, a teacher with a CSE score of 1.88, explained how the support of a team helped with successful technology integration:

> My learning curve is still on the up rise and I have a really great team. They are much more technologically savvy than I am. So, when I think of something I'd like to do, they can usually figure out a way that it can be done. I am rarely the one who's setting it up.

Alex also described the benefits of help from a team lead:

> My former team lead was great at technology. I got more comfortable the more we did. I can see myself figuring out yet another piece. I've heard good things about SpeedGrader on the iPad …that's what my team lead always does.

Sidney also shared about learning to use the SpeedGrader tool from a team member. The team member said, "No, no, no! You need to combine those two classes together. You're making it harder than it has to be. Here, let me show you." These accounts provide further evidence for an established digital age learning culture in HTISD. Inductively, these accounts represent evidence of a culture of collaboration among well-established teams, or PLCs.

In addition to providing evidence for a well-established collaborative culture among teams, teachers also shared their perceptions of collaborating with campus support teams, including technology integration specialists, media resource specialists (MRS), instructional coaches (IC), and technical support teams. Jordan described a collaborative approach to technology integration and the variety of support available:

> The first thing I do is reach out to other teachers that I know have done it, or used it in their instruction. Also, our media resource specialist here on campus, I reach out to her and see if they can help me. Beyond that, we have a very easy, simple process in [HTISD] where we have an icon on our desktop. Usually within a week or so we have a technology person contact you and they resolve whatever problem you're having.

Casey shared:

> I have definitely used the help of staff members and the media resource specialist, but the instructional coach is a little quicker and easier to get at because she's not being pulled all over the campus, just within the department, and it's very helpful with the team members to know all the things that have been created for years. That means less creating on my end.

Alex described support received in the fall of 2020 when trying to reconfigure a classroom for virtual learning:

> Our technology integration specialist and MRS…they were very helpful in helping us get resources that were already on campus. If you need a 15 foot HDMI cable, you'll have one. If she had one, she'd bring it to you. We all managed to get a second screen to go with our laptops so we can put our Zoom [students] over on the right and still have our regular screen up.

These accounts provided evidence that HTISD has staff members devoted to assisting teachers with technology integration and that teachers regularly collaborate with these staff members.

In addition to collaborating with colleagues, teacher teams, and campus support teams, teachers also shared experiences of collaborating with students to better incorporate technology into their lessons. Alex grappled with how to have students turn in digital work and a student suggested: "Why don't I create a folder in my Google Drive and share it with you? I'll just put all of my documents in there." The teacher responded: "That works." Alex shared another experience of learning from a student how to manipulate a PDF. "One of them [students] did show me how (on his iPad) he was able to edit a PDF by going into PDF preview and there's an edit tool at the top. I shared that with the whole gang." Joe described being inspired by a student to provide only digital assignments:

> So, she's completely paperless. At first, I hesitated because I was like, "I really think you need a notebook. You know, at least a notebook to jot things down." She has it completely under control and I'm learning from her.

Joe continued explaining how the paperless student helped when the Apple Pencil computer input device stopped working:

> There've been a couple of days in class when my Apple Pencil didn't work and I couldn't figure out why. I would go to her and she would immediately tell me, "It isn't a stylus, it's called a Pencil." We used to call them a stylus, but it's different with Apple. The first time I realized my [Apple] Pencil quit working in class and I was like, "What's wrong, what's wrong? It's not working!" and she goes, "You have to charge it."

These accounts of teachers learning from students provide further evidence of an entrenched digital age learning culture. Inductively, these accounts were included in the collaboration theme because HTISD teachers were also willing to learn from students.

A few HTISD teachers reported collaborating in teacher networks beyond HTISD. Robin described groups that helped her with technology integration: "I joined a lot of different teacher groups across the nation. I have several different Facebook teacher groups. I have an AP mentor for College Board; we have a little group we're all a part of and share ideas." Drew reported getting ideas for technology integration from the Physics Teachers' Association and the Conference for the Advancement for Science Teachers. These accounts were coded under digital age learning culture and the theme of collaboration as they provide evidence that teachers engage with learning communities beyond the district.

- *Encouragement*. The second theme that emerged within the data for a digital age learning culture was encouragement. A few teachers provided accounts of when they encouraged fellow teachers to try new digital tools, or when they had been encouraged by others to acquire new skills. Casey described being willing to help teammates:

> I'm at the top of the totem pole in the technology department for my team. I definitely help them with a lot of things that when they see how it's done and how it's really easy, the have "oh" moments, like, "Oh, I should have known that." But I don't mind.

Drew described encouraging teammates to learn how to use the Canvas LMS:

> The teachers I was co-teaching with at the time were a little hesitant to use it [Canvas LMS] because they were stuck in their little groove and had not started creating one [a Canvas course]. I told them, "OK, let's do this, let's go ahead, we need to get going." I was kind of curious to know what it was and how to do it…The first and second year it was like baby, baby steps just convincing everybody to start using it.

Drew also described encouraging teammates to have students make digital presentations of their lab reports rather than traditional presentation boards:

> When I first started working here it [lab presentation] was done on a poster board or the tri-fold presentation boards. It was so 1980s. I said to the team, "Can we please stop using posters and actually have these kids do digital presentation? Nobody does things on poster board anymore except little kids. We need to do the digital version."

Sidney described the value of encouragement in getting motivated to learn how to use the SpeedGrader tool:

> I don't know if just having [the MRS] would not have been enough…having both of them [colleague from across the hall and a teammate] say, "Come on, I know you can do this; come on, this is not that hard. Just give it a chance and roll with it. They kept telling

> me to use it, it's easy. [The teacher across the hall] came over one day and said, "Come on, you're going to love it so much more. Please, just trust me." So, probably two days later, I know she's coming back….so I finally decided to use it.

These examples of encouragement provided further evidence of a digital age learning culture within HTISD. Inductively, these examples were coded as encouragement as they provided examples of teachers encouraging one another.

Excellence in Professional Practice a priori Code

According to the ISTE standards (2009), administrators should, "promote an environment of professional learning and innovation that empowers educators to enhance student learning through the infusion of contemporary technologies and digital resources" (p. 1). Teachers shared 33 accounts of their perceptions of professional learning related to technology and digital resources. Once these accounts were categorized using the a priori code, teachers' perceptions were analyzed inductively. Two themes emerged during inductive analysis: job embedded professional learning and continuous improvement. Teachers frequently described scenarios in which professional learning was provided by MRSs and ICs during team meetings.

Table 17

Development Emerged Themes Within Excellence in Professional Practice a priori Code

Teacher Perceptions Related to Excellence in Professional Practice	Emerged Themes
• Professional learning delivered campus technology support teams: o MRS (12)Technology Integration Specialist (2) o IC (5) • Professional learning delivered by teachers (5) • Professional learning delivered by outside vendors (3)	Job embedded professional learning
Need for additional professional learning (6)	Continuous improvement

Teachers also gave recommendations for improving professional learning for new teachers. Table 17 displays teacher perceptions related to the excellence in professional practice a priori code and includes the themes that emerged through inductive analysis.

- *Job embedded professional learning.* The most common accounts of perceptions of professional learning shared by teachers included learning from campus support teams, including MRSs, ICs, and technology integration specialists. Sidney and Joe both shared accounts of learning digital skills from ICs who had produced video lessons to teach specific digital skills. Regarding video lessons produced by ICs, Sidney reported learning to create digital interactive notebooks and use the Flipgrid application. Joe reported learning to use the Google Slides web-based presentation program to replace hands-on manipulatives in the science classroom. Teachers reported that these videos were produced as part of the beginning-of-the-year in-service in the fall of 2020 and were available to teachers through a professional learning Canvas course maintained by the campus MRS. Sidney shared her perception of having access to the videos:

> Having those videos was a huge help. You've got to see it three, four, five, six, seven times. Especially if you do it at the beginning of the semester and don't do it again for a while. You feel crazy for asking for help because you think you've already done it. So, having those videos was a big thing.

Blake also reported utilizing the video lessons in the Canvas course:

> I can't say enough about our MRS and the little digital lessons that's she's done on how to navigate some of our online apps [such as] Nearpod. Those have been invaluable. A true servant leader makes a big difference for our campus; one that is pragmatic and solution oriented is a huge, huge bonus for any team.

Drew also expressed appreciation for the how-to videos produced by fellow teachers, explaining:

> The videos have helped us. Having them show step-by-step because I'm one of those. I have to see it and hear it and then write my notes and try it, and if I mess up, I go back and watch it again. I'm not the one that could just read directions and run with it; show me some pictures, walk me through it, and then let me try it myself.

Teachers also shared that fellow teachers produced video lessons for the Canvas course. Corey shared an experience of learning to create video lessons for students by watching a video lesson created by teachers. Corey stated, "With teachers putting together that Flexile video, it was easy to pick up."

In addition to sharing experiences using video lessons, teachers also shared experiences of campus support teams visiting with teachers' teams, PLCs, or individually to provide instruction related to technology integration. Taylor described a time when the campus MRS helped a team learn to use the Mastery Paths feature:

> Something that was wonderful, learning in small groups where we can ask all of the questions that come up, that we know how to solve those itty-bitty issues are fantastic. Like when [the MRS] comes to our PLC and walks us through the entire step of how to create Mastery Paths in Canvas.

Taylor also detailed how the campus MRS helped the team master the Nearpod application:

> [The MRS] walked us through the teacher view, to number one, how to set them up. She showed us how to create the module, then she told us how to put students in each of those groups, or how to create initial assignments that would place them in groups. She showed us how to create individualized lessons for each of those groups and how to arrange them physically so that they would progress through them without being able to see all of them at one time. They'd have to do activity one to be able to see activity two, and so on and so forth. And then she showed us how to download the student progress reports so that we see where they were falling and see if they mastered [the material] in their specific group or if we might need to reassess and assign them to be a different group.

Robin described a time when the campus MRS helped a PLC team learn how to incorporate applications like Flipgrid into a lesson:

> She's super good at it [technology integration] and I think she's helped our teams quite a bit. She's come to our PLCs for trainings to help us learn how to access external tools like Flipgrid…She's been really key; I think for all of us in upping our technology game.

Robin also described the MRS helping less tech-savvy teachers during virtual learning:

> The MRS was absolutely a godsend in that she would literally spend hours with [a teacher]. One day [the teacher] would share a screen and [the MRS] would tell [the teacher] click by click. [The MRS] went through step by step with [the teacher]. Now [the teacher] is actually doing OK. I mean, it's basic stuff, but you know, it's big progress. So, it's all about measuring against where [the teacher] started. Everybody's on their own journey.

Alex described learning new digital skills from campus technology integration specialist during staff development:

> Our technology [integration] specialist is phenomenal and is right here on our campus…She runs a lot of our staff development meetings and she's really good at helping us trouble shoot and figure out how to do things. She helped us with Mastery Paths and we're in the process of converting all of our quizzes into Canvas.

These teacher perceptions of support were coded with the a priori code of excellence in professional practice as they provided evidence of a well-established system of support related to digital learning. Inductively, these accounts were coded under the theme job-embedded professional learning as they represent examples of professional learning being provided in the context of teachers planning when the learning was most relevant.

While most teachers shared their perceptions of learning new digital skills from fellow staff members, a few staff member shared perceptions of professional learning provided by HTISD from vendors outside the district. Taylor described choosing to attend a live webinar conducted by a Nearpod representative as part of the district's beginning-of-the-year professional learning:

> There was a live webinar at this year's academy. There was an hour-long session and our rep for Nearpod went through every single function and how to create lessons to share those lessons so that we could, teachers could work collaboratively on them and decide what works best. [Paraphrasing Nearpod representative]: "Here's how you create an assignment." They scaffolded it [the training] for us so that we're able to progress into the further skills.

Sidney shared learning how to use the Zoom video conferencing application from a representative hired by the district to help teachers learn to use the application as they moved to a synchronous virtual learning platform in the fall of 2020:

> She [the instructor] would walk us through as a student, but also as a teacher to show how all that was orchestrated on her end…It was vital for me because I was able to see her pull all the bells and whistles; it was just so neat because I thought, "OK, this is doable, we can make this work."

Because all of these accounts described teachers' perceptions of how they were supported in learning new digital tools, they were coded with the a priori code excellence in professional practice. Once the deductive codes were codified, these accounts were coded inductively as job embedded professional learning. This inductive code was chosen because teachers seemed to be describing instances in which they were being supported with professional learning within a particular context to meet a specific challenge.

- *Continuous improvement.* Although many teachers shared their positive perceptions of professional learning, other teachers shared that additional professional learning was needed. Robin shared the struggles of a senior SS team when digital learning accelerated due to the pandemic in the spring of 2020:

> They [the senior SS team] had Canvas the least amount of time and struggled due to a lack of training: The first year [of the district one-to-one implementation] we got a lot of training on Canvas. After that, the training on Canvas went downhill quickly. The next groups just didn't get much. They need training, and they want training or they are going to get frustrated. That's why you see teams not using Canvas effectively. We had an entire group that needed to be trained on Canvas and Google.

Robin asserted that all teachers need additional training for the Canvas LMS: "I think we're just providing the surface of what Canvas can do for us. I would love for us to have more really advanced trainings on Canvas." Jordan advised leaders to implement more training about how to use the Canvas LMS for new teachers:

> For new hires, thinking of myself, having specific training on what Canvas can do. I'd never heard of Canvas before I got here…. I was brand new to online lessons, so specific training over programs that are district-wide.

Because these accounts referenced the need for specific professional learning related to digital tools, they were coded with the a priori code excellence in professional practice. However, they were inductively coded as continuous improvement as they represented teachers' recommendations for improving professional learning supports.

Systematic Improvement a priori Code

According to ISTE standards (2009), administrators should "lead purposeful change to maximize the achievement of learning goals through appropriate use of technology and media rich resources" (p. 2). Teachers shared 206 examples of incorporating media rich resources into their lessons. Although no themes emerged as a result of inductive analysis of the data for this a priori code, it was useful to categorize the types of digital resources teachers described using. Most of the software applications described by teachers were either provided with the laptop devices or were integrated into the Canvas LMS. Table 18 summarizes the technologies and digital resources HTISD teachers described utilizing.

Table 18

Contemporary Technologies and Digital Resources Used by HTISD Teachers

Hardware (with Included Software)	Learning Management Systems	Google Products	Other
• MacBook	• Canvas LMS (34)	• Google Slides (14)	• Zoom (14)
• Adobe Suite (5)	• SpeedGrader (9)	• Google Docs (10)	• Flipgrid (10)
• Pages (1)	• Groups (3)	• Google Sheets (3)	• Edpuzzle (4)
• QuickTime Player (3)	• Discussions (2)	• Google Cloud (2)	• Near Pod (4)
• iMovie (1)	• Mastery Paths (5)	• Google Search (2)	• Bitmoji (4)
• Screencastify (2)	• Online Textbooks (14)	• Google Survey (1)	• Kahoot! (3)
• iPad (9)	• Study Sync (3)	• Google Sites (1)	• Flexcil (2)
• Notepad (1)	• Quill (3)	• Google Draw (1)	• Word (2)
• Apple Pencil (13)	• StudyBlasts (2)	• Google Cardboard (1)	• Gizmos (2)
• Presentation boards (8)	• AP Classroom (1)	• YouTube (5)	• Membean (2)
• Webcam (1)			• Podcasts (2)
• Multiple Screens (2)			• Ted Talk (1)
			• PowerPoint (1)
			• Prezzi (1)
			• Quizlet (1)
			• Quizziz (1)
			• QR Code (1)
			• Padlet (1)
			• Plickers (1)
			• Name generators (1)

Note. Numbers in parentheses represent the number of instances of use in a particular lesson, not the number of times participants referred to these devices or applications.

Several teachers described devices and hardware they utilized during digital learning. Sam described a variety of hardware used when teaching in the hybrid model, including "three computer monitors, the district-provided laptop, plus two additional screens, a microphone, a camera, drop down screen background, and digital presentation board at the front of the room." Lane described using a Vivetek™ (Delta Inc., Taiwan, China) digital presentation board at the front of the room that allowed virtual students to present their science projects to a class with both virtual and face-to-face learners:

> [Students] made little videos [using the Flipgrid application]. I hooked up my Vivetek board to my laptop with a video cable, and we could project their projects on screen so the entire face-to-face class also got to see what they were presenting. That was interesting. I'm very encouraged.

In addition to describing the physical setup of their technology, teachers readily shared how they utilized a variety of software applications. During a focus group interview, Tony described using the Canvas LMS: "This year we have been using it daily. Our agendas and all of our assignments, at least the initial introduction to the assignment, is loaded into Canvas." Frankie added, "All of my assignments are in Canvas; they submit things on Canvas." Lane shared how the integration of the Canvas LMS with other software applications had improved over time:

> This is our seventh year and I've seen how even Canvas has improved a lot. We can now integrate so many of these programs into Canvas so you're not going back and forth between programs. Not telling students, "Hey, now you have to sign up with this account or that account." It's pretty much integrated.

Corey described how the EdPuzzle video platform was integrated into the Canvas LMS stating:

> I have a lot of EdPuzzles integrated into my Canvas. Students do not have to go to EdPuzzle; they go to Canvas modules and the assignment is there, the video is there, the questions are there, they just complete the assignment and submit, it grades it for them, the SpeedGrader does it.

Jordan explained that the learning curve with district technology was made easier because the district had integrated so many programs to work together:

> I'd say most of [my learning curve] was pleasant because of the programs and resources that our district provided and paid a lot of money for. They work. They integrate with other programs and work smoothly. I've had experiences in the past in my previous district where you would use this resource with that resource and they didn't read each other, or they just didn't work.

Joe also shared the perceived benefits of the district integrating software programs:

> This is key because I know how frustrating it is to ask the kids to sign up for something, or go out and use something else. Just as a parent of three kids, no kidding, we've probably signed up for 25 apps this year. If we can keep it all streamlined for the kids, they won't get as frustrated and they will be more likely to complete assignments.

Although most teachers reported using Canvas as their primary LMS, some teachers shared their experiences using the LMS features of newly adopted online textbooks. During a focus group interview, Sam elaborated on the features of an online English textbook:

> It's more than a textbook and I think that's important to note. It's not just a digitized textbook. It's a learning platform. Why I bring that up is that it's got integrated activities such as vocabulary development. It can also evaluate. So instead of having to do separate assignments or submit something, they can do writing assignments directly in the StudySync platform. And for me, that's helpful as I'm trying to pare down the number of different platforms kids are on.

Sunny added, "We used a StudySync unit on Hamlet. Hamlet activities came through the units. There were background vocabulary and questioning, then students had to write a paragraph within the StudySync unit." Tony also described using the features of the digital textbook, explaining: "We also use the digital textbook with StudySync. We have been using StudySync since we have been using the Blasts, usually a current event or some sort of issue that they have to comment about." Jordan explained the benefits of using a new digital textbook:

> Everything was in one location…there were tons of resources. If I need a lesson over a grammar structure, or vocabulary, or whatever I was doing, I could just search and it would pull something that I could use and turn around and put into my lessons.

Dallas also described exploring the features of a newly adopted digital textbook: "We're beginning to use the digital textbooks some…really cool assignments in our [digital] textbook that are laid out almost like Nearpod. Nice set up; we are really excited. It has a pretty good grammar component." Dallas shared that unlike the Canvas LMS, online textbooks do not integrate well with all programs, but the district was trying to help. Dallas stated:

> That textbook doesn't communicate with our stuff so we end up doubling the work on things. The gradebook is not conducive with our stuff and we found out that the kid's log ins are the same in World Geo. The district is trying to help with the grading piece and the single sign on. It is getting resolved.

These accounts of teachers' perceptions of using LMSs such as Canvas and online textbooks were included under the a priori code of systematic improvement as they represented use of technology and media rich resources provided by HTISD.

In addition to sharing perceptions of using LMSs, teachers provided other accounts of innovative use of software applications. Quinn described learning to record lessons taught via the Zoom video conference application:

> One thing that is super helpful, and I've tried to do this for years, was recording lessons. This year I've been recording Zoom meetings and making YouTube videos of that and putting it in Canvas. My students seem to love it because they ask me before I'm finished for the day…It's been huge for me.

Taylor described using the Canvas Mastery Paths feature in the Canvas LMS to differentiate lessons:

> Mastery Paths are where you can create student groups based off of where they are hitting their skills for differentiation. When your students are exceeding the skills and they need to be pushed to a higher level, we really promoted mainly self-inquiry in English. Then, for another student group who is just mastering skills and need to be pushed to exceed on skills. Another group who missed skills might just need to focus on remediation and just need to have a different way to have that lesson retaught to them, or additional practice to succeed.

Jordan shared the usefulness of the Flipgrid application, explaining:

> It gives them an opportunity to demonstrate verbally their understanding of the content…that might be embedded into their warm-up for the day. They may have to read,

or watch a video, and then they would respond to questions orally for me; it gives them a workspace to be able to present their ideas in a logical and consistent fashion.

Jordan described enjoying using the digital resources the district provides: "I've definitely learned a lot of programs, online resources, and ways we can utilize Canvas. I wouldn't go back. It'd be very hard to go back because it can spoil you." Taken together, these accounts provide examples of the systematic improvements made by HTISD, especially the provision of digital resources.

Digital Citizenship a priori Code

According to ISTE standards (2009), school leaders should ensure "equitable access to appropriate digital tools and resources to meet the needs of all learners" and "promote, model and establish policies for safe, legal, and ethical use of digital information and technology" (p. 2). Teachers shared only 17 perceptions that were coded with this a priori code. During inductive analysis of these accounts, two themes emerged: equity, and safe, legal, and ethical use. Table 19 displays teacher perception phrases related to the digital citizenship a priori code and includes the codes that emerged through inductive analysis.

Table 19

Development of Emerged Themes Within Digital Citizenship a priori Code

Teacher Perception Phrases Related to Digital Citizenship	Emerged Themes
Perceptions that one-to-one helps them reach all students (12)	Equity
Perceptions of management of technology (5)	Safe, legal, and ethical use

- *Equity*. Within the theme of equity, teachers shared their perceptions of how one-to-one technology helped them reach students who were learning virtually. Jordan explained the importance of one-to-one technology during virtual learning:

During the pandemic, during all the virtual learning, I feel [one-to-one technology] has

> been a must because we have to do it to reach all of our kids… even the students that are still at home can still be getting exactly what other students in the classroom are getting…Things that I've explored this year have only benefited my ability to reach kids. And of course, my focus has been on reaching my kids virtually.

Joe described the benefits of one-to-one technology and the Canvas LMS for reaching virtual learners:

> Obviously, we have to use Canvas with the kids at home right now; without that we would have no connection to students at home. I have a virtual whiteboard on Canvas with what we're going to do, what our objectives are, and any links to resources or paper now have gone all digital.

Lane expressed concerns about supporting every student during the pandemic: "We're trying to support every student, even those face-to-face and on Zoom, keeping it equitable. We just want to keep the river going."

- *Safe, legal, and ethical use.* Finally, several teachers shared their struggles with

students using technology in safe, legal, and ethical ways, suggesting that teachers perceive a need for additional support in this area. Casey described the challenges of managing computer use in the first year of teaching:

> That first year, teaching freshman, I noticed they may not be ready for such an unrestricted technology use, so, games were being played. It was a bit of a distraction. Now I'm okay with that. I know it's going to be there. There is going to be off-task behavior; it happens no matter what.

Sidney described monitoring students' use of laptops in the classroom: "I teach at the back of the room because I want to see all the screens…I think it helps to move the lessons along so that you don't have people who are distracted, doing whatever."

Teachers shared that monitoring students' computer use had become more difficult during virtual learning. Alex explained:

> The whole online kid thing is mostly about academic honestly and their integrity. You can't watch them take the test…I've had some questionable moments, but there is nothing I can question them about…there's absolutely no way I can prove it one way or

> the other. It would be just a he said/she said conversation that would damage the relationship. I cannot count the number of times I have submitted a quiz because a kid disappears from Zoom but I know they are still there. They email the teacher, "My Internet went out, but I was still taking the quiz" … [Alex replies] "You are still taking the quiz but your Internet went out? Your Internet went out but you were able to email me? How does that work? No, I submitted your quiz."

Tony described the challenges of the lack of engagement of some virtual learners:

> I think it is very difficult to manage the hybrid classrooms with both in-person and virtual students at the same time because you fight battles that are impossible to win, but we have to fight, we are expected to fight the battle…kids that link into the [Zoom] meeting and then immediately turn off their camera and never respond…those are very real issues…I'm thankful we have had a leg up on the one-to-one; that made a huge difference, but it's been much more difficult to teach this year than it's ever been, in my opinion.

Darby also described struggling to engage online learners, stating: "But we fight; we are expected to fight the battle. Kids link into meetings and then immediately turn off their camera and never respond. Things like that, those are very real issues."

These findings suggest that teachers perceive that the district's one-to-one laptop technology program helped them equitably reach students during virtual learning. However, these accounts also suggest teachers need additional support related to managing students' use of these devices.

Summary

The purpose of this study was to discover, from the perspective of teachers, which supports promoted teachers' CSE for integrating laptop technology into their lessons and to what extent those supports lead to transformational levels of digital pedagogy. Quantitative data were collected through a survey administered with the Qualtrics platform and descriptive statistics were calculated using SPSS software. Qualitative data gathered from six individual semi-structured interviews and two focus group interviews were gathered using the Zoom application. Interview transcripts were deductively analyzed according to a priori codes developed from the four levels of the SAMR model (2006) to determine the extent to which transformational digital pedagogy was being incorporated into classrooms. To ascertain teachers' perceptions of support, transcripts were deductively analyzed according to a priori codes developed from ISTE administrator standards (2009). Data related to support were re-examined and coded inductively, resulting in the following emerged themes: shared vision; realistic and supportive climate; collaboration; encouragement; job embedded professional learning; continuous improvement; equity; and safe, legal, and ethical use of technology. A discussion of the findings and supporting evidence related to each research question is included.

Chapter 5 includes a summary of the results, including the purpose of the study, research questions, and overview of methodology. A discussion based on the findings and the analysis and interpretation of results in relationship to the conceptual framework and review of literature is also included. Finally, Chapter 5 ends with implications for practice, recommendations for further study, and conclusions.

CHAPTER 5

DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

This chapter contains a summary of a mixed-methods study of teachers' perceptions of supports that promote computer self-efficacy (CSE) and transformational digital pedagogy in one-to-one learning environments. The summary includes an overview of the study, the purpose of the study, research questions, and the methodology. A discussion of findings is also included. The chapter concludes with a discussion of the implications for action and recommendations for future studies.

Overview of the Study

The findings of this study support and broaden the limited literature available related to how school leaders support teachers in schools with one-to-one laptop technology programs. Findings of this study are reported based on the perceptions of high school teachers in one large, suburban school district in northeast Texas in its seventh year of implementing a one-to-one laptop technology program. Previous studies related to one-to-one technology in K-12 schools focused on districts in the early stages of implementation (Geer et al., 2017) and the provision of technology tools rather than leadership issues related to technology integration (Richardson et al., 2012). Additionally, Marlatt (2019) called for more investigation into how to help teachers gain the skills and confidence required to use technology in innovative ways. The International Society for Technology Education (ISTE) (2009) outlined five standards to serve as guidelines for school administrators: (1) visionary leadership, (2) digital age learning culture, (3) excellence in professional practice, (4) systematic improvement, and (5) digital citizenship. While McLeod (2015) urged leaders to embrace the ISTE Standards for Administrators as guiding principles for technology leadership, the author lamented the lack of concrete examples provided, and suggested more research regarding the critical leadership behaviors required to facilitate successful technology initiatives. To address these gaps in the literature, I investigated teachers' perceptions of the supports provided by leaders as the teachers attempted to integrate laptop technology into their classrooms, and how those supports impacted their CSE and digital pedagogy.

Researchers attribute teachers' slow up-take of computer technology to two categories of barriers to effective technology integration: first- and second-order barriers (Ertmer, 1999, 2005; Ertmer et al. 2012). These barriers are included in the conceptual framework for this study. Ertmer and colleagues described first-order barriers as external, institutional barriers such as insufficient internet connectivity. Second-order barriers, primarily teachers' beliefs about their abilities to use computers to improve student learning, have proven to be the most significant impediments to changes in teacher practice (Ertmer, 2005; Ertmer et al., 2012; Machado & Chung, 2015). CSE, a construct developed by Compeau and Higgins (1995) and grounded in the efficacy beliefs of Bandura (1977, 1982, 1986), "represents an individual's perception of his or her ability to use computers to accomplish a task" (p. 191). An adaptation of Compaeu and Higgin's model was included in the conceptual framework for this study because the use of computers in teaching and learning is largely determined by teachers' beliefs (Topkaya, 2010).

An adaptation of the substitution, augmentation, modification, and redefinition (SAMR) model (Puentedura, 2006) was incorporated into the conceptual framework for this study as a theoretical framework to distinguish between enhanced digital pedagogies (substitution and augmentation) and those that are transformational (modification and redefinition). Hockly (2013) asserted that the true potential of one-to-one programs to increase student achievement can only be realized when teachers incorporate technology at the transformational level of the SAMR model. According to Marlatt (2019), many schools appear to be fixated on the substitution stage of the SAMR model, where students primarily use technology for consumption rather than creation.

This study began with an investigation of the levels of CSE for technology integration among teachers in three suburban high schools. Once perceived levels of CSE were established through an online survey, they were compared to teachers' levels of digital pedagogy according to the SAMR model (2009). Finally, the perceptions of teachers pertaining to supports provided by leaders related to their digital pedagogy were examined. The teachers' responses and the resulting findings offer insights into how teachers perceive the supports provided by administrators and how those supports impact teachers' CSE and quality of technology integration.

Purpose Statement and Research Questions

According to Hull and Duch (2019), a gap in the literature exists regarding school leaders' supports in one-to-one learning environments. The purpose of this mixed-methods study was to discover, from the perspective of teachers, which supports lowered first-order and second-order barriers, as defined by Ertmer (1999, 2005), to one-to-one technology integration and which supports promoted teachers' CSE for technology integration, as suggested by Compeau and Higgins (1995), and Puentedura's (2006) transformational levels of digital pedagogy. The study was designed to determine if high CSE for technology integration serves as a prerequisite condition for the emergence of transformational levels of digital pedagogy in one-to-one technology learning environments, as well as what supports leaders employ to support transformational use of technology.

To achieve the purpose of this study, a mixed-methods case study research design was employed to explore teachers' perceptions of their own CSE, the ways teachers incorporated technology into their instruction, and teachers' perceptions of the supports provided by leaders.

These areas were addressed through the following research questions:

1. What are the levels of teachers' perceived computer self-efficacy for technology integration in schools with mature one-to-one laptop programs?
2. To what extent does computer self-efficacy predict teachers' ability to incorporate transformational levels of digital pedagogy in one-to-one learning environments?
3. According to teachers' perceptions, what supports do leaders in schools with mature one-to-one programs employ to increase teachers' computer self-efficacy related to digital pedagogy?

Review of Methodology

Data were aligned with the conceptual framework for the study, including teachers' perceptions of their own CSE, teachers' accounts of their digital pedagogy, and teachers' perceptions of support by school leaders. Quantitative data were gathered from an online survey developed by Wang et al. (2004) to gauge the perceived levels of CSE of teachers administered via the online survey Quatltrics™ survey software (Qualtrics Inc., Seattle Washington). The Statistical Package for the Social Sciences (SPSS) software™ (IBM Inc., Armonk, NY) was employed to yield descriptive statistics for teachers' levels of CSE.

Qualitative data were gathered via eight semi-structured interviews and two focus group interviews conducted via the Zoom™ video conferencing application (Zoom Video Communications Inc., San Jose, CA). Originally, interview protocols were designed to be utilized in person. Due to safety precautions related to COVID-19, interviews were conducted virtually. Despite this change, copious amounts of interview data were collected to address RQ2 and RQ3. Although I originally anticipated needing to analyze various documents provided by teachers, as examples of their use of transformational technology, only two teachers provided documents from their lessons to help illustrate their accounts.

Unexpectedly, data from both interview types (individual and focus group) yielded findings to address RQ2 and RQ3. Originally, focus group protocols were designed to address RQ2, while the semi-structured interview protocol was designed and to address RQ3. Field testing of the protocols produced data tightly aligned to the research questions these protocols were designed to address; however, at the time these protocols were employed in the actual study, teachers' circumstances had drastically changed due to the COVID-19 pandemic. In the spring of 2020, teachers moved from traditional face-to-face instruction to 100% virtual instruction. When data collection began in the fall of 2020, teachers had just moved from virtual teaching to a hybrid model of instruction in which teachers were required to deliver face-to-face instruction for students who chose to learn at school, while simultaneously delivering virtual learning to the 30% of students who chose to learn from home. This change in instructional dynamics resulted in all teachers readily sharing accounts of their digital pedagogy (RQ2), along with accounts of supports they were receiving (RQ3). While this dynamic was unexpected, it resulted in extensive data related to both RQ2 and RQ3. The interview data were manually coded using two sets of a priori codes. A priori codes developed from the SAMR model (2006) were employed to evaluate levels of digital pedagogy (RQ2), while a priori codes based on the ISTE (2009) standards for school administrators were used to code teachers' perceptions of leadership support (RQ3). Data were inductively analyzed using in vivo and descriptive codes to determine emerged themes.

Discussion for Each Research Question

Research Question

> *What are the levels of teachers' perceived computer self-efficacy (CSE) for technology integration in schools with mature one-to-one laptop programs?*

The findings from the survey data revealed that in the seventh year of HTISD's one-to-one laptop technology program, most teachers perceived their ability to effectively deliver digital instruction as strong. An analysis of the findings resulted in an overall district CSE mean of 4.05 (n=62) based on the 5.0 Likert scale, with a SD of 0.626. Additionally, of the 62 survey respondents, 50 posted average CSE scores within 1 SD above or below the district CSE mean of 4.05, while an additional five respondents posted a CSE score one SD above the district mean. According to Compeau and Higgins (1995), CSE "represents an individual's perception of his or her ability to use computers to accomplish a task" (p. 91). CSE has proved a useful framework for understanding the uptake and use of computers for instruction, as the beliefs, perceptions, and attitudes of teachers greatly influence the application and acceptance of computers (Topkaya, 2010). The overall district mean score of 4.05 suggests that overall, teachers in HTISD perceive they have the ability to effectively deliver digital pedagogy.

As further evidence of the relatively high CSE among HTISD teachers, the highest scoring survey item (Item 2) assessed teachers' perceived confidence in having the "skills necessary to use computers for instruction," with 96.8% of teachers responding with a 4 or 5 rating, resulting in a mean of 4.48 for this item. Additionally, 96.8% of survey respondents posted a 4 or a 5 rating for Item 12, which tapped into teachers' perceived levels of confidence to "regularly incorporate technology lessons when appropriate," while 93.5% posted ratings of a 4 or 5 to Item 11 regarding teachers' confidence to "successfully teach relevant subject content with appropriate use of technology." In all, 10 of the 16 survey items had mean CSE scores above the district CSE mean of 4.05, with survey results revealing that teachers possess a relatively high degree of confidence for technology integration related to selecting technology based on curriculum requirements, understanding computer capabilities, mentoring students regarding the appropriate use of technology, and using a variety of technology resources.

Although the mean CSE for the district was high overall, four teachers posted CSE scores within one SD below the district mean, and three posted CSE scores three SDs below the district mean, indicating some teachers lacked confidence in their ability to integrate laptop technology effectively. With this in mind, it is important to note the context in which the survey data were collected. This study was designed before the necessary safety precautions precipitated by the COVID-19 pandemic radically changed how teachers were expected to deliver instruction. Although HTISD was in the seventh year of implementing a one-to-one laptop program, teachers never before had been expected to deliver all instruction digitally. Campus dynamics related to these stressors also may have contributed to the varying survey participation rates among the three high schools (43 SHS participants, 13 HSH participants, and only 6 VHS participants).

It is unknown to what extent the pressure of these changes had on teachers' perceptions of their ability to effectively deliver digital instruction. Survey data revealed specific areas related to digital pedagogy in which a significant number of teachers expressed less confidence. Six survey items posted CSE mean scores below the overall district mean of 4.05. Approximately one-quarter of teachers indicated lower confidence in their abilities to motivate students during technology-based projects and computer use (Items 5 and 8), help students having difficulty with their computer (Item 6), monitor student computer use (Item 7), or evaluate software for teaching and learning.

Although the survey responses revealed some areas of weakness in teachers' perceptions of their ability to effectively integrate technology, it is worth noting that the majority of survey participants rated a 4 or a 5 for on all survey items, with percentages of 4 and 5 ranging from 61.3% to a high of 96.8%. Thus, it is reasonable to conclude that in the seventh year of the district's one-to-one laptop technology program, teachers in HTISD generally have a high level of CSE for technology integration. This finding is significant, as Paraskeva (2008) asserted that a positive attitude toward computers and strong teacher CSE are pre-conditions for meaningful digital pedagogy.

Research Question 2

> *To what extent does CSE predict teachers' ability to incorporate transformational levels of digital pedagogy in one-to-one learning environments?*

During the qualitative phase of this study, teachers were eager to share their experiences related to digital pedagogy. Because of the unusual teaching paradigms precipitated by the COVID-19 pandemic, teachers accelerated their digital pedagogy and were happy to share how they were converting traditional analog lessons into digital lessons. As recommended by Romrell et al. (2014), teachers' descriptions of lessons were analyzed based on the four levels of the SAMR model (Puentedura,2006): substitution, augmentation, modification, and redefinition. Data addressing this research question were reported in two categories: enhancement (substitution and augmentation), and transformation (modification and redefinition). Although the enhancement codes of augmentation and substitution were not transformational, it was important to identify those codes in the findings, as they show how teachers might be progressing toward transformational pedagogy. Additionally, these rich accounts add to the limited number of studies available regarding pedagogy at the various levels of the SAMR model.

Enhancement

Substitution and augmentation comprise the two lower levels of the SAMR model categorized as enhancements of traditional instructional practices. Although use of technology at this level is not considered transformational, enhancement level technology use may yet provide value to teachers and encourage their further integration of technology. All individual interview and focus group interview participants (n=18) reported using laptop technology at the enhancement level.

- *Substitution a priori code*. At the substitution level, technology is used as a direct tool substitute with no functional change (2006). Data revealed that all focus group and individual interview participants incorporated technology at the substitutional level. The primary way in which teachers incorporated laptop technology at this level was by using the district's learning management system (LMS), Canvas, as a direct tool substitute for posting agendas and assignments rather than posting agendas in the classroom or handing out and collecting paper assignments. Schaffhauser (2015) listed several features of LMSs that make them capable of transforming digital classrooms, including enhanced sharing of resources, intuitive interfaces similar to social media, collaboration platforms for discussion, and responsive analytic functions that can help drive instruction. Frankie, a science teacher, reported an increased use of the Canvas LMS due to precautions needed to prevent the spread of the COVID-19 virus. Frankie explained, "We're basically paperless at this point. Our book is online, so they [students] read the chapters of the book online. All of my assignments are in Canvas; they submit them on Canvas." Other substitution level activities reported by teachers included accessing digital data bases and using video clips to reinforce basic concepts. While most of the substitution level activities described by teachers were activities involving the Canvas LMS, successful experiences at this level may boost teachers' CSE and give them the confidence needed to use the higher level features of the program.

- *Augmentation level a priori code.* Augmentation level activities are those activities in which technology acts as a direct substitute but with functional improvements (Puentedura, 2006). Teachers reported using the word processing and hyperlink functions of the Google Docs™ web-based word processing application, graphing capabilities and drag and drop features of Google Sheets™ online spreadsheet program (Google LLC, Mountain View, CA), adaptive quiz games, and the SpeedGrader function of the Canvas LMS. Among the 23 different augmentation level activities described, the SpeedGrader application was the most popular among teachers. Sunny, an ELA teacher, proclaimed, "I love SpeedGrader! I use a rubric and I click, click, click! It's incredible. You can have 150 essays done in three hours instead of two weeks." Sam also described a function of the Canvas LMS that allowed for video feedback: "…for the resume project I found it more beneficial to do video feedback. For the majority of [students], I gave a 20 second video clip because I wanted to have a reason for the feedback." Although these teachers' accounts do not represent transformational pedagogy, they do represent functions that teachers perceive to be helpful to them in doing their jobs, especially in the current virtual-learning environment. Positive experiences with enhancement level technology implementation may increase teachers' confidence for integrating technology in more innovative ways.

Transformation

Modification and redefinition comprise the transformation category of the SAMR model. According to Hockly (2013), the modification and redefinition levels must be reached to realize the true potential of instructional technology. All but one of the individual and focus group participants (n=18) reported using technology at the transformational level. It stands to reason that teachers in HTISD reported frequent technology integration at the transformation level as the district CSE mean among all teachers was a 4.05 of a possible 5.0. These data suggest that teachers' levels of CSE may serve as important predictors of transformational levels of technology integration.

- *Modification a priori code*. Digital pedagogies coded at the modification level included tasks that had been significantly redesigned due to the affordance of a new tool, as suggested by Puentedura (2006) for this level. All teachers, except for Joe, who was new to the district, described lessons in which they incorporated technology at the modification level. Technology integration at the modification level included student-produced videos, discussion boards, interactive teacher presentations, digital presentations produced by students, adaptive learning programs, interactive video lessons, interactive digital notebooks, differentiated digital lessons, and complex lab simulations. Many teachers incorporated technology at the modification level because tools within software applications, such as Google Docs online word processing program, Google Slides online presentation program, Flipgrid™ video application (Flipgrid Inc., Minneapolis, MN), and the Zoom video conferencing application, enhanced their ability for students to collaborate. Six teachers described lessons in which they used the Flipgrid application for video discussion and collaboration. Jordan described the Flipgrid application, stating:

> Flipgrid is a platform where students can record video or audio recordings. I've used it several times and I love it. It has emojis and stickers, and little fun props that kids can add to their videos to personalize them and have fun with them. They [the students] go online to record their responses to the prompt of the assignment. There's a viewer where other students can go in and view their classmates and watch each other's videos. They can add comments, or respond by recording themselves giving a comment or feedback.

Taylor provided an example of students collaborating with each other and the teacher using both Google Docs online word processing program and the Zoom video conferencing application: "I pair student groups together or just put me and a student in a group [via Zoom]."

While some teachers appreciated collaborative features of software applications, others valued features that allowed them to create more interactive presentations. Three science teachers reported learning to produce video lessons during virtual learning. Quinn explained:

> One thing that has been super helpful was to record lessons by recording Zoom meetings, making a YouTube video of that [Zoom meeting] and putting it on Canvas. My students seem to love it because they ask me before I'm finished for the day if I'm going to put it in Canvas, and I tell them, "I will post before I leave."

Six teachers expressed enthusiasm for the improved functionality of newly adopted online textbooks. Sam shared, "It's more than just a textbook and I think that's important to note. It's not just a digitized textbook. It's a leaning platform." Two science teachers described using a complex lab simulation program. Alex elaborated, stating:

> The simulation goes all the way down to the level where students watch osmosis occur. They click and choose variables and they have case study handbooks; they have to mess with the pore size of the dialysis tubing and look at the difference between parallel flow and counter current flow to figure out that counter current flow does a better job.

These examples represent but a few ways in which HTISD teachers incorporated one-to-one laptop technology at the modification level. Because these teachers were able to incorporate technology at this level, their instruction is considered transformational, according to the SAMR model. Curiously, 4 of the 18 interview participants who posted CSE scores more than one SD below the district CSE mean of 4.05, (Alex: 1.88, Blake: 2.18, Sunny: 3.06, and Drew: 3.13) were able to achieve transformational digital pedagogy. This finding suggests conditions beyond CSE may also promote transformational digital pedagogy.

- *Redefinition a priori code.* Four participants reported integrating laptop technology at the highest level of the SAMR model, redefinition. At this level, lessons must include activities that would be inconceivable without technology. All reported redefinition level activities involved student-produced multi-media productions that included both video and audio. One teacher reported having students create multi-media presentations for student-produced websites. Dallas described a student project in which a student:

> …set up her camera on still frame and she would practice her drawing. She would take pictures and come back and speed it up. Her blogs were actually drawing different things, but sped up at a fast, fast pace. That was a cool blog.

Other teachers described students creating multi-media projects, including a video senior legacy video, a public service announcement, and a multi-media video to report lab findings. Of the four teachers that described redefinition level pedagogy, three of the four posted CSE scores above the district CSE mean of 4.05: Dallas (4.31), Sam (4.44), and Sidney (4.88). Curiously, one participant, Drew, posted a CSE one SD below the district mean at 3.13.

Based on these findings, it is reasonable to conclude that high levels of CSE are likely a significant contributor to transformational level pedagogy. However, because teachers with CSE scores well below the district mean were able to incorporate technology at a transformational level, CSE is not likely to be the only factor contributing to teachers' ability to incorporate technology at the highest levels. Further study is warranted to examine factors that contribute to a teacher's ability to deliver transformational pedagogy in one-to-one learning environments.

Research Question 3

> *According to teachers' perceptions, what supports do leaders in schools with mature one-to-one programs employ to increase teachers' CSE related to digital pedagogy?*

To answer this question, data gathered in individual and focus group interviews were analyzed deductively using a priori codes based on the ISTE (2009) leadership standards for administrators: visionary leadership, digital age learning culture, excellence in professional practice, systematic improvement, and digital citizenship. Once data were categorized according to these codes, a further inductive analysis of data revealed emerged themes within four of the five a priori codes. Table 20 summarizes the themes that emerged within these ISTE a priori codes.

Table 20

Emerged Themes within ISTE a priori Codes

ISTE Standard for Administrators	Emerged Themes
Visionary Leadership	• Shared vision • Realistic and supportive climate
Digital Age Learning Culture	• Collaboration • Encouragement
Excellence in Professional Practice	• Job embedded professional learning • Continuous improvement
Digital Citizenship	• Equity • Safe, legal, and ethical use

Visionary Leadership a priori Code.

According to Ertmer and Ottenbreit-Leftwhich (2103), a lack of vision for technology integration among school leaders can pose a significant external obstacle (first-order barrier) to meaningful technology integration. When analyzing data for this a priori code, data were examined to glean teachers' perceptions of the district's vision of technology integration. According to findings, teachers perceived that the district had a clear vision of how and why a one-to-one laptop program was being implemented. Providing a clear vision for teachers provided support in that it provided both a reason for learning new skills and parameters for teachers so they could focus their efforts. Two themes emerged within this data set: shared vision and realistic and supportive climate.

- *Shared vision theme*. Data categorized under the shared vision theme revealed that teachers were generally excited about having a one-to-one laptop program and believed that the program would benefit students. Taylor, an ELA teacher, shared this perception of the program:

> Overjoyed! Simply because technology is something that I feel is imperative for today's children to understand... My teachers had to schedule computer lab time and there was no working outside of class on anything, so it was a huge learning curve for me in college. Learning that there were districts that were one-to-one and then coming here where there were one-to-one devices was revolutionary in my thinking. I was very excited about that.

Even teachers who were initially apprehensive about learning new skills reported being willing to adapt because they saw value in the program. Jordan shared, "I've seen the payoff for some of the programs and tools we have available, so I'm willing to put in the legwork and find out how to use it." Teachers' perceptions of excitement related to the district's one-to-one program are important, according to the Compeau and Higgins' (1995) model, as affect, or "liking technology" (p. 196), is associated with lowered anxiety and strong CSE, important precursors to behavior. Bandura (1997) suggested that affective states such as excitement can increase efficacy. Data from interviews revealed initial excitement among teachers upon learning of the district's one-to-one program. This affective state may have contributed to higher levels of CSE, resulting in transformational pedagogies employed by HTISD's teachers.

- *Realistic and supportive climate theme.* A second theme that emerged under the visionary leadership code was realistic and supportive climate. Findings showed that teachers perceived that the district's expectations were realistic regarding how they were to integrate technology into their lessons. Teachers did not perceive pressure to integrate technology for its own sake, but rather when technology improved their ability to improve student learning. Dallas' comments provide a good example of teachers' perceptions regarding technology use:

> I don't think that there were super high expectations from the outset as to how teachers were going to have students utilize computers in their classrooms. I think that built gradually over time. We are trying to work on meaningful lessons and stick to the TEKS.

Additionally, teachers perceived that they were afforded a reasonable amount to time to learn skills. Blake explained, “Not rushing into things but really giving us time to think through and learn and do, has been one of the most amazing things.” Finally, teachers expressed gratitude for the district’s forward thinking in having a well-established one-to-one program prior to the move to virtual learning, and for support provided as teachers prepared for a hybrid learning model. Tony explained, “The learning curve for technology integration into lessons has been extremely steep, but having our foot in the door by having one-to-one already in place was instrumental in getting us moving a little bit faster on this.” Alex shared, “I cannot even tell you how amazing I feel the support on my campus has been…There’s flexibility in what we are doing and tremendous support.”

These examples provide evidence that teachers had a clear understanding of the importance of having a laptop program and of how they were supposed to use it, and they felt that the expectations for implementation were reasonable. These perceptions are important as a clear vision is an important support needed to lower first-order (external) barriers to technology integration. In contrast to the examples provided by HTISD teachers, literature suggests that teachers frequently report having to work around administrators rather than with them (Ertmer & Ottenbreit-Leftwich, 2013). It is clear from the accounts of HTISD teachers that teachers and administrators shared a realistic and focused vision for technology integration and teachers felt supported in their pursuits.

Digital Age Learning Culture a priori Code

Two themes emerged from data categorized under digital age learning culture: collaboration and encouragement. Numerous teachers described collaboration among colleagues; teacher teams or professional learning communities (PLCs); teachers and campus support teams, including media resource specialists (MRS); instructional coaches (IC); teachers and students; and with professional organizations.

- *Collaboration theme.* Teachers' perceived that there was an established collaborative culture, which is an important finding as this collaborative culture may have lowered teachers' second-order (internal) barriers to technology integration. Ertmer (1999) posited that ongoing conversations with colleagues during common planning periods and supportive networks helped enhanced meaningful technology use. Likewise, Compeau and Higgins (1995) reported a positive relationship between an individual's reference group and an individual's CSE. Similar to Bandura's (1977) construct of vicarious experiences, Compaeu and Higgins (1995) included "use by others" (p. 195) among their sources of CSE. Data analysis revealed that collaboration with colleagues was a primary avenue for HTISD teachers seeking to enhance their digital pedagogy.

Even among teachers with lower CSE, like Alex with a CSE of only 1.88, collaboration with a team seemed to provide essential support. Alex explained:

> My learning curve is still on the up rise and I have a really great team. They are much more technologically savvy than I am. So, when I think of something I'd like to do, they can usually figure out a way that it can be done. I am rarely the one who's setting it up.

Although Alex posted the lowest CSE among participants, this account is important because, with the help of a team, Alex was able to incorporate laptop technology at the transformational level (modification level lab simulation). This finding has important implications for leaders regarding the importance of creating collaborative cultures on campuses so teachers who lack confidence in their own abilities can rely on the support of their colleagues, ultimately enhancing their own CSE. According to Compaeu and Higgins (1995), "The actual behavior of others with respect to technology is a source of information used in forming self-efficacy" (p. 195).

Data revealed that teachers perceived that HTISD valued collaboration, as teachers frequently reported having dedicated time with their teams and opportunities to collaborate with campus support personnel, such as MRSs, ICs, and technology integration specialists. Teachers frequently reported that MRSs and ICs attended team meetings to support teachers with their technology integration.

- *Encouragement theme.* A second theme that emerged under digital aged learning culture was encouragement. Data revealed that teachers encouraged each other and perceived being encouraged by others. Sydney shared learning to use the Speed Grader function of the Canvas LMS because of the encouragement of a teacher across the hall and a teammate. Sidney described:

> Having both of them [colleague from across the hall and a teammate] say, "Come on, I know you can do this; come on, this is not that hard. Just give it a chance and roll with it." They kept telling me to use it, it's easy.

Having a culture of encouragement is an important supportive condition as Compaeu and Higgins (1995) found that encouragement from people to whom an individual looks for guidance positively influences CSE. This component of the Compaeu and Higgins model is based on Bandura's (1977) construct of verbal persuasion in which "people are led, through suggestion, into believing they can successfully cope with what has overwhelmed them in the past" (p. 198). It is significant that the theme of encouragement emerged within this code because a culture of encouragement is an important supportive condition for enhancing teachers' confidence in their abilities to learn new skills regarding technology integration. Based on findings, this culture of encouragement is likely the result of the district leaders creating conditions in which teachers are encouraged to work together to solve problems related to teaching and learning.

Excellence in Professional Practice a priori Code

Participating teachers shared 33 accounts of their perceptions of professional learning related to technologies and digital resources coded deductively under this a priori code. Among these accounts, two themes emerged: job embedded professional learning and continuous improvement.

- *Job embedded professional learning theme.* Most accounts involved professional learning provided by MRSs and ICs during team meetings, or PLCs. Several teachers also shared accounts of learning new skills by using a collection of how-to videos produced by MRSs, ICs, and fellow teachers. A few teachers described attending webinars offered by district vendors. Because the descriptions provided by teachers were of teachers learning in the context of a challenge they were currently facing, these accounts were grouped under the theme of job-embedded professional learning. Drew provided a description of using how-to videos provided by teachers:

> The videos have helped us. Having them show step-by-step because I'm one of those I have to see it and hear it and they write my notes and try it, and if I mess up, I go back and watch it again. I'm not the one that could just read directions and run with it; show me some pictures, walk me through it, and then let me try it myself.

Taylor shared an experience in which an MRS guided a team to use an application within the Canvas LMS:

> Something that was wonderful, learning in small groups where we can ask all of the questions that come up; that we know how to solve those itty-bitty issues are fantastic. Like when [the MRS] comes to our PLC and walks us through the entire step of how to create Mastery Paths in Canvas.

These examples contain similar comments frequently found within the data, such as "walk me through it" or "walks us through." This finding is significant because it relates to Compaeu and Higgins (1995) construct of usage, which is analogous to Bandura's (1986) construct of guided mastery. As recommended by Compaeu and Higgins (1995), it is evident from these teachers' accounts that HTISD provided hands-on experiences in which teachers were able to build confidence and skill. This finding has implications for school leaders as they design professional learning related to digital pedagogy.

- *Continuous improvement theme.* Despite the numerous accounts of job-embedded professional learning, a few teachers recommended that the district continue to offer trainings for the Canvas LMS and Google applications. Teachers reported that training for these two critical resources was robust in the initial stages of the one-to-one program, but newer cohorts of teachers in later stages of the implementation were not afforded the same training. Robin shared that the last cohort of teachers to teach students with one-to-one devices was not sufficiently trained in the use of the Canvas LMS. "The senior team is the most reluctant…they have had technology the least amount of time, so they are just learning Canvas really during the pandemic." Additionally, teachers new to the district reported not receiving sufficient training with these critical programs. These accounts were coded under the theme of continuous improvement. Teachers advised that the district should be more intentional about training teachers that are new to the district or otherwise new to the use of devices and software programs. These findings are important for school leaders designing their professional learning. It is important that leaders include induction programs for teachers beyond initial training.

Systematic Improvement a priori Code

Data reported under this code related to teachers' accounts of appropriately using technology and media rich resources. Teachers shared 206 examples of incorporating media rich resources into their lessons. These accounts fell into four categories: hardware, learning management systems, the Google Suite of software applications, and an *other* category that included 21 separate software applications. Teachers touted the benefits of software applications, but they also shared that integrations of programs with the Canvas LMS was extremely helpful. Lane shared:

> This is our seventh year and I've seen how even Canvas has improved a lot. We can now integrate so many of these programs into Canvas so you're not going back and forth between programs. Not telling students, "Hey, now you have to sign up with this account or that account." It's pretty much integrated.

It is important for school leaders to recognize that the provision of devices and software must occur in a manner that does not prevent frustration for teachers. Integrating software applications with the district's LMS was perceived as an important support by HTISD teachers. If school leaders are not cognizant of these types of supportive conditions, they may inadvertently introduce first-order barriers that prevent effective uptake of laptop technology. Jordan shared, "I have had experiences in the past in my previous district where you would use this resource with that resource and they didn't read each other or, they just didn't work." It is important that school leaders work to prevent these types of technology failings.

According to the data, HTISD provided a robust suite of well-integrated software applications, in addition to providing all students with 24-hour, year-round laptop technology. While the provision of laptop technology and robust, integrated software applications are important supports, the provision of these resources alone will not guarantee changes in teacher practice (Sung et al., 2016; Wang et al., 2014). For districts to maximize investments in these resources, second-order barriers that primarily are teachers' attitudes toward technology must also be addressed (Hull & Duch, 2019).

Digital Citizenship a priori Code

Data within this code revealed that one-to-one technology was perceived by teachers as being critical to their ability to reach students during virtual learning. However, the findings of the study also revealed that teachers continue to struggle in managing how students use their devices.

- *Equity theme*. Joe described being able to reach virtual learners using the Canvas LMS, "Obviously, we have to use Canvas with the kids at home right now; without that, we would have no connection to students at home." Accounts such as these were coded with the emerged theme of equity as they represented teachers' perceptions of having the tools needed to reach all learners.

- *Safe, legal, and ethical use theme.* The second theme that emerged under this code was safe, legal, and ethical use. Data revealed that teachers perceived a need for additional support related to students' use of their devices. Teachers reported struggling to monitor student use of devices in both face-to-face and online settings. In face-to-face settings, teachers lacked confidence in their ability to monitor how students were using their devices. In virtual settings, teachers struggled with students' lack of academic integrity and engagement. These accounts suggest that further study is needed for leaders to understand how to support teachers struggling with how students utilize district-provided devices.

Implications for Action

Results from this mixed-methods study have the potential to inform leaders in schools with one-to-one technology programs how best to support teachers and eliminate computer efficacy barriers that inhibit adoption of transformational pedagogies. Specifically, both first order- and second-order barriers must be addressed. Once high-quality devices and integrated software applications are provided (first-order barrier), leaders must turn their attention to creating conditions that address second-order barriers. First, leaders must clearly articulate a vision for technology integration and have realistic expectations regarding the time it takes teachers to learn new skills. To ensure all teachers are supported, administrators must intentionally foster a collaborative and encouraging learning culture. Based on the findings of the analyzed data, teachers learn best when professional learning is provided in the context of current job-related challenges. Additionally, teachers appreciate the availability of experts, such as media resource specialists and instructional coaches, to work side-by-side and step-by-step with them and their teams as they learn the new skills. Finally, leaders must provide assistance to teachers as they attempt to provide equitable learning opportunities to all students and guidance regarding safe and ethical use of devices.

Recommendation for Further Research

This targeted study centered on teachers' perceptions of supports provided by school leaders to foster high levels of CSE and transformational digital pedagogy. The participating schools were located in a suburban district in the northeastern part of Texas. Additional studies, including urban and rural districts, could provide additional insights regarding supports that promote effective technology integration. Findings of this study included numerous accounts of teachers collaborating with teams of teachers that all taught a particular subject. This was a collaborative dynamic among teachers in the studied suburban district. Further studies focused on rural districts may support leaders of smaller, rural schools who may need help in fostering collaboration when subject-level teams are not possible. Finally, findings from this study may serve as a foundation for further studies related to second-order barriers, including: (a) the link between CSE and digital pedagogy, (b) how to intentionally design professional learning for continuous improvement, and (c) how to better support teachers in managing safe, legal, and ethical use of student devices.

Conclusion

The findings of this study serve as a foundation for understanding how school leaders can best support teachers as they attempt to integrate one-to-one technology into their lessons, thus improving teachers' CSE that results in improved digital pedagogy. Through data collected in an online survey and participants' individual and focus group interviews, deductive and inductive analyses revealed that teachers in the participating district had relatively high levels of CSE and were overwhelmingly able to implement laptop technology at the transformational level, even in the midst of a pandemic that severely impacted instructional delivery. The following themes emerged from data regarding teachers' perceptions of support: (a) shared vision, (b) realistic and supportive climate, (c) collaboration, (d) encouragement, (e) job embedded professional learning, (f) continuous improvement, (g) equity, and (h) safe legal and ethical use. The districts' equitable provision of laptops and supporting integrated software applications provided evidence that HTISD had intentionally eliminated first-order barriers to technology integration. Data within the themes of shared vision, realistic and supportive climate, collaboration, encouragement, and job embedded professional learning aligned with Compaeu and Higgins (1995) sources of CSE, providing evidence that HTISD had addressed second-order barriers and provided the supports that fostered transformational digital pedagogy. Findings revealed that school leaders may need to reconsider professional learning for teachers new to the district and provide additional supports to teachers related to how to manage students' use of devices.

APPENDIX A

DOCUMENTS RELATED TO ONLINE SURVEY TOOL

Computer Technology Integration Survey*

Directions:

The purpose of this survey is to determine how you feel about integrating laptop computer technology into classroom teaching. For each statement below, indicate the strength of your agreement or disagreement by selecting one of the five scales.

Consider this definition of one-to-one laptop computer integration as you make your choices. One-to-one laptop computer integration includes using computers to support students as they construct their own knowledge through the completion of authentic, meaningful tasks.

These examples of one-to-one laptop computer integration might help you guide your thinking:

- Students working on research projects, obtaining information from the Internet.
- Students constructing Web pages to show their projects to others.
- Students using application software to create student projects (such as composing music, developing presentation, developing HyperStudio stacks).

Using the above as a baseline, please mark one of the following responses for each statement:
Strongly disagree, Disagree, Neither agree or disagree, Agree, Strongly agree

	SD	D	NA/ ND	A	SA
I feel confident that I understand computer capabilities well enough to maximize them in my classroom.					
I feel confident that I have the skills necessary to use the computer for instruction.					
I feel confident that I can successfully teach relevant subject content with appropriate use of technology.					
I feel confident in my ability to evaluate software for teaching and learning.					
I feel confident that I can use correct computer terminology when directing students' computer use.					
I feel confident I can help students when they have difficulty with the computer.					
I feel confident I can effectively monitor students' computer use for project development in my classroom.					
I feel confident that I can motivate my students to participate in technology-based projects.					

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* Source: Wang, L., Ertmer, P. A., & Newby, T. J. (2004). Increasing pre-service teachers' self-efficacy beliefs for technology integration. *Journal of Research on Technology Integration, 36,* 231-250. Reproduced with permission from Ling Wang.

	SD	D	NA/ ND	A	SA
I feel confident that I can mentor students in appropriate uses of technology.					
I feel confident that I can consistently use educational technology in effective ways.					
I feel confident that I can provide individual feedback to students during technology use.					
I feel confident that I can regularly incorporate technology into my lessons when appropriate to student learning.					
I feel confident about selecting an appropriate technology for instruction based on curriculum standards.					
I feel confident about assigning and grading technology-based projects.					
I feel confident I can be responsive to my students' needs during computer use.					
I feel confident about using technology resources (such as spreadsheets, electronic portfolios, etc.)					

Are you willing to participate in a follow-up focus group or individual interview? Participants that are willing to continue into the next phase of the study may be contacted via email to arrange for a focus group or individual interview.

- □ Yes, I am willing to participate in a focus group or individual interview.
- □ No, I am not interested in participating in a focus group or individual interview.

Text from Email Requesting Participation in Online Survey

My name is Paula Kent and I am a doctoral candidate at the University of North Texas. I am currently conducting my dissertation research and would be pleased if you would consider participating in an online survey regarding your comfort level with integrating district-provided laptop technology into your lessons. The survey should take less than 15 minutes to complete.

The purpose of this mixed methods case study is to examine how teachers implement one-to-one technology into their classrooms and to gain insights about how leaders can best support teachers in adapting their pedagogy in one-to-one learning environments.

You are under no obligation to participate in the study and you will not be compensated for your participation. An informed consent letter is presented at the beginning of the survey. At the end of the consent letter, you will be asked if you do or do not consent to taking the survey. If you consent, you will enter the survey.

University of North Texas Internal Review Board
Informed Consent Form Notice

Informed Consent for Studies with Adults (IRB-20-76)

Title of Research Study: Supports That Promote Teachers' Computer Self-Efficacy and Transformational Digital Pedagogy in One-to-One Learning Environments

Research Team: Paula Kent, Department of Teacher Education and Administration, University of North Texas ([redacted]) [redacted]-[redacted], PaulaKent@my.unt.edu. This project is part of a dissertation being conducted under the supervision of Dr. Robert Voelkel, Department of Teacher Education and Administration, University of North Texas, (940) 565-4800, Robert.Voelkel@unt.edu.

You are being asked to participate in a research study. Taking part in this study is voluntary. If you agree to participate and then choose to withdraw from the study, that is your right, and your decision will not be held against you. For any who now me, or of me, your participation is solely based on my interest in better supporting one-to-one laptop integration and there is no intent, in any way, to evaluate your instructional practices.

You are being asked to take part in a research study about the uses of one-to-one technology in the classroom, and the supports needed to successfully integrate one-to-one technology into instruction.

Your participation in this research study involves taking a 16 item Likert-style survey, exploring your level of comfort with the implementing one-to-one technology into your lessons. The final question will ask if you are or are not willing to participate in a follow-up focus group or individual interview. More details will be provided in the next section.

You might want to participate in this study if you are a teacher in grade 9-12 incorporating one-to-one technology into your lessons. However, you might not want to participate in this study if you do not have time to participate in a 15 minute online survey.

You may choose to participate in this research study if you are an English, social studies, or science teacher that has been incorporating district-provided one-to-one technology into lessons.

The reasonably foreseeable risks or discomforts to you if you choose to take part are any minimal privacy or confidentiality concerns, which you can compare to the possible benefit of participating in educational research to explore how leadership supports impact instructional practices in one-to-one learning environments.
Detailed Information About This Research Study: The following is more detailed information about this study, in addition to the information listed above.

Compensation: There is no compensation for this study.

Purpose of the Study: You are being asked to participate in a research study which involves exploring the relationship between the degree of transformational technology integration and the supports leaders must provide to facilitate effective practice.

Time Commitment: The expected total time for participation in the online survey is less than 15 minutes.

Study Procedures: This study will include an online survey. We will also gather your email address. At the completion of the survey, you will be asked if you may be further contacted for an interview or focus group session. This consent form pertains only to the online survey portion of the study. Additional consent will be required for survey participants who elect to participate in focus group or individual interviews.

Possible Benefits: This study is not expected to be of any direct benefit to you; however, we hope to learn more about the leadership practices that support successful technology integration in one-to-one laptop programs. We believe this study has the potential to provide insight into how leaders can create supportive conditions that improve instructional practices in one-to-one learning environments.

Possible Risks/Discomforts: This research study has risks to confidentiality similar to everyday use of the internet. However, if you do experience any discomfort, please inform the research team.

If you experience excessive discomfort when completing the research activity, you may choose to stop participating at any time without penalty. The researchers will try to prevent any problem that could happen, but the study may involve risks to the participant, which are currently unforeseeable. UNT does not provide medical services, or financial assistance for emotional distress or injuries that might happen from participating in this research. If you need to discuss your discomfort further, please contact a mental health provider, or you may contact the researcher who will refer you to appropriate services. If your need is urgent, helpful resources include Lifepath Systems crisis hotline at (866) 260-8000.

Confidentiality: Efforts will be made by the research team to keep your personal information private, including research study records, and disclosure will be limited to people who have a need to review this information. All paper and electronic data collected from this study will be stored in a secure location on the UNT campus and/or a secure UNT server for at least three (3) years past the end of this research. Throughout the duration of this study, all participant data will be stored on a password-protected laptop with security provisions in the researcher's office. Following the completion of the study, all data will be stored on a password protected remote storage device that will be stored in a locked cabinet in the university office of the supervision investigator, for the required three years. Research records will be labeled with a pseudonym and the master key linking names with codes will be maintained in a separate and secure location.

While confidentiality measures will be taken to protect confidentiality of shared information, other school personnel may be aware of your participation in this research. Please be advised that although the researchers will take these steps to maintain confidentiality of data, the nature of focus groups prevents the researcher from guaranteeing confidentiality. The researchers will remind the participants of focus groups to respect the privacy of your fellow participants and not repeat what is said during the interview.

The results of this study may be published and/or presented without naming you as a participant. The data collected about you for this study may be used for future research studies that are not described in this consent form. If that occurs, an IRB would first evaluate the use of any information that is identifiable to you, and confidentiality protection would be maintained.

While absolute confidentiality cannot be guaranteed, the research team will make every effort to protect the confidentiality of your records, as described here and to the extent permitted by law. In addition to the research team, the following entities may have access to your records, but only on a need-to-know basis: the U.S. Department of Health and Human Services, the FDA (federal regulating agencies), and the reviewing IRB.

This study uses Qualtrics and is subject to the privacy policies of Qualtrics noted here: https://www.qualtrics.com/privacy-statement/

Contact Information for Questions About the Study: If you have any questions about the study, you may contact Paula Kent at ([redacted]) [redacted]-[redacted], or Dr. Robert Voelkel at (940) 565-4800. Any questions you have regarding your rights as a research subject, or complaints about the research may be directed to the Office of Research Integrity and Compliance at 940-565-4643, or by email at untirb@unt.edu.

Consent: By clicking the "I agree..." button below, you acknowledge that your participation in the study is voluntary, you are 18 years of age, and that you acknowledge that you are aware that you may choose to terminate your participation in the study at any time and for any reason. If you click "I do not wish to participate in the survey," you will be removed from the study.

___ I agree to the terms of the informed consent document and would like to participate in the survey.

___ I do not wish to participate in the survey.

APPENDIX B

DOCUMENTS RELATED TO FOCUS GROUP INTERVIEWS

Focus Group Interview Protocol

Prior to beginning the interview:

- Researcher introduces self.
- Review IRB informed consent document by sharing the screen with participants and reviewing the document.
- Explain that the purpose of the focus group is to ascertain the ways in which participants incorporate the district-provided laptop computer into their teaching.
- Ask participants to choose a pseudonym and to introduce themselves with the pseudonym when they speak.
- Thank participants for their participation.
- Ask if participants have any questions before proceeding with questions.

Location ___________________________ Date_________________

Participant numbers: ________________

Interview questions related to digital pedagogy (RQ2):

1. What are your teaching responsibilities and how long have you been teaching in this role in the district? (Background/rapport building)
2. What are the predominant ways in which you and your students utilize the district-provided laptops in your classroom?
    a. Probe for descriptions of how learning platforms/apps/software are utilized.
    b. Probe for why the learning platforms/apps/software are utilized.
    c. Probe to ascertain the value of using learning platforms/apps/software. Are they used…
        i. to improve student learning?
        ii. for differentiation?
        iii. for administrative efficiency?
        iv. for assessment?
3. Please describe a lesson utilizing one-to-one technology integration that you designed and that was particularly successful.
    a. Probe to ensure rich descriptions of lessons.
    b. Probe to ascertain level of lessons on SAMR model, including digital tools used, student products, audience for student product, if and how the product was shared.
    c. Probe to understand how the lesson was designed.

i. What was the goal of the lesson?
ii. What kind of student products were produced? For what audience?
iii. What sparked the idea for the lesson?
iv. Was the lesson planned alone or collaboratively?

4. (If time allows) After listening to the lessons described by your colleagues, do you remember other noteworthy lessons you would like to share in which you incorporated the laptop? (If so, use the same probes as above).
5. Would any of you be willing to share student products or lesson plans from your most successful lessons or strategies for using the district provided laptops in your lessons?
6. Is there anything else you would like to share with me?

Text from Email Requesting Participation in Focus Group Interview

My name is Paula Kent and I am a doctoral candidate at the University of North Texas. Recently you participated in an online survey I conducted about your comfort level with integrating laptop technology into your lessons. In the survey you expressed an interest in participating in a follow-up focus group or individual interview. I would be pleased if you would consider participating in a 60-minute focus group interview related to your digital pedagogy, via the third party application, Zoom. The focus-group interview will take place at ____ am/pm. Here is the link you will need to participate: _______. Noted here is a link to the Zoom privacy policies: https://zoom.us/privacy.

The purpose of this mixed methods case study is to examine how teachers implement one-to-one technology into their classrooms and to gain insights about how leaders can best support teachers in adapting their pedagogy in one-to-one learning environments.

You are under no obligation to participate in the study and you will not be compensated for your participation. If you are willing to participate, please respond to this email. An informed consent letter is attached to this email. Please read it prior to the interview. I will go over it with you before the interview begins and answer any questions you may have.

University of North Texas Internal Review Board
Informed Consent Form Notice

Informed Consent for Studies with Adults (IRB-20-76)

TITLE OF RESEARCH STUDY: Supports That Promote Teachers' Computer Self-Efficacy and Transformational Digital Pedagogy in One-to-One Learning Environments

RESEARCH TEAM: Paula Kent, Department of Teacher Education and Administration, University of North Texas. This project is part of a dissertation being conducted under the supervision of Dr. Robert Voelkel, Department of Teacher Education and Administration, University of North Texas.

You are being asked to participate in a research study. Taking part in this study is voluntary. The investigators will explain the study to you and will any answer any questions you might have. It is your choice whether or not you take part in this study. If you agree to participate and then choose to withdraw from the study, that is your right, and your decision will not be held against you. For any who know me, or of me, participation is solely based on my interest in better supporting one-to-one laptop integration and that there is no intent, in any way, to evaluate your instructional practices.

You are being asked to take part in a research study about the uses of one-to-one technology in the classroom, and the supports needed to successfully integrate one-to-one technology into instruction.

Your participation in this research study involves being interviewed in a focus group, exploring your experiences with the implementation of your district's one-to-one technology initiative.

You may be asked for documents that pertain to the district or campus support of the one-to-one program, or instructional practices involving one-to-one technology. More details will be provided in the next section.

You might want to participate in this study if you are a teacher in grade 9-12 incorporating one-to-one technology into your lessons. However, you might not want to participate in this study if you do not have time to participate in a 45 to 60-minute interview or focus group.

You may choose to participate in this research study if you are a teacher that has been incorporating district-provided one-to-one technology into your lessons.

The reasonably foreseeable risks or discomforts to you if you choose to take part are any minimal privacy or confidentiality concerns, which you can compare to the possible benefit of participating in educational research to explore how leadership supports impact instructional practices in one-to-one learning environments. You will not receive compensation for participation.

DETAILED INFORMATION ABOUT THIS RESEARCH STUDY: The following is more detailed information about this study, in addition to the information listed above.

PURPOSE OF THE STUDY: You are being asked to participate in a research study which involves exploring the relationship between the degree of transformational technology integration and the supports leaders must provide to facilitate effective practice.

TIME COMMITMENT: The expected total time for participation in the study is between one and one and a half hours. This includes the interview plus the opportunity to member check my analysis of the transcription of that interview. It is possible that an additional minimum amount of time will be needed for collecting and providing any documents that will help me answer the research questions.

STUDY PROCEDURES: This study will include an online survey, two focus group interviews, four individual interviews, and document analysis for collecting data. This study uses a third party software called Zoom and is subject to the privacy policies of Zoom noted here: https://zoom.us/pricacy. Each interview will last approximately 60 minutes. The interview protocols to be used includes open-ended questions about instructional practices and leadership supports related to one-to-one technology in your district. No other staff members will be present for one-to-one interviews. The focus group will have other teachers present. I will request your permission to audio-record the interview for completeness of data collection, but audio-recording is not required. If you agree, please check the appropriate boxes below. Once analysis of the interviews is complete, you will be asked to review the interpretation for accuracy.

AUDIO/VIDEO/PHOTOGRAPHY:

- ☐ **I agree** to be audio recorded during the research study.
- ☐ **I agree** that the audio recording can be used in publications or presentations.
- ☐ **I do not agree** that the audio recording can be used in publications or presentations.
- ☐ **I do not agree** to be audio recorded during the research study.

You may participate in the study if you do not agree to be audio recorded. The audio recordings will be kept with other electronic data in a secure UNT OneDrive account for the duration of the study.

POSSIBLE BENEFITS: This study is not expected to be of any direct benefit to you; however, we hope to learn more about the leadership practices that support successful technology integration in one-to-one laptop programs. We believe this study has the potential to provide insight into how leaders can create supportive conditions that improve instructional practices in one-to-one learning environments.

POSSIBLE RISKS/DISCOMFORTS: The reasonably foreseeable risks include the potential for loss of confidentiality. This interview will be transcribed using a third party application, TranscribeMe!. Noted here is the link to TranscribeMe!'s privacy policy: https://www.transcribeme.com/privacy/. However, if you do experience any discomfort, please inform the research team.

If you experience excessive discomfort when completing the research activity, you may choose to stop participating at any time without penalty. The researchers will try to prevent any problem that could happen, but the study may involve risks to the participant, which are currently unforeseeable. UNT does not provide medical services, or financial assistance for emotional distress or injuries that might happen from participating in this research. If you need to discuss your discomfort further, please contact a mental health provider, or you may contact the researcher who will refer you to appropriate services. If your need is urgent, helpful resources include Lifepath Systems crisis hotline at (866) 260-8000.

COMPENSATION: There is no compensation for this study.

CONFIDENTIALITY: Efforts will be made by the research team to keep your personal information private, including research study records, and disclosure will be limited to people who have a need to review this information. All paper and electronic data collected from this study will be stored in a secure location on the UNT campus and/or a secure UNT server for at least three (3) years past the end of this research. Throughout the duration of this study, all participant data will be stored on a password-protected laptop with security provisions in the researcher's office. Following the completion of the study, all data will be stored on a password protected remote storage device that will be stored in a locked cabinet in the university office of the supervision investigator, for the required three years. Research records will be labeled with a pseudonym and the master key linking names with codes will be maintained in a separate and secure location.

While confidentiality measures will be taken to protect confidentiality of shared information, other school personnel may be aware of your participation in this research. Please be advised that although the researchers will take these steps to maintain confidentiality of data, the nature of focus groups prevents the researcher from guaranteeing confidentiality. The researchers would like to remind the participants to respect the privacy of your fellow participants and not repeat what is said in focus groups with others.

The results of this study may be published and/or presented without naming you as a participant. The data collected about you for this study may be used for future research studies that are not described in this consent form. If that occurs, an IRB would first evaluate the use of any information that is identifiable to you, and confidentiality protection would be maintained.

Please be advised that although the researchers will take steps to maintain confidentiality of the data, the nature of a focus groups prevents the researchers from guaranteeing confidentiality. While absolute confidentiality cannot be guaranteed, the research team will make every effort to protect the confidentiality of your records, as described here and to the extent permitted by law. In addition to the research team, the following entities may have access to your records, but only on a need-to-know basis: the U.S. Department of Health and Human Services, the FDA (federal regulating agencies), the reviewing IRB, and sponsors of the study.

CONTACT INFORMATION FOR QUESTIONS ABOUT THE STUDY: If you have any questions about the study, you may contact Paula Kent at (903) 449-6237, or Dr. Robert Voelkel at (940) 565-4800. Any questions you have regarding your rights as a research subject, or complaints about the research may be directed to the Office of Research Integrity and Compliance at 940-565-4643, or by email at untirb@unt.edu.

CONSENT:
Your signature below indicates that you have read, or have had read to you all of the above. You confirm that you have been told the possible benefits, risks, and/or discomforts of the study.

You understand that you do not have to take part in this study and your refusal to participate or your decision to withdraw will involve no penalty or loss of rights or benefits.
You understand your rights as a research participant and you voluntarily consent to participate in this study; you also understand that the study personnel may choose to stop your participation at any time.

By signing, you are not waiving any of your legal rights.

Please sign below if you are at least 18 years of age and voluntarily agree to participate in this study.

SIGNATURE OF PARTICIPANT **DATE**

***If you agree to participate, please provide a signed copy of this form to the researcher team. They will provide you with a copy to keep for your records.**

APPENDIX C

DOCUMENTS RELATED TO INDIVIDUAL INTERVIEWS

Individual Interview Protocol

Prior to beginning the interview:

- Researcher introduces self.
- Review IRB informed consent document.
- Explain that the purpose of this interview is to gain an understanding of the supports that were most helpful to them as they integrated the district provided laptop computer into their teaching.
- Thank participants for their participation.
- Ask if participants have any questions before proceeding with interview.

Location: ____Date: ________________

Participant number: ________________

Interview Questions:

1. What is your role in the district and how long have you been in your current position? How long have you been with the district? (Background)
2. Please describe your initial reaction and feelings when you first learned that you and your students would all have 24-hour, year-round access to a district-provided laptop computer?
    a. Probe to find out what excited them, if anything.
    b. Probe to find out what caused them concern, fear, or anxiety, if anything.
    c. Probe to find out their current comfort level with the initiative.
    d. Probe to discover their perceptions of what is expected of them, or what they perceived as the vision for the program.
3. Describe your personal learning curve for integrating laptop technology into your lessons.
    a. Probe for situations in which they learned by doing.
    b. Probe for situations in which they learned by watching others (professional development, observing a colleague, etc.).
    c. Probe for examples of encouragement from others during their learning curve.
    d. Probe for their affective state during the learning curve.
4. Please describe some of the successful experiences you have had integrating the laptop into your teaching.
    a. Probe into the supports that led to the successful experience.
    b. Probe into the origin of the idea for this particular use of the laptop (professional development, a colleague, social media, etc.).
    c. Probe into the help they received (if any) to develop the idea, learn the skill, or implement the practice.

d. Probe to find out what learning platforms/applications/software were needed for the integration lessons, how they were obtained, and how they learned to use them.

5. What advice do you have for school leaders regarding the supports that have been most valuable to you, and what supports you would like to see them provide?
6. Is there anything else you would like to share with me?

Text from Email Requesting Participation in Individual Interview

My name is Paula Kent and I am a doctoral candidate at the University of North Texas. Recently you participated in an online survey I conducted about your comfort level with integrating laptop technology into your lessons. In the survey you expressed an interest in participating in a follow-up focus group or individual interview. I would be pleased if you would consider participating in a 60-minute virtual individual interview via the Zoom application to discuss the supports that are most helpful to you as you attempt to integrate one-to-one laptop technology into your lessons.

The purpose of this mixed methods case study is to examine how teachers implement one-to-one technology into their classrooms and to gain insights about how leaders can best support teachers in adapting their pedagogy in one-to-one learning environments.

You are under no obligation to participate in the study. If you are willing to participate, please respond to this email so we can arrange a time and location for the interview that is convenient for you. An informed consent letter is attached to this email. Please read it prior to the interview. I will go over it with you before the interview begins and answer any questions you may have.

University of North Texas Internal Review Board
Informed Consent Form Notice

Informed Consent for Studies with Adults (IRB-20-76)

TITLE OF RESEARCH STUDY: Supports That Promote Teachers' Computer Self-Efficacy and Transformational Digital Pedagogy in One-to-One Learning Environments

RESEARCH TEAM: Paula Kent, Department of Teacher Education and Administration, University of North Texas. This project is part of a dissertation being conducted under the supervision of Dr. Robert Voelkel, Department of Teacher Education and Administration, University of North Texas.

You are being asked to participate in a research study. Taking part in this study is voluntary. The investigators will explain the study to you and will any answer any questions you might have. It is your choice whether or not you take part in this study. If you agree to participate and then choose to withdraw from the study, that is your right, and your decision will not be held against you. For any who know me, or of me, your participation is solely based on my interest in better supporting one-to-one laptop integration and there is no intent, in any way, to evaluate your instructional practices.

You are being asked to take part in a research study about the uses of one-to-one technology in the classroom, and the supports needed to successfully integrate one-to-one technology into instruction.

Your participation in this research study involves being interviewed in a focus group, exploring your experiences with the implementation of your district's one-to-one technology initiative. You may be asked for documents that pertain to the district or campus support of the one-to-one program, or instructional practices involving one-to-one technology. More details will be provided in the next section.

You might want to participate in this study if you are a teacher in grade 9-12 incorporating one-to-one technology into your lessons. However, you might not want to participate in this study if you do not have time to participate in a 45 to 60-minute interview or focus group.

You may choose to participate in this research study if you are a teacher that has been incorporating district-provided one-to-one technology into your lessons.

The reasonably foreseeable risks or discomforts to you if you choose to take part are any minimal privacy or confidentiality concerns, which you can compare to the possible benefit of participating in educational research to explore how leadership supports impact instructional practices in one-to-one learning environments. You will not receive compensation for participation.

DETAILED INFORMATION ABOUT THIS RESEARCH STUDY: The following is more detailed information about this study, in addition to the information listed above.

PURPOSE OF THE STUDY: You are being asked to participate in a research study which involves exploring the relationship between the degree of transformational technology integration and the supports leaders must provide to facilitate effective practice.

TIME COMMITMENT: The expected total time for participation in the study is between one and one and a half hours. This includes the interview plus the opportunity to member check my analysis of the transcription of that interview. It is possible that an additional minimum amount of time will be needed for collecting and providing any documents that will help me answer the research questions.

STUDY PROCEDURES: This study will include an online survey, two focus group interviews, eight individual interviews, and document analysis for collecting data. This study uses a third party software called Zoom and is subject to the privacy policies of Zoom noted here: **https://zoom.us/pricacy.** Each interview will last approximately 60 minutes. The interview protocols to be used includes open-ended questions about instructional practices and leadership supports related to one-to-one technology in your district. No other staff members will be present for one-to-one interviews. The focus group interviews have other teachers present. I will request your permission to audio-record the interview for completeness of data collection, but audio-recording is not required. If you agree, please check the appropriate boxes below. Once analysis of the interviews is complete, you will be asked to review the interpretation for accuracy.

AUDIO/VIDEO/PHOTOGRAPHY:

- ☐ **I agree** to be audio recorded during the research study.
- ☐ **I agree** that the audio recording can be used in publications or presentations.
- ☐ **I do not agree** that the audio recording can be used in publications or presentations.
- ☐ **I do not agree** to be audio recorded during the research study.

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CONSENT:
Your signature below indicates that you have read, or have had read to you all of the above.
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You understand your rights as a research participant and you voluntarily consent to participate in this study; you also understand that the study personnel may choose to stop your participation at any time.
By signing, you are not waiving any of your legal rights.

Please sign below if you are at least 18 years of age and voluntarily agree to participate in this study.

SIGNATURE OF PARTICIPANT **DATE**
***If you agree to participate, please provide a signed copy of this form to the researcher team. They will provide you with a copy to keep for your records.**

REFERENCES

Abdullah, Z. D., Mustafa, K. I. (2019). The underlying factors of computer self-efficacy and the relationship with students' academic achievement. *International Journal of Research in Education and Science (IJRES), 5*(1), 346-354.

Baker, E., Gearhart, M., Herman, J. L. (1990). *Apple classrooms of tomorrow (ACOT): Evaluation study of first- and second-year findings.* Apple Computer, Inc. & UCLA Center for Technology and Assessment.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215.

Bandura, A. (1993). Percieved self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*(2), 117-148.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* Freeman.

Berry, A. M., & Wintle, S. E. (2009). *Using laptops to facilitate middle school science learning: The results of hard fun.* Center for Education Policy, Applied Research in Education.

Bryman, A. (2016). *Social research methods*, 5th ed. Oxford University Press.

Cavanaugh, C., Dawson, K., & Ritzhaupt, A. (2011). An evaluation of the conditions, processes, and consequences of laptop computing in K-12 classrooms. *Journal of Educational Computing Research*, *45*(3), 359-378.

Celik, V., & Yesilyurt, E. (2013). Attitudes to technology, perceived computer self-efficacy and computer anxiety as predictors of computer supported education. *Computers in Education, 60*(1), 148-158.

Chen, F. H., Looi, C. K., & Chen, W. (2009). Integrating technology in the classroom: A visual conceptualization of teachers' knowledge, goals and beliefs. *Journal of Computer Assisted Learning*, *25*(5), 470-488.

Christensen, C. M., Horn, M. B., & Staker, H. (2013). *Is K-12 blended learning disruptive? An introduction to the theory of hybrids.* Retrieved from Christensen Institute website: http://www.christensentinstitute.org/publications/hybrids

Coghlan, D. & Brannick, T. (2005). *Doing action research in your own organization,* 2nd ed. Sage.

Compeau, D. R., & Higgins, C. A. (1995). Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly, 19*(2), 189-211.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches, 5th Ed.* [Kindle version]. Sage.

Creswell, J. C., & Poth, C. N. (2018) *Qualitative Inquiry & Research Design, 4th Ed.* [Kindle version]. Sage.

Cuban, L. (1986). *Teachers and machines: The classroom use of technology since 1920.* [Kindle version]. Teachers College Press.

Cuban, L. (2001). *Oversold and underused: Computers in the classroom.* [Kindle version]. Harvard University Press.

Donovan, L., Hartley, K., & Studler, N. (2007). Teacher concerns during initial implementation of a one-to-one laptop initiative at the middle school level. *Journal of Research on Technology in Education, 39*(3), 263-286.

Elementary and Secondary Education Act of 1965 [As Amended Through P.L. 115-141]. (2018). Retrieved 30 June 2018 from https://legcounsel.house.gov/Comps/ Elementary%20And%20Secondary%20Education%20Act%20Of%201965.pdf

Ertmer, P. A. (1999). Addressing first- and second- order barriers to change: Strategies for technology integration. *Educational Technology Research and Development 47*(4), 47-61.

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

Ertmer, P. A., Ottenbreit-Leftwich, A. (2013). Removing obstacles to pedagogical change by Jonassen's vision of authentic technology-enabled learning. *Computers & Education, 64,* 175–182.

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., Sendurur, P. (2012) Teacher beliefs and technology integration practices: A critical relationship. *Computers in Education (59)*2, 423-435.

Every Child Succeeds Act of 2105, P.L 114-95 (2015). Retrieved on 20 Feb. 2021 from https://www.congress.gov/114/plaws/publ95/PLAW-114publ95.pdf

Fosnacht, K., Sarraf, S., Howe, E., & Peck, L.K. (2017) *The review of higher education 40*(2), 245-265.

Fullan, M. (2007). *The new meaning of educational change.* Teachers College Press.

Gardner, D. P., & others. (1983). A nation at risk: The imperative for educational reform. An open letter to the American people. A report to the Nation and the Secretary of Education.

Geer, R., White, B., Zeegers, Y., Wing, A., & Barnes, A. (2017). Emerging pedagogies for the use of iPads in schools. *British Journal of Educational Technology 48*(2), 490-8.

Granger, C.A., Morbey, H., Lotherington, Owston, R. D., & Wideman, H. H. (2002). Factors contributing to teachers' successful implementation of IT. *Journal of Computer Assisted Learning, 18*(40), 480-488.

Heath, M.K. (2017). Teacher-initiated one-to-one technology initiatives: How teacher self-efficacy and beliefs help overcome barrier thresholds to implementation. *Computers in Schools 34*(1), 88-106.

Hesse-Biber, S. N. (2017). *The practice of qualitative research: Engaging students in the research process*, 3rd ed. [Kindle version] Sage.

Herold, B. (2016). Technology in education: An overview. *Education Week*. https://www.edweek.org/ew/issues/technology-in-education/index.html

Hew, K. F. & Brush, T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. *Educational Technology, Research, and Development, 5,* 232-252.

Hockly, N. (2013). Mobile learning. *ELT Journal, 67*(1), 80-84.

Hodkinson, P., & Hodkinson, H. (2001). *The strengths and limitations of case study research*. Harvard University Press.

Howard, S. K., Chan, A., & Caputi, P. (2014). More than beliefs: Subject area and teacher integration of laptops in secondary teaching. *British Journal of Educational Technology 46*(2), 360-369.

Hull, M., & Duch, K. (2019). One-to-one technology and student outcomes: Evidence from Mooresville's digital conversion initiative. *Educational Evaluation and Policy Analysis, 41*(1), 79-97.

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

Jude, L. T., Mugisha, A. K., & Muyinda, P. B. (2014). Adoption of the SAMR model to assess ICT Pedagogical Adoption: A case of Makerere University. *International Journal of e-Education, e-business, e-Management, and eLearning, (4)*2, 106-115.

Keppler, M., Weiler, S., & Mass, D. (2014). Focused ubiquity: A purposeful approach to providing students with laptops. *Educational Technology & Society, 17*(4), 278-288.

Krueger, R. A., & Casey, M. A. (2015). *Focus groups: A practical guide for applied research,* 5th ed*.,* Sage.

Lawless, K. A. (2016). Educational technology: False profit or sacrificial lamb? *Policy insights from the Behavioral and Brain Sciences, 3*(2), 169-176.

Lei, L., & Zhao, Y. (2008). One-to-one computing: What does it bring to schools? *Journal of Educational Computing Research, 39*(2), 97-122.

Livingstone, S. (2012). Critical reflections on the benefits of ICT in education. *Oxford Review of Education, (38)*1, 9-24.

Lincoln, Y., & Guba, E. (1985). *Naturalistic inquiry.* Sage.

Machado, L. J., & Chung, C. J. (2015). Integrating technology: The principal's role and effect. *International Education Studies, 8*(5), 43-53.

Marlatt, R. (2019). "I didn't say, 'Macbeth,' it was my Google Doc!": A secondary English case study of refining learning in the 21st century. *E-Learning and Digital Media, 16*(1), p. 46-62.

McLeod, S. (2015). Instructional leadership through the use of a technology integration discussion protocol. *Journal of Research on Leadership Education, 10*(3), 227-233.

McLeod, S. & Richardson, J. W. (2013). Supporting effective technology integration and implementation. In Militello, M., & Friend, J. I. (Eds.), *Principal, 2.0, Technology and educational leadership,* 224-272. Information Age Publishing.

McLeod, S., Richardson, J. W., & Sauers, N. J. (2015). Leading technology-rich school districts: Advice from tech-savvy superintendents. *Journal of Research on Leadership Education, 10*(2), 104-126.

No Child Left Behind Act of 2001, P.L. 107-110. (2002). Retrieved from https://www2.ed.gov/policy/elsec/leg/esea02/107-110.pdf

Paraskeva, F., Bouta, H., & Papagianni, A. (2008). Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology into educational practice. *Computers & Education, 50,* 1084-1091.

Puentedura, R. R. (2006). *Transformation, technology, and education in the state of Maine* [Web log post]. Retrieved from http://www.hippasus.com/rrpweblog/archives/2006_11.html

Puentedura, R. R. (2013). *SAMR: Moving from enhancement to transformation* [Web log post]. Retrieved from http://www.hippasus.com/rrpweblog/archives/00095.html

Puentedura, R. R. (2014a). *SAMR: First steps.* [Web log post] Retrieved from http://www.hippasus.com/rrpweblog/archives/000134.html

Puentedura, R. R. (2014b). *The SAMR model: Six exemplars* [Web log post]. Retrieved from http://www.hippasus.com/rrpweblog/archives/2012/08/14/SAMR_SixExemplars.pdf

Penuel, W. R. (2006). Implementation and effects of one-to-one computing initiatives: A research synthesis. *Journal of Research in Education, 38*(3), 329-348.

Puttick, G., Drayton, B., & Karp, J. (2015). Digital curriculum in the classroom: Authority, control, and teacher role. *International Journal of Emerging Technologies in Learning, 10*(6), 11-20.

Richardson, J. W., Bathon, J., Flora, K., & Lewis, W. D. (2012). NETS* A scholarship: A review of published literature. *Journal of Technology in Education, 45*(2), 131-151.

Roberts, C. & Hyatt, L. (2019). *The Dissertation Journey*, 3rd ed. Corwin.

Robinson, O.C., (2014). Sampling in interview-based qualitative research: A theoretical and practical guide. *Qualitative Research in Psychology, 11*(1), 25-41.

Romrell, D., Kidder, L., & Wood, E. (2014). The SAMR model as framework for evaluating mLearning. *Journal of Asynchronous Learning Networks, 18*(2), 1-15.

Russell, D., Bebell, D., & Higgins, J. (2004). Laptop learning: A comparison of teaching and learning in upper elementary classrooms equipped with shared carts of laptops and permanent 1:1 laptops. *Journal of Educational Computing Research, 30*(4), 313-330.

Saettler, P. (2004). *The Evolution of American Educational Technology.* Information Age Publishing.

Saldana, J. (2009). *The coding manual for qualitative researchers.* Sage Publications, Inc.

Schaffhauser, D. (2015). Four features to look for in 21st century LMS. *THE Journal, 42*(4), 19-22.

Shapley, K., Sheehan, D., Maloney, C., & Caranikas-Walker, F. (2011). Effects of technology on middle school students' learning opportunities and achievement. *The Journal of Educational Research, 104*(5), 299-315.

Simon, M. K. & Goes, J. (2013). *Dissertations and scholarly research: Recipes for success*. Dissertation Success LLC. Retrieved from: www.disertationrecipes.com

Sung, Y. T., Chang, K. E., & Liu, T. C. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers in Education, (94)*, 252-275.

Texas Education Agency. (2019) tea.texas.gov

Topkaya, E. Z. (2010). Pre-service English language teachers' perceptions of computer self-efficacy and general self-efficacy. *The Turkish Online Journal of Educational Technology, 9*(1), 143-156.

Tschannen-Moran, M., Woolfolk Hoy, A. & Hoy, W. K., (1998). Teacher efficacy: Its meaning and measure. *Review of Education Research, 68,* 202-248.

Wang, L., Ertmer, P. A., & Newby, T. J. (2004). Increasing pre-service teachers' self-efficacy beliefs for technology integration. *Journal of Research on Technology Integration, 36,* 231-250.

Weston, M. E., & Bain, A. (2010). The end of techno-critique: The naked truth about 1:1 laptop initiatives and educational change. *The Journal of Technology, Learning, and Assessment, 9*(6), 5-25.

Zheng, B., Warschauer, M., & Farkas, G. (2013). Digital writing and diversity: The effects of school laptop programs on literacy processes and outcomes. *Journal of Educational Computing Research, (48)*3, 267-299.