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INSTRUCTIONAL TECHNOLOGY IN EDUCATION. WHAT ARE DISTRICTS IN A SOUTHERN U.S. STATE SPENDING MONEY ON AND HOW IS IT BEING MANAGED?

A DISSERTATION APPROVED FOR THE DEPARTMENT OF EDUCATIONAL LEADERSHIP AND POLICY STUDIES

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Abstract

In the United States, K-12 public schools are collectively investing around $13 billion annually on educational technology. One of the central aims of integrating technology into K-12 schools is to improve or sustain school performance. Student outcomes have long been a chosen indicator of a school's success and the existence educational technology *should* positively influence this indicator, but studies demonstrate an often-tenuous relationship between technology, technology use, and student performance. Recent empirical research seems to fall short of demonstrating a clear, comprehensive understanding of what instructional technology schools are acquiring, and how they manage and/or use it according to educational technology industry best practices. Moreover, research still does not fully understand the reasons why districts and/or schools want to adopt said instructional technology, as these reasons may be related to their use. Since different types of technology serve different purposes, having a strong understanding of a school or district's underlying rationale for technology selection and its management and/or use of technology may help link technology to performance. To address this gap, this qualitative study identifies which instructional technology software systems are commonly used, why they were adopted, and how these systems are being managed by the district. Qualitative data was collected through a series of interviews (n = 6) and surveys (n = 6) of key district leaders from two urban, two suburban, and two rural school districts in a Southern U.S. state. Findings from the study indicate that there are many kinds of instructional technologies – some of which have existed over time and some of which have been recently adopted - that the focal districts intended to serve one or more stakeholder groups. According to the district leaders who participated in this study, recent adoptions in instructional technology include the technologies themselves as well as the adoption of many new strategies for utilization. Furthermore, district leaders indicated that the majority of instructional technology in their schools were adopted to serve primarily students and that adoptions have been made largely to enhance many existing aspects of teaching and learning. Responses to surveys and interviews by the district leaders included in this study indicate that utilization and tracking of instructional technology is not always being done in alignment with education and technology standards and best practices.

Chapter 1: Introduction

The release of Microsoft Windows in August of 1995 helped change the way many industries conducted business. It was considered a technology revolution and was a significant contributor to the expansion of internet connected services. Students born after 1992 likely started their schooling after Microsoft Windows and personal computers became a mainstay in homes and schools. They have never known a world that does not involve interactions with robust personal computing, internet connectivity, or the use of mobile devices. In many modern-day school settings, students are expected to interact with technology on a daily basis to complete required coursework. Examples of such technology could include hardware such as tablets or computers or digital technology such as instructional software and other web-based systems. Furthermore, many U.S. schools have adopted technology-driven platforms, such as Canvas and Blackboard, that organize the entire academic experience for all students.

Schools seem to have plenty of choices when it comes to finding technology that can meet their needs. The United States Department of Education suggests that instructional technology applications can facilitate several common functions including attendance, grading, testing, and student work/portfolio maintenance (National Center for Education Statistics, 2020). Education practitioners appear to understand the demand for instructional applications as they adapt existing software systems to meet instructional needs. Technology companies have demonstrated their desire to offer instructional goods and services by creating education-centered initiatives. Microsoft Education (Microsoft, 2020) and Google for Education (Google, 2020) are examples of entire educational technology ecosystems offered by two of the largest technology firms in the world.

In recent years, technology has been leveraged as an instructional tool in education. This emergence of technology suggests that education decision makers believe that educational technology will ultimately benefit students (Chen & Price, 2006; Karlin, Ottenbreit-Leftwich, Ozogul, & Yin-Chan, 2018). While the benefits of educational technology and its use to student performance is often tenuous (Zhao & Lei, 2009), some studies have found positive effects of educational technology on outcomes like student engagement, academic achievement, high attendance rates, and student persistence in learning (Bruhn, Hirsch, & Vogelgesang, 2017; Martin & Bolliger, 2018; Henrie, Halverson, & Graham, 2015).

For students who are engaged through educational technology, requiring it as a means of learning can offer certain benefits, but for those students who struggle, the effect on them can be negative (Yeager Neuzil, 2016; Tofel-Grehl, et al., 2017). While students stand the chance to benefit from instructional technology, it is important to recognize some significant challenges. Teachers and students each face obstacles when it comes to interacting in a more technology-centric environment. Some examples of challenges faced by teachers include an increased need for professional development (Tondeur, Forkosh-Baruch, Prestridge, Albion, & Edirisinghe, 2016; Li, Garza, Keicher, & Vitaliy, 2018; Tondeur et al., 2019), limited access to digital devices, broadband internet connectivity, and technical support (Christ, Arya, & Liu, 2018) which can slow down and add complexity to the overall instructional process. One challenge for students is what is deemed the “digital divide,” which is an indicator that some students lack access to reliable, necessary technology such as high speed (broadband) internet or access to a device capable of facilitating the teaching and learning process (Wang, 2013; Chen & Price, 2006).

In addition to this fundamental gap in access, oftentimes student barriers related to their ability to learn through technology are also present (Tang & Bao, 2020). Digital literacy refers to having the skills you need to live, learn, and work in a society where communication and access to information is increasingly through digital technologies like internet platforms, social media, and mobile devices (Western Sydney University, 2020). Being digitally literate means that an individual can utilize technology in a way that the technology was intended to be used. When it comes to interacting with instructional technology, digital literacy is a factor that, when present, can help the student optimize technology as an educational resource.

Aside from these challenges, school districts must also do all they can to keep track of what they have and how they are using it. New technology and upgrades to existing technology are happening constantly and many times without full consideration of the impact on industries, institutions, or individuals. Education itself also has the potential to rapidly change course. Education policies might shift in ways that require re-thinking how technology is used. Because education policies and available technologies both have the potential to change at any time, periodic industry analysis may benefit technology companies by identifying some needs of schools and school districts that they can meet through innovation or technology development. Periodic industry analysis may benefit education by informing education professionals about the *current* technology available to meet their *current* needs and help educational leaders maintain efficiency in their acquisition and management of technology. In short, professionals on both sides of this equation may find great value in understanding the current state of technology adoption, management, and use in schools and districts.

Statement of the Problem

School districts may benefit by having intimate, in-depth knowledge about instructional technology they maintain, manage, and use in their districts but they may not necessarily have it currently. Districts are purchasing technology because it is seen to increase or at least sustain productivity and efficiency (Tulsa Public Schools, 2020), but as new technology emerges, the number of options for adoption are numerous. Such a large and rapidly increasing number of options and desire to invest and use technology on the part of districts and schools makes it easy for issues to arise in how such technology is used and managed. The nearly $13 billion annual educational technology spending of U.S. K-12 schools suggests a need for better district and school organization in the areas of technology selection and maintenance. To help guide such policies for technology adoption in schools, the United Sates Department of Education created a set of policy guidelines that provided a structure for how elementary and secondary schools should handle these critical aspects of technology. This handbook covers areas such as finance, technology policy planning, selection of appropriate technologies, and implementation and integration considerations (National Center for Education Statistics, 2020). This handbook has effectively created a set of federal-level standards for technology adoption and policy making within and across districts.

Outcomes such as student engagement, student achievement and student attainment have some significant research supporting their positive relationship to technology (Basham et al., 2016; Clayton & Murphy, 2016; Everett, 2015; Harrell & Bynum, 2018; Howard & Howard, 2017; Martin & Bolliger, 2018; United States Department of Education, 2017; 2019). It is believed that, with the addition of research focused on what technology is being adopted and how it is being managed in schools and districts, stakeholders can strengthen the link between instructional technology use and key student outcomes. Furthermore, the nature of unexpected disruptions in schooling, such as what was experienced in 2020 during the COVID-19 pandemic, suggests a need for expanded research on instructional technology.

Purpose of the Study

The purpose of this study is to identify which instructional technology systems urban, suburban, and rural school districts in a Southern U.S. state are being used, why they were adopted, and how usage and management of these systems is being handled and tracked by the district—both before and after the COVID-19 pandemic. Instructional technology in this study refers to instructional software applications—digital technology that is designed to directly support and/or facilitate teaching and learning. Having a comprehensive list of current instructional technology along with a shared understanding of how the technology is managed and/or used is a necessary first step in informing a coherent approach its use for teaching and learning. A technology inventory conveys school district priorities while identification of the ways in which the technology is being used can signal whether it is likely to lead to desirable (or undesirable) results. The latter may be especially important given the current teaching and learning climate of the COVID-19 pandemic.

In this mixed methods study, data from a sample of urban, suburban, and rural public school districts will be used to compile a list of software and hardware currently used in districts to advance teaching and learning goals. The data will be gathered through surveys as well as interviews with district office staff. The following questions frame the current study:

Research Question 1. Which instructional technologies have been adopted by K-12 school districts and what new adoptions have occurred since the start of the COVID-19 pandemic?

Research Question 2. According to district leaders, what is the perceived function of key technology investments and how are these investments thought to be related to core district goals?

Research Question 3. According to district leaders, how are districts using these technologies and do district leaders report that district adoption is aligned with ISTE and ITIL standards for technology innovation?

Definition of Terms

Instructional technology. Instructional technology, often referred to as "educational technology", can be defined as the theory and practice of design, development, utilization, management and evaluation of the processes and resources for learning (Watson College of Education, 2020). Instructional technology can include tangible hardware, or it may consist of digital software. Although it is relatively easy to distinguish hardware from software, familiarity with different specific types of each can be beneficial for education professionals who may need to interact with or refer to different instructional technologies. This study will focus on instructional technology in the form of software systems.

COVID-19 pandemic. Covid-19 pandemic refers to a global health pandemic of respiratory illness that emerged in December 2019 (Johns Hopkins Medicine, 2022). In March 2020, the World Health Organization (WHO) declared COVID-19 a pandemic followed by the declaration of COVID-19 as a national emergency by the President of the United States (American Journal of Managed Care, 2021). Shortly after the national emergency declaration, many U.S. school districts began to shut down in person schooling.

Common technologies. The term "Common technology" refers to technology that has been in place or has existed for a long period of time. This might be referred to as "older" technology. In conversations used for data collection in this study, there was no indication of exactly how many years qualify a particular technology as common. Rather, within the context of the dialogue, the question sought to identify what had been in place over the past "many" years.

Newer technologies. The term "Newer" technology" refers to "more recent" examples of technology adopted by the district. This does not reflect how long a particular technology has been available to consumers nor does it reflect a specific time frame. Rather, the term newer indicates that the technology has been more recently adopted.

Hardware. Instructional technology hardware refers to a wide range of technology tools used in education. Laptops, desktop computers, tablets, and smartphones are some common instructional technology hardware (EdTech Magazine, 2020; Hull & Duch, 2019; Martin & Carr, 2015).Virtual reality, drones, point of sale machines, projectors, interactive displays, 3D printers, barcode scanners, servers and e-readers are other examples of hardware that can facilitate teaching and learning that would fall into the category of *instructional technology* (EdTech Magazine, 2020). Hardware by nature is somewhat limited inits ability to serve the individual needs of multiple students. Interactive displays (digital whiteboards, tv's, projectors) for example, can present content to a large number of students at once but cannot meet differing student needs at the same time. Personal computing devices such as laptop or desktop computers, tablets and smartphones can be operated by one student at a time, making it possble for technology to meet a variety of vastly different needs. For this reason, many schools seek to have a 1:1 ratio of computing devices to students in their environments (Hull & Duch, 2019; Islam & Gronlund, 2016; United States Department of Education, 2020). This phenominon, if apropriately achieved, helps increase the liklihood that students have access to technology required for lesrning. Instructional technology hardware can thus be a necessity for some schools looking to incorporate technology. When it comes to keeping track of hardware inventory however, the process can be challenging since accounting for items requires knowing where each asset is physically located at all times (AXELOS Global Best Practice, 2019). This study will not seek to address aspects of asset tracking specific to hardware. It is valuable to recognize, however, that tracking hardware assets differs from tracking of software.

Software. Instructional technology software includes simple and sophisticated digital, computer software applications that are either installed directly onto hardware or that hardware connects to through cloud computing (AXELOS Global Best Practice, 2019; U.S. Department of Education Office Of Educational Technology, 2019). Software can be designed to support efforts of students, teachers, adminstrators or coaches. These systems can focus on curricular or other relevant areas such as teacher professional development opportunities, classroom management or student assessments (ISTE, 2020, July 31c). Asset management for software involves keeping track of several system attributes which can be a very involved process, but tends to rely less on aspects of asset management used in tracking hardware. For example, as cloud-computing systems have become the norm for software platforms (Accenture, 2020; Plummer et al., 2008), system tracking should become even less reliant on software's association with any specific hardware.

Study Significance

With the emergence of virtual charter schools and other competing online learning options for K-12 students, many stakeholders can benefit from a strengthened body of literature that looks at which current technologies are available to schools, what they are adopting, and how their using it. Researching what technology is currently being used by schools provides an opportunity for decision makers to make informed decisions when it comes to allocating technological resources. Schools and districts can better leverage technology effectively to respond to the needs of students, parents, and teachers when research exists to justify technology resource allocation choices. Further, as school districts face funding issues and are forced to find creative solutions for saving money, the ability to effectively move away from traditional brick and mortar versions of teaching may soon be less of an option and more of a necessity. Since the days of the one room schoolhouse, education has evolved in a way that gives teachers many options for keeping students engaged. If virtual or other technology-driven alternatives lead to less face-to-face instruction (which could have some impact on student outcomes), education professionals can benefit from having as much knowledge on educational technology adoption and use as possible in their schools.

Chapter 2: Review of the Literature

Educational technology comes in many different forms. As an industry, educational technology produces opportunities for learning throgh hardware and software formats (Mango, 2015; Marino, et al., 2013; Riegel & Mete, 2017). Some examples of educational technology include interactive whiteboards, mobile devices, computers and educational software. Literature suggests that each has the potential to impact the learning experience of students (Crompton et al., 2019; Karolcik et al., 2015; Richards et al., 2018). While this evidence is plentiful, as is evidenced below, there are no known studies which attempt to understand and catalog what technology districts and schools adopt, how they manage/use such technology. Because significant investments are being made in educational technology among schools and districts and, as with any sound investment, it would be helpful to know as much as possible about what technology is being used and how it is linked to important outcomes in education. With this in mind, the main aim of this literature review is to examine research on potentially positive student outcomes made possible through technology and to examine linkages to management and use. To accomplish this, literature on the relationship between educational technology and student engagement, achievement and attainment will first be reviewed. Identification of the need for additional research on what technology schools are purchasing, managing, and using will serve as the jumping off point for the larger question – What educational technology currently exists in schools and how is it being managed and used?

Student Engagement

Student engagement is an important student outcome to pay attention to for those seeking a deep understanding of the school effectiveness. In recent years, education researchers have looked increasingly at how well students are engaged to better understand how educational and instructional approaches are impacting student experiences. Research on student engagement can use a mixture of quantitative and qualitative methods—some of which is collected through surveys (Hamlin, 2021). Student engagement can be broadly defined as effortful involvement in learning (Henrie et al., 2015). Bomia et al. (1997) describe student engagement as being centered around students' willingness, need, desire and compulsion to thrive academically.

Existing evidence indicates that when students are engaged, they tend to perform better academically (Bruhn et al., 2017; Martin & Bolliger, 2018). Once schools engage students, they appear to be able to increase student committment (Henrie et al., 2015). Research suggests that appropriately implemented technology has the potential to directly influence student engagement (Howard & Howard, 2017; Heinrich et al., 2019;Kim et al., 2012). There are many examples of how technology can fuel student engagement, including the usage of games (Bruhn et al., 2017; Callaghan et al., 2017; Chen & Price, 2006), personalized learning (Basham et al., 2016; Maseleno et al., 2018; Kim et al., 2012) or discussion boards (Greene et al., 2015; Kim et al., 2012).

Students do benefit from technology that has been implemented in purposeful and intentional ways (Harrell & Bynum, 2018). In other words, technology implementation at the classroom level should account for both what *generally* works in teaching through technology as well as what the *unique* learning needs of the students in question (Bruhn et al., 2017). Technology that is seen as engaging for students includes smartphones and tablets, mobile apps, desktop applications and various uses video platforms. These forms of technology are identified as engaging because of their ability to provide "anytime, anywhere" access to learning and because of the individualized naure of their use (Clayton & Murphy, 2016; Howard & Howard, 2017; Martin & Bolliger, 2018). However, technological advances in educational technology do seem to be evolving in such a way that new educational opportunities that rely on technology will continue to become available over time, meaning thiese examples are certainly not an exhaustive list When educational technology is not implemented well, it can adversely impact student engagement (Everett, 2015; Heinrich et al., 2019).

Kim, Kim, and Karimi (2012) conducted a study in which they surveyed 1500 K-12 public online charter school students in an effort to better understand student perceptions related to engagement. They found that some components of technology seem to be more engaging than other components and that engagement also varied based on subject (math, science, reading, etc.). One apparent challenge for education professionals is that not all students are engaged or motivated by the same things. In an article examining personalized learning, Maseleno, et al. (2018) identified how personalized learning has a large focus on engagement as a means for succeeding academically. In their article, they work to provide clarity on personalized learning in general and how the constant access to data can keep students and parents engaged. The focus of this article was to provide a description for how a particular piece of technology (personalized learning) by describing how data (learning analytics) are used in watys that create potentially engaging learning opportunities.

Basham et al. (2016) also looked at personalized learning and how it relates to engagement. In an 18 month qualitative study of students and teachers using personalized learning, the authors conducted observations and interviews in an effort to gague how well students were engaging with and performing in the technology. They found that students with and students without learning disabilities showed the potential to succeed with the technology. Here, the authors focus on development and implementation of personalized learning systems. They conclude that personalized learning has the potential to benefit student outcomes especially through engagement. Regardless of the delivery mechanism, student engagement seems to be an important area and warrents continued research. When it comes to technology and student engagement, the literature proposes that simply purchasing technology and making it available to students may not be enough to improve student outcomes (Howard & Howard, 2017; United States Department of Education, 2017; 2019).

When teachers have a good understanding of how to implement educational technology (and do so), they can make the learning process for students a positive and engaging one (Heinrich et al., 2019). A common way teachers learn about educational technology is through professional development. Professional development, when administered with fidelity and embraced by teachers, can lead to effective implementation of new teaching tools (Chen & Price, 2006; Karlin et al., 2018). When a new technology (e.g. tablets, Chromebooks or a new software system) is implemented in a school and teachers are expected to use it, there is no guarentee that the teacher will know how to utilize the new tool nor is there certainty that they will appreciate the potential value that the technology brings. Research, however, suggests that when technology-specific professional development is available, teachers tend to be willing to incorporate technology tools into their teaching and do so more effectively (Karlin et al., 2018). The notion of having adequate and appropriate professional development available to teachers means that schools and school districts will need to invest time and money into the development of such training for teachers.

To be engaging, technology may also be used to meet unique needs of students. Some students may face challenges in how they learn due to poverty (Vitale & Moore, 2018) while others might experience challenges due to disability (Bruhn et al., 2017). These areas are important to note because technology inaccessiblity that results from these circumstances can thwart engagement. Examples of inaccessibility include low income students not having access to high-speed internet or reliable device outside of school, hardware or software that is not in compliance with Uniform Design standards of accessiblity or applications that are not alligned with a student's IEP (Marino, et al., 2013; Vitale & Moore, 2018; Wang, 2013). For low income students, the challenge of using technology for schooling can be lack of home access to a high speed (broadband) internet connection (Fox & Jones, 2019) but many times is also punctuated by the lack of access to a device such as a laptop or desktop computer or access to mobile device (KewalRamani et al., 2018). Examples of technology accessibility considerations for students with disabilities are that the technology is perceivable, operable, understandable, and robust (Shaheen & Lazar, 2017). This means that student-facing technology should not be too complex nor should it be so simple that it does not add educational value.

Research also suggests that student engagement is often a result of autonomous learning opportunities and can be strengthened through student choice and opportunities for self-management (Bruhn et al., 2017). Many emerging technologies that students interact with have the chance to provide these opportunities for authentic engagement, so the distribution of technologies should perhaps take into account the student populations they are expected to serve. This includes incorporating appropriate and current technology with a distinct purpose in mind. Technology seems to have a relationship to student outcomes, and the relationship seems to be a positive one (Everett, 2015). When schools and districts incorporate technology into their environments, familiarity with the relationship between student outcomes may prove to benefit how educational technology is selected and subsequently put in use.

Student Achievement

Educational technology may influence student achievement under certain circumstances (Harrell & Bynum, 2018; Hung et al., 2019; Shapely & Sheehan, 2010). However, research does not explicitly suggest that student achievement is *always* improved through its usage. Rather, studies indicate the definite *potential* for improved academic achievement if technology is supported by an effective teacher (Callaghan et al., 2017; Cheung & Slavin, 2011). Callaghan et al. (2017), for example, found that when educational computer games are accompanied by technology professional development, the games can positively impact student learning. In a mixed methods research study, they worked with 863 teachers who were using an educational computer game to teach lessons. They found that as educational technology is accompanied by other adequate resources (such as training for teachers), student achievement stands to benefit from its existence in classrooms. Cheung and Slavin (2011), in a meta-analysis of 75 qualifying studies, expanded on previous research on educational gaming and found that educational software for mathematics and reading has the potential to positively contribute to student achievement. They examined student grade level student SES, type of technology, level of implementation, and level of intensity in their analysis and found that in each area of focus, the potential for a positive relationship between technology and student achievement does exist. While some research does indicate a positive relationship between technology use and student achievement, more research is needed in this area.

As technology continues to evolve and, as teachers learn and apply new strategies for incorporating technology in their teaching, the ability to rely on the current body of literature may be inadequate. Finding the right situation in terms of appropriate technology and the right teacher can be challenging and certainly makes an empirically claim of a relationship between technology and student achievement daunting. Some of the factors that constitute this 'right situation' may include teachers' willingness and preparedness to include technology in their instruction, students' access to teacher assistance (Callaghan et al., 2017), students' access to technology at school and willingness to use technology for learning while at home have proven to positively contribute to student achievement (Shapely & Sheehan, 2010). These examples of the right place and time must be underscored by the fact that the right technology is in place. First, as with student engagement, student achievement through educational technology requires that the technology is accessible to the student while the evidence also indicates that it may help if students can access technology at school and home as needed (Wang, 2013).

As mentioned, different forms of technology exist in education. Not all technologies have the same impacts on the teaching and learning process. One technology that seems to be consistently positively correlated with improved student achievement is computer gaming (Callaghan, et al., 2017; Cheung & Slavin, 2011). Studies have shown that using computerized games, student achievement has grown consistently when the games are appropriately tied to curriculum. In fact, mixed methods research has shown that when digital games are tied directly to learning objectives the games have shown to be associated with improvement in student test scores. (Callaghan et al., 2017). Additionally, when teachers receive adequate professional development, they have shown to have improved self-efficacy which, when applied in the context of digital game integration for teaching, seemingly has a positive impact on student achievement (Callaghan et al., 2017).

When the factors of technology type, place, and time are aligned and properly supported, it is possible that student achievement can improve using educational technology. While the evidence of improvement through educational technology is not completely clear, research does suggest that investments in educational technology are academically worthwhile (Shapely & Sheehan, 2010).

Student Educational Transitions and Attainment

Student attainment refers to the cumulative experiences gained by working with and succeeding in a variety of educational institutions. It accounts for academic and social success and potential for continued intellectual and social success resulting from having mastered skills in educational settings (Magnuson et al., 2016). In the context of this review of literature, more attention will be paid to post-high school activities such as college and career achievement. Literature suggests links between different aspects of schooling and life outcomes (Chatterji, 2018; Magnuson et al., 2016; Riegel & Mete, 2017; Roberts, 2018; Wang, 2013). One example is that how a person behaves as a student in school has shown to indicate how they are likely to behave on the job (Roberts, 2018). Another in the context of this study is that technological aptitude of students, at least partially as a result of their interaction with technology in school using technology as a tool for productivity, can equip them with relevant skills once they enter the workforce (Chatterji, 2018; Riegel & Mete, 2017). Chatterji (2018) explored the economic literature and educational policy relating to technology in education. He identifies that innovation, and the injection of technology may not be providing rapid gains in student productivity but calls for increased funding into educational technology research and development, identifying that the ability to measure productivity tied directly to innovation can be quite complex. That said, it is possible, that as more attention is paid to the ability to tie productivity to educational innovations, a linkage between student attainment and technology may become easier to identify.

In a longitudinal, mixed methods study, Heinrich et al. (2019) identify challenges associated with educational technology (in the form of online learning) but also identify some ways it seems to be beneficial for many students. Heinrich and her colleagues examined data from five school years (2013 – 2017) from 46 schools (making this a strong sample) and found that online learning provided attainment opportunities for students. Pei-Yu Wang (2013), in a survey study of 275 teachers and 293 students from a mixture of urban and rural schools outside of the U.S., looked at the difference between technology's place in urban versus rural settings. This is a potentially important concept when looking at student attainment because if geographic factors such as living in a rural versus an urban area impact access to (or understanding of) technology, the way students interact with (and thus stand to develop transferrable skills from) technology stands to perhaps be impacted. Wang found that while teacher attitudes toward educational technology was similar in both urban and rural schools, the amount of available technology was significantly greater in urban schools. Additionally, the fidelity of implementation was shown to be much higher in urban settings. These empirical findings related to geographic location and technology access may need to be considered in future research looking at technology's relationship to student attainment.

What does seem clear about the relationship between technology and student attainment and transitions is that the potential exists for technology to positively influence some student's unique situations. For students who transition from high school to college, technology skills learned in school, such as the ability to view it as a productivity tool, can also carry over into how they perform in their college courses. This perspective on technology usage is an example of practicing good study habits which has shown to be a strong predictor of student success in the transition from high school to college (Beattie et al., 2017). Whether a student is transitioning from high school to college or from high school to the workforce, research suggests that attainment prior to the transition may play a role in future success.

Other factors important to attainment include geographic area (such as rural versus urban settings) or income level (high SES versus low SES), both of which can potentially directly influence the relationship between technology and student attainment. Research has shown that rural schools have a significant disadvantage in many aspects of incorporation of technology than their urban counterparts (National Center for Education Statistics, 2019; Wang, 2013; Williams, Phillip, Farrington, & Fairhurst, 2016). Often, they lack facilities that can support current technology such as broadband internet, 3-D printing or other technology that relied on location or the facility itself (Wang, 2013). Rural schools lack technologically competent teachers, and, in many cases, they lack adequate professional development programs that can increase teacher knowledge of technology designed to contribute to learning.

These factors are exacerbated by the fact that sometimes in rural areas, teacher attitude towards technology as a requirement in schooling is negative (Wang, 2013). Teachers' opinion and understanding of technology is important because their ability to implement technology in their teaching directly impacts whether students benefit from it. Overall, the opposite is indicated as being true for urban schools, where facilities will support high speed connections, modern equipment is available and not only do teachers tend to have higher opinions on technology, but more professional development opportunities are also available for teachers (Wang, 2013). Acknowledgement of the gap between rural and urban schools helps scholars better understand how technology can potentially influence student attainment. When it comes to income level and student attainment through educational technology, research highlights some very interesting factors as well.

Starting at very young ages (usually around three years old), children begin developing the ability to become intrinsically motivated. This concept is important to note because as children at this age begin to interact with technology, they begin associating technology with its purpose (Chen & Price, 2006; Mak & Nathan-Roberts, 2017). A 2013 study indicated that nearly 47 percent of students in the United States live in low-income or poverty-level homes and that the tendency for these homes is to promote technology usage an entertainment or socialization medium rather than an educational or learning one (Shing & Yuan, 2017). To illustrate this, 75 percent of high-income homes were found to promote technology to learn compared with only 35 percent of low-income homes. Additional findings indicate that higher levels of readiness (potentially shaped by how they are encouraged to use technology) typically lead to higher levels of earnings through life (Shing & Yuan, 2017). While predicting student attainment is not an exact science, answers can form as researchers consider the right variables. SES and geographic area are not an exhaustive list, but they contribute insightful knowledge toward understanding the relationship between education technology and student attainment. As with other areas of student outcomes, it seems like more continued research on the relationship between educational technology and student attainment might also be useful. With additional research, scholars and practitioners can potentially address the gaps created by virtue of the speed at which technology evolves .

Making Use of, Integrating, and Scaling up Technology in Education

Technology is used in a variety of ways within the context of education. Literature suggests that *how* technology exists depends on where it exists and on contextual factors that may vary across different environments. Moreover, it appears that education professionals at every level play important roles in the overall diffusion of technology throughout the their state, district, and/or school site (Beberman, 2020; Lee & Choi, 2017; Niederhauser et al., 2018; Webster, 2017). By taking a look at literature on different ways technology is currently put to use in education (including subsequent considerations that arise as a result), more sense can be made of the body literature that suggests technology has an impact on student outcomes. In this section of the literature, many areas are considered, such as: how school districts appropriately sustain and scale technology, what assumptions they have about technology in education, how teachers and students view technology's role in education, and the role of district-provided technology professional development.

In a 2018 article, Neiderhauser and colleagues published a review of discussions of four case studies (from Austrailia, Ghana, Tanzania, and Canada) presented at the EDUSummit 2017—an international conference on information technology in education—and how they relate to educational technology sustainability and scalability. The case studies provide some examples of diffusion of educational technology in different contexts. Sustainability refers to the maintenance and change of technology over time and takes into account Rogers' (2003) theory of the Diffusion of Innovations characterized by persistent and ongoing change of educational culture. Scalability addresses more than just quantity and refers to the liklihood that a technology will diffuse effectively across a culture/context (Niederhauser et al., 2018).

The first case discussed in the article highlights a study from Austrailia in which the goal was to examine how teachers and other stakeholders handled and interacted with new and upgraded technology brought to them through an initiative called the Digital Education Revolution (DER). In the study, students, parents, and teachers from five different schools across a single region were surveyed and school leaders were interviewed about perceptions of engagement with the DER program. In terms of sustainability and scalability, results varied across the schools but schools that allocated resources to technology efforts did indicate an ability to appropriately sustain and scale technology usage.

In the Ghana study, longitudinal, mixed-method research was conducted to assess first year teachers' ability to the develop in students analytical thinking habits as well as the capacity to apply knowledge in solving practical problems. This study took place after a large sum of money was allocated to the establish computer labs in many of the area high schools. The goal was to examine how 3 areas – the characteristics of the innovation itself, beginner teachers' learner characteristics, and chool environment characteristics influenced transfer of learning in teachers' professional and teaching practice. Data was collected at three points (2009, 2010, and 2011) and found that throughout the study teachers held positive pedagogical views stemming from a deep understanding of the innovation – which suggests depth and possible sustainability and that both scalability as well as sustainability can be influenced by teacher-related factors.

In the Tanzania case, researchers worked alongside groups of teachers in three different schools for ten weeks in an effort to collaboratively design and implement technology enhanced lessons. Teachers were interviewed six to twelve months after completion of the project with a focus on four factors contributing to sustained use of technology: characteristics of the intervention, personal factors, institutional factors, and technology factors. The findings were that some teachers in the three groups had stopped using technology altogether. This was identified as a result of contextual differences between the schools – for example, lack of ongoing technical support and poor school leadership, lack of access to electricity and overcrowded classrooms. In cases where technology use was sustained, similarly challenging conditions existed but teachers filled in the gaps as much as possible. In the schools where technology use was not sustained, the schools did retain teacher collaboration efforts (which were a product of the technology implementation initiative).

The final case, Canada, was a 14-year research and intervention initiative (2002-2016) examining how technology can help small rural schools enrich their learning environment to meet requirements of then new national curriculum. Teachers in participating schools were asked to co-design their school alongside many stakeholder groups to create remote learning environments. The goal of this study was to observe ways the remote designs were focused on the five dimensions of scalability: depth, sustainability, spread, shift (in ownership), and evolution. The findings identify challenges resulting from diffusion of technology given different contextual factors and how these challenges can be addressed. The prevailing idea across all cases is that technology can be sustainable and scaleable through effective management of certain context-specific factors (Niederhauser et al., 2018).

Webster's (2017) grounded theory study examined what technology assumptions are present in the thinking of K-12 technology leaders, to investigate how the assumptions may influence technology decision making and to explore whether technological determinist assumptions are present. This study includes surveys and interviews with K-12 technology and instructional technology specialists (31 total from 19 Virginia school districts). The goal of the study is to investigate which broad philosophy of technology assumptions are present in the thinking of K-12 technology directors and instructional technology specialists, to explore how philosophy of technology assumptions could influence the decisions that leaders make about educational technology, and to investigate what assumptions charaterized by technological determinism. The research revealed three broad categories: *technology is a tool* to be put to use by users for their purposeful ends, *technological change is inevitable* (which represents the idea that participants recognize how technology has historically evolved and seems to continue to evolve), and *technological optimism*, which refers to how technology leaders in this study are generally optimistic about the potential for technology to improve education and the world, and they embraced its possibilities.Findings showed that three categories related to technology decision making were prevalent: educational goals and curriculum drive technology, keep up with technology (or get left behind), there should be consideration for ethical factors associated with technology. Overall, this article suggests that, as education technology leaders respond to the inevitability of technological change and their concerns for preparing students for a technological future, keeping up with technology (or get left behind) emerges as the primary concern for leaders and is given a good deal of weight in decision making (Webster, 2017).

In a study on higher-order thinking in technology-enhanced learning environments, Lee and Choi (2017) look at the role of learner factors by conducting a study on 487 students across seven universities in South Korea. Undergirded by the premises that critical thinking and problem-solving (reflecting higher-order thinking) help to navigate multi-dimensional and unpredictable situations and that higher-order thinking is considered a critical predictor of success, the researchers used a structural equation modeling (SEM) approach, to identify students attitudes and beliefs toward technology use as well as their approach to learning. Researchers have agreed that higher-order thinking involves complicated cognitive activities such as formulating hypotheses; elaborating, interpreting, and analyzing information; applying multiple criteria; constructing arguments; making comparisons and inferences; integrating and synthesizing information; and yielding multiple solutions (Lee & Choi, 2017). Results this indicated that while the deeper learning approach (both motivation to employ a deep learning approach and strategies to actualize the approach) can promote higher-order thinking in technology-enhanced environments, neither motivation nor strategies related to a surface learning approach impeded higher-order thinking. In other words, a deeper learning approach clearly exerted positive and strong effects on higher-order thinking. It was also noted that while a deeper learning approach had the strongest direct influence on higher-order thinking, attitude factors had a more indirect impact (Lee & Choi, 2017).

Beberman's (2020) study conducted on teacher self-efficacy for K-12 classroom technology integration and the role professional development and growth mindset analyzed 156 surveys from currently practicing Nassau County, New York teachers in early 2020. The surveys collected demographic (gender, subject taught, years of teaching experience) and growth vs. fixed mindset measures. The goal (purpose) of the study was to better understand factors that predict teachers' self-efficacy for technology integration in their classrooms, including the technology integration professional development (TIPD) they have received, their demographics, subject matter, and their mindset. "Technology integration," as she defines it is the use of technology tools in general education content areas, allowing students to apply computer and technology skills to learning and problem-solving. TIPD, therefore, intends to help teachers learn to evolve and change as new technology emerges. The two models that were contrasted as a frame for this study were the *traditional* model, which was a lecture delivered to 3-15 participants involving some sort of hands on activity considered a one size fits all approach; and *coaching*, which was a much more adaptable, and therefore a more individualized approach. The author found that teacher self-efficacy for technology integration in their classrooms was low and this suggests that more research could be beneficial to an understanding the potentially complex relationships between teacher mindset, teacher self-efficacy, professional development and technology integration (Beberman, 2020).

As it pertains to this purpose of this study, clear gaps in this research exist. While there is much known about how technology is linked to outcomes and the factors related to technology integration, a big piece of the puzzle that matters to the success of technology use in districts is related to how such technology is adopted and managed. However, a review of the literature on educational technology reveals little focus on the tracking of currently-used instructional technology, its management, and the reasons for adoption. As technology has the potential to change rapidly, having a more current collection of research on how technology is being tracked and put to use in schools may be beneficial.

Chapter 3: Conceptual Framework

The purpose of this study is to identify which instructional technology software systems urban, suburban, and rural school districts in a Southern U.S. state were in use, why they were adopted, and how usage and management of these systems is being handled and tracked by the district—both before and after the COVID-19 pandemic. Having a comprehensive list of current instructional technology along with a shared understanding of how the technology is managed and/or used is a necessary first step in informing a coherent approach its use for teaching and learning. The following questions framed the current study:

Research Question 1. Which instructional technologies have been adopted by K-12 school districts and what new adoptions have occurred since the start of the COVID-19 pandemic?

Research Question 2. According to district leaders, what is the perceived function of key technology investments and how are these investments thought to be related to core district goals?

Research Question 3. According to district leaders, how are districts using these technologies and do district leaders report that district adoption is aligned with ISTE and ITIL standards for technology innovation?

This study identifies what technology (in this case, instructional technology software) is being adopted by schools and how the technology is being managed. 'Management' of technology is defined by the National Research Council as "a process, which includes planning, directing, control and coordination of the development and implementation of technological capabilities to shape and accomplish the strategic and operational objectives of an organization" (Tas & Yeloglu, 2018, p. 250). In recent years, technology management in education has seen an emerging emphasis on issues such as equity, access, and change management (United States Department of Education, 2021). The goal here is to identify which instructional technology software is in use by constructing a comprehensive list of software that is in place; then to build on the list by identifying how school districts used the systems in response to the COVID-19 pandemic. Establishment of an instructional technology software inventory establishes a jumping off place for a discussion on reasonable expectations for outcomes resulting from the use of instructional technology.

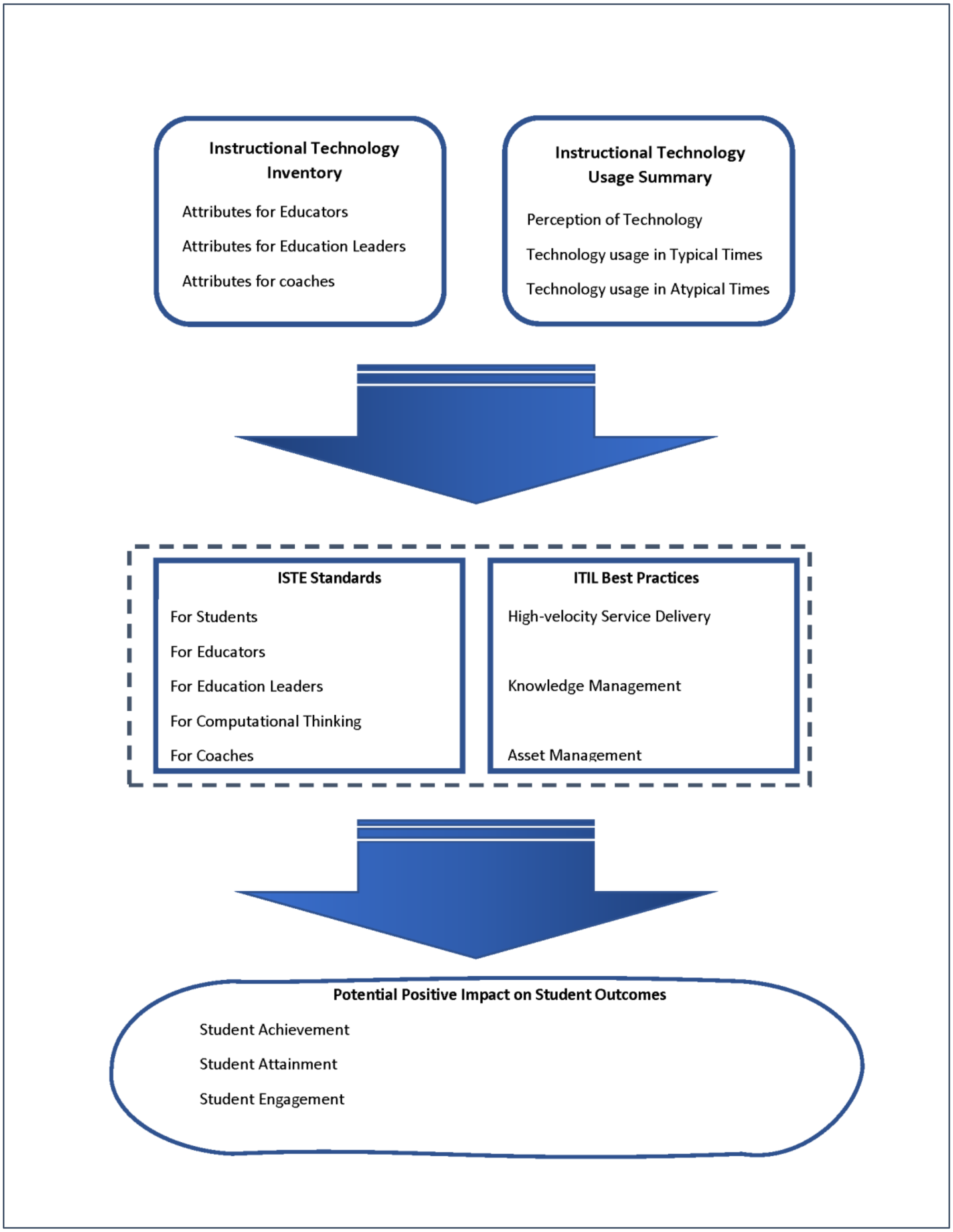
A conceptual framework (See Figure 1) was developed to represent the linkages between high-quality instructional technology inventory and usage, industry standards for technology use, and student outcomes and was derived from a combination of literature and industry best practices from the education and technology sectors. Each of these are important elements related to identification of appropriate instructional technology, but the focus of this study is on the first two of the three sections: high-quality instructional technology inventory and usage, industry standards for technology use. The framework will organize the analysis of specific instructional technology tools currently in schools and can highlight some ways education professionals can oversee the technology management process. Each of the sections of Figure 1 are discussed in turn below.

Instructional Technology: Software Inventory

This conceptual framework is intended to guide education professionals through the process of capturing and maintaining information on technology, in this case instructional technology. The intention is not to present a roadmap applicable only to IT experts or to only

Figure 1.

Conceptual Framework for understanding technology usage and adoption



make sense to authorities on instructional technology. Rather, this framework seeks to blend literature on student potential, methodologies associated with successful technology management and factors that are designed to lead to student thriving (ISTE, 2020, July 31b). The outcome of these areas can result in establishing a list or database of what technology is in use at a school. Given the responsibilities of different roles within education as identified through the ISTE Standards (2020) and the value added by effectively keeping track of technology assets (AXELOS Global Best Practice, 2019), an effective approach to inventorying instructional technology may need to include quantitative and qualitative variables that are updated and readily accessible for educators, education leaders and instructional coaches.

Instructional Technology: Usage Summary

An instructional technology usage summary is a statement that describes how instructional technology is being used by a school district. This representation is simply a summary of how the systems are thought of and how they are implemented (used) by an education entity – for example, a school district. Districts may or may not implement systems with a high degree of planning, and the purpose of developing a usage summary is not to persuade anyone to take a specific stance. Rather, the purpose of this output is to identify and communicate the way in which systems are in use at a given time. Both the ITIL best practices and the ISTE standards inform and provide a framework for articulation of how technology systems are used by a school district.

Technology Use: ISTE Standards

The International Society for Technology in Education (ISTE) is an educational non-profit organization focused on leveraging innovation for the benefit of K-12 students. Founded in the 1970’s in Eugene, Oregon by education professionals, ISTE has grown into a globally recognized leader in education technology collaboration (ISTE, 2020, July 30a). ISTE focuses on transforming the world of teaching and learning through innovation and use of technology. They promote collaboration and inspire education professionals at all levels through professional learning opportunities, membership, events, community, and publishing (ISTE, 2020, July 30a).

ISTE Standards are a framework for how innovation can exist in education. Standards exist for specific education stakeholders such as teachers, administrators, coaches, and students. In addition to standards tailored to each of these roles, a set of standards have been established for “computational thinking.” The computational thinking standards are designed with the aspirational goal of ensuring that every student understands and can harness the power of computing to succeed in their personal, academic, or professional lives (ISTE, 2020, July 30b). ISTE has developed each set of standards through over 30 years of classroom observation and direct feedback from educators, administrators, and students (ISTE, 2020, July 30a). The standards are all designed with the understanding that new innovations and technologies must be accounted for on a regular basis.

The list of ISTE standards for students is comprised of areas that help support students' ability to be empowered learners, digital citizens, knowledge constructors, innovative designers, computational thinkers, creative communicators, and global collaborators. These student guidelines were designed to give students a high level of input in terms of how technology strengthens their ability to thrive (ISTE, 2020, July 31b). Synthesis of the twenty-eight standards presented for students suggests that through rigorous adherence to the standards, students may likely see sustained positive impact on their achievement, attainment, and engagement (ISTE, 2020, July 31b). For students, the benefit of information managed about technology in the school is more indirect. Information available through technology inventorying processes are more likely to directly impact those in professional, technology facilitation roles. Educators, education leaders and coaches will benefit directly from a well-managed technology inventory and can pass along the information to students in an appropriate manner.

The standards for educators consist of broad areas including Learner, Leader, Citizen, Collaborator, Designer, Facilitator, and Analyst. Synthesis of these areas reveal inclusion of specific goals and expectations for educators that, when met, provide a roadmap for support of students' ability to learn at an optimal level using innovation-centered resources (ISTE, 2020, July 30d). Information (variables) on instructional technology that may help educators align with these standards might include basic information such as the name of the system, grade level or age the system is designed to serve, curriculum area, delivery method and what research the system is designed to reflect.

Standards for Education Leaders are made up of Equity and Citizenship Advocate, Visionary Planner, Empowering Leader, Systems Designer and Connected Learner. Synthesis of these areas indicates expectations for leaders to continuously ensure that teachers can independently manage their ability facilitate the teaching of students through adequate and appropriate use of technology. The standards for education leaders guide education administrators through methods of learning about technology and encourage promoting of technology when suitable. The emphasis seems to be on information gathering and collaborating as a mechanism to support the needs of educators (ISTE, 2020, July 30c). Information that may help education leaders align with these standards might include all variables important to educators along with the addition of qualitative variables such as if the instructional technology has earned an ISTE seal of alignment and ratings from users of the system if available.

Standards for Computational Thinking are different than the other families of standards as the computational thinking standards are designed to facilitate a computer science mindset for teachers, students, coaches, and leaders. The standards incorporate several broad areas of emphasis including Computational Thinking (Learner), Equity Leader (Leader), Collaborating Around Computing (Collaborator), Creativity and Design (Designer), and Integrating Computational Thinking (Facilitator). The twenty-five Computational Thinking competencies were designed for students of all ages with computer science concepts in mind. The goal is to adequately equip all students with the ability to thrive because of proper thinking about and use of computing in the modern age. Synthesis of these competencies requires that education professionals to be familiar the CSTA Computer Science Standards for Students, understand the power of computing as it relates to personal, personal and academic thriving, take the lead in promoting responsible use of technology and communicate what technology is available (ISTE, 2020, July 30b). As instructional technology information is kept, variables that support computational thinking standards include attributes that identify instructional approach, research base and curriculum and grade levels covered by the technology.

Seven areas of focus comprise the standards for coaches. These areas are Change Agent, Connected Learner, Collaborator, Learning Designer, Professional Learning Facilitator, Data-driven Decision Maker, and Digital Citizen Advocate. Coaches' responsibilities generally center around support of educators and these standards reflect this responsibility. Synthesis of these standards indicate the need for coaches to encourage educator use of technology. The standards also require coaches to remain as informed as possible about currently available technology, to ensure technology in use is appropriate and to update others on changes to technology. The role of a coach is vital in successful incorporation of technology. Coaches have the responsibility of working directly with all other stakeholder groups in education and need access to timely and accurate information on available technology (ISTE, 2020, July 31a). Some Information that coached might need access to could include instructional approach, research base and ISTE alignment status in addition to other basic information such as system name and curriculum covered . With their natural big picture perspective on teaching and learning, coaches might be a good option in many cases as the group to keep information on technology updated. To effectively update information such as an inventory of technology, this big picture understanding can benefit from following best practices related to technology management.

Technology Management: ITIL Best Practices

ITIL is a framework for providing technology (IT) services. The framework has been regarded as an effective approach to managing technology since the 1980's (AXELOS Global Best Practice, 2019). Often, this framework is used within an organization by an Information Technology or other technical support department to sustain the technology initiatives of the organization. Technology in the workplace began to evolve rapidly in the 1990s and this required attention in the form of identification and management of technology-related services. Service management is at the core of ITIL. It is suggested that, as technology has emerged in different industries, there are inherent changes to how work is done. These transformations, while not always easy to adapt to, are regarded as positive because the infusion of technology brings with it the goal of organizational flourishing. Through proper service management, ITIL is expected to help organizations of all sorts navigate technology-related change successfully (AXELOS Global Best Practice, 2019).

High-velocity service delivery. Providing technology support in the modern age may require quick response. High-velocity service delivery refers to the need for rapidly delivered technology services in response to a fast-changing technology environment. As competition in the technology marketplace increases, technology companies have boosted their speed to market which means new innovations and technologies are available frequently. This shorter time to market has resulted in expectations for equally rapid delivery of technology services. In short, Changes in technology do not necessarily end with the addition of an additional item to choose from. New business practices, new staff, new infrastructure, and financial changes are examples of areas affected by the infusion of technology. Industries that regularly use new, modern technology may not experience much of a negative impact from these changes. In other industries where technology management might focus more on efficiency, reliability and low cost, changes may struggle in keeping up with implications related to new technology. High-velocity service delivery helps address some of these challenges by presenting some specific areas of interest focusing on how to provide services in a rapidly-changing modern technology-driven environment – even if the organization is not as comfortable with the pace of change (AXELOS Global Best Practice, 2019).

Knowledge management. Knowledge management is the practice of identifying and documenting key information such that the information is available and helpful to those who need it. AXELOS (2019) identifies the purpose of knowledge management as maintaining and improving the effective, efficient, and convenient use of information and knowledge across the organization. The prevailing idea behind ITIL in general is to become strategic and intentional about providing exceptional support for technology in an organization. Knowledge management asserts that relevant information about technology should be documented and kept current. Example include information tracked for technology hardware or for software systems. Information is typically stored in a database of some sort and is intended to be available to the right audience as seamlessly as possible. Appropriate knowledge management considers the context in which different people are concerned about the technology. Thus, an accountant may look at a software system in terms of cost while a teacher may look at it in terms of whether it will help them teach their curriculum effectively. A Helpdesk Agent may want to know how to fix common technical glitches and errors. It imperative, then, to capture and maintain a variety of information on the technology across the organization such that anyone can find current and relevant information as needed (AXELOS Global Best Practice, 2019).

Asset management. The purpose of IT asset management is to plan and manage the full lifecycle of all technology assets (AXELOS, 2019). This may take the different forms depending on the nature of the organization. More than likely, asset management will be digital and accessible by appropriate staff. Some, but not all aspects of asset management focus on costs associated with ownership. Vendor information, contract details, licensing information and software version are expamples of system information that may be needed to ensure optimal use. The ITIL framework emphasizes keeping timely and accurate inventory information and acknowledges that storing information about technology items should reflect the value they bring to an organization. The more information that can be effectively managed, the better. Essentially, attributes tracked should represent as much about the technology as possible.

Technology's Potential Positive Impact on Student Outcomes

Student achievement. For years scholars have asserted that technology can have a positive effect on student achievement (Callaghan et al., 2017; Cheung & Slavin, 2011; Shapely & Sheehan, 2010). It is suggested that educational technology can improve performance in core subjects when it is well-aligned with curriculum (Cheung & Slavin, 2011) and that when adequate supports are in place, it can have positive effects on overall student achievement

(Shapely & Sheehan, 2010). Synthesis of most literature regarding educational technology suggests that the outcome of achievement stands to benefit through its existence.

Student attainment. Student attainment can be enhanced through educational technology (Chatterji, 2018; Magnuson et al., 2016; Riegel & Mete, 2017; Roberts, 2018; Wang, 2013). As described by many scholars, student attainment is important in the transition from schooling to the workforce or other post-schooling ventures. Practically speaking, exposure educational technology helps set the tone for how technology might help develop a more technology savvy workforce (Chatterji, 2018; Riegel & Mete, 2017), which helps employers as well as the individuals filling occupational roles. The potential for student attainment to be impacted by educational technology also draws attention to the conversation of access to technology. Because geographical areas have less ability to access basic technology such as a broadband internet connection (National Center for Education Statistics, 2019; Williams et al., 2016; Wang, 2013), it is critical that attention is paid to the inequity – creating more opportunity for bridging the divide.

Student engagement. Student engagement is the ability for students to connect authentically and deeply with their learning. It is an outcome of interest to many education scholars (Henrie et al., 2015; Mango, 2015; Marino, et al., 2013; Riegel & Mete, 2017). Student engagement is an outcome that, when supported, can transcend a particular subject or lesson and can permeate into whether or not a student will have the ability to participate to the fullest in their schooling. Research over the past decade or so indicates that student engagement stands to be improved through appropriate implementation of educational technology (Mango, 2015; Marino, et al., 2013; Riegel & Mete, 2017). Because student engagement is such a potentially powerful concept that can be impacted throgh technology, the notion of student engagement will serve as a consideration for why districts adopt the technology they do.

Chapter 4: Method

Recent empirical research seems to fall short of providing a clear, comprehensive understanding of what instructional technology schools are acquiring and how they manage and/or use it according to educational technology industry best practices—particularly given the additional stresses and strains of the COVID-19 pandemic. Moreover, we still do not fully understand the reasons why districts and/or schools want to adopt said instructional technology, as these reasons may be related to their use. Since different types of technology serve different purposes, having a strong understanding of a school or district's underlying rationale for technology selection and its management and/or use of technology may help link technology to performance. The purpose of this study was to identify which instructional technology software systems urban, suburban, and rural school districts in a Southern U.S. state were in use, why they were adopted, and how usage and management of these systems was being handled and tracked by the district—both before and after the start of the COVID-19 pandemic. The following questions framed the current study:

Research Question 1. Which instructional technologies have been adopted by K-12 school districts and what new adoptions have occurred since the start of the COVID-19 pandemic?

Research Question 2. According to district leaders, what is the perceived function of key technology investments and how are these investments thought to be related to core district goals?

Research Question 3. According to district leaders, how are districts using these technologies and do district leaders report that district adoption is aligned with ISTE and ITIL standards for technology innovation?

Data Sources and Participants

The data from this study was collected from interviews with key district technology leadership personnel derived from a sample of six school districts in the Southern United States. This purposive sample of districts included two urban, two suburban, and two rural school districts. The decision to include multiple districts and to maximize the variation in those districts by urbanicity was done in anticipation of how technology acquisition and use is tied to district funding, access, and capacity. For this sample, leaders from districts who were identified as utilizing instructional technology to at least *some* degree were selected. In terms of who in the district was selected to represent their district, the researcher contacted each district directly to establish the participants most appropriate in consultation with the district Superintendent and other key personnel whenever possible. The sample had elements both a convenience sample (due to familiarity and geographic proximity) and a representative sample, covering multiple districts of a variety of types. *Types* of school districts who participated in this study are classified as either “Urban”, “Suburban”, or “Rural”. Districts are considered as belonging to one of these three categories based on data from the Oklahoma Department of Education (Oklahoma Department of Education, 2020) utilizing United States Department of Education NCES Locale Classifications and Criteria (United States Department of Education, 2022). The districts in this study categorized as *Urban* are classified as “City – Large” by the NCES Locale Classification. This study’s *Suburban* districts are classified by NCES Locale criteria as “Suburban – Large” and the *Rural* districts included in this study are considered “Town – Distant” in the NCES Local framework. District enrollment for the 2020-2021 school year (Oklahoma State Department of Education, 2022) was also included to demonstrate the relative difference in size between the different types of school districts (see Table 1).

Table 1.

2020 District Classifications by NCES Locale with SY 20-21 Enrollment Data

District	**NCES Locale Classification**	**SY 20-21 Enrollment**
Urban District A	City - Large	37344
Urban District B	City - Large	35765
Suburban District A	Suburban - Large	14959
Suburban District B	Suburban - Large	9035
Rural District A	Town - Distant	3392
Rural District B	Town - Distant	2569

Data Collection Procedures

To address this study's research questions, a series of semi-structured interviews and online surveys were conducted with each of the key district technology leaders chosen. For the interviews, each interviewee was asked a series of ten questions about the instructional technology in their school district. Each of the ten interview questions in the protocol (see Appendix A) was designed to produce responses that help answer one or more of the study's research questions. Furthermore, the interview questions were designed to be general enough in nature that interviewees could easily respond in insightful ways. For example, some of the questions ask about identifying specific technology, but the interviewees were not asked to provide an exhaustive list with specific software titles. Rather, the interviewee could discuss the types of instructional technology that they are familiar with. This approach of keeping questions more general was intended to allow for more robust extemporaneous answers.

Data was collected from a combination of interviews with district-level technology and/or instructional leaders at each district in the sample. The individuals included in the sample were contacted prior to administering of interviews and were asked to commit and formally consent to participation for the purpose of this study's data collection. Interviews consisted of two people – the interviewer and the interviewee, each of whom were in their own work setting during the interview. Throughout the fall of 2021, interviews were held with each of the district leaders remotely using Zoom web conferencing software. This technology allowed the interviewee and interviewer to see one another throughout the conversation. Video recordings with audio were captured for each of the interviews. The interviews consisted of ten questions that were designed around the three research questions that guided this study. Answers provided in the interviews provided qualitative data that was analyzed by generating tables with interview responses, categories that emerged and frequencies of the categories. From the audio portion of each recording, transcriptions of the interviews were then generated. The responses to these interview questions were analyzed to indicate the different technology/system types, groups who are primarily served by the different instructional technologies, the functions and/or purposes of instructional technology, whether a particular technology is a new adoption or a commonly used technology, areas of emphasis, how well the technology aligned with core teaching and learning goals and to what extent education and/or technology industry standards and best practices are being employed in management of instructional technology.

Following each interview, the participants were asked to complete an online survey with additional questions relating to instructional technology in their district. The three-question survey (see Appendix B) provided an opportunity for each participant to expand on the discussion of what instructional technology is in their district, discuss how they go about tracking the inventory of instructional technology and to talk about their overall mission and vision for instructional technology. The surveys were administered through Qualtrics, an online survey tool. Participants were each informed of the survey during the closing conversation towards the end of the interview. They were sent an email with a link to the survey where they could gain access to the survey. Results from the survey were analyzed to identify different technology/system types, groups who are primarily served by the different instructional technologies, the functions and/or purposes of instructional technology, the frequency by which the inventory of instructional technology is updated and the overall mission/vision for instructional technology.

Information Collected on Technology Types and Use

This goal of this study was to identify which instructional technology systems exist in the sample school districts and to provide information on how districts use the instructional technology. The information captured through the series of interviews included data on technology/system type, new adoption, group served, category, area of emphasis, function and/or purpose, group served as percentage, descriptions of alignment, employs ISTE, and ITIL Values for each of these measures. Below, the nature of these different sources of information on technology type and use are explicated in more detail in the hopes of better understanding of what instructional technology existed in the focal K-12 districts how it was managed.

Technology/System Type. The study captured information on the type of technology in terms of broad functionality and grouping of type for instructional technology software systems that have been adopted and instructional technology hardware systems that have been adopted. This information was collected through the interviews and through the surveys.

New Adoption. The study captured information on whether the type of technology adopted/used was a new adoption or had been in existence for several years at the time of the study. This information was collected through the interviews but was not captured or confirmed in the surveys.

Group Served. This study captured information on the stakeholder group that a particular technology is designed to ultimately impact. This measure does not exclusively refer to who is using the technology as some technologies are used by one group but are designed to impact another group. Teachers, for example, may use many different instructional technologies but the group the technology is designed to impact may be the student or parent. This information was collected through the interviews and through the surveys.

Category. The study captured information on whether certain instructional technology is a software system, hardware, or a technology strategy. Data collected in this study, at least in part, addresses new adoptions in technology. Some of the new technology adoptions were not in the form of software or hardware but were adoptions of new strategies for the management and/or utilization of instructional technology. This measure indicates whether a new instructional technology adoption is a new technology or if it is an instructional technology management/utilization strategy. This information was collected through the interviews but was not captured or confirmed in the surveys.

Area of Emphasis. The study captured information on what a particular new technology adoption emphasizes. The measure could refer to the implementation of a certain type of software system or the newly adopted focus on an instructional technology management/utilization strategy. This information was collected through the interviews but was not captured or confirmed in the surveys.

Function/Purpose. The study captured information on the perceived function and purpose of instructional technology refers to the reason the technology was adopted (what the district leaders were hoping adopting the technology would lead to). This information was collected through the interviews and through the surveys.

Group Served as Percentage. The study captured additional information on the function and purpose of instructional technology. This measure considers the frequency of times a particular stakeholder group (student, teacher, parent, etc.) is identified as the function and/or purpose's group served and displays it as a percentage of total Group Served instances. This information was collected through the interviews and through the surveys.

Descriptions of Alignment. The study captured information intended to help identify the degree to which instructional technology in their district aligned with core teaching and learning goals. This information was collected through the interviews but was not captured or confirmed in the surveys.

Instructional Technology Mission/Vision. The study captured information on what district leaders consider the overall mission and/or vision of instructional technology present in their district. This information was collected through the surveys but was not explicitly confirmed in the interviews.

Frequency of Inventory Updating. The study captured information on how frequently the district's instructional technology inventory is updated. When responding to this question, the participants could choose from "Once monthly," "As needed," or "Unsure." This information was collected through the surveys but was not captured or confirmed in the interviews.

Employs ISTE. The study captured information on the presence of ISTE standards/best practices in the adoption and/or use of instructional technology is represented by "Yes, "No," or "Unclear." These answers reflect the ability to confirm employment of ISTE standards/best practices. The absence of a confirmed "Yes" or "No" by the district leader resulted in as reported answer of "Unclear."

Employs ITIL. The study captured information on the presence of ITIL standards/best practices in the tracking of instructional technology is represented by "Yes," "No," or "Unclear." These answers reflect the ability to confirm employment of ITIL standards/best practices. The absence of a confirmed “Yes” or “No” by the district leader resulted in as reported answer of “Unclear.” This information was collected through the interviews but was not captured or confirmed in the surveys.

Data Analysis

Through content analysis of a series of interviews and surveys with key district leaders, answers to this study’s research questions were provided. Table 2 below outlines the linkages between the research questions and the data sources and analytical approaches used to answer them. For research question 1, both the interviews and the surveys were used. In the interviews, the participants discussed both common (older) and newly adopted instructional technology present in their district, and in the survey, the participants were asked to list specific titles of instructional technology software systems. From this data, a table was created that lists out the types of instructional technology that exists in each school district. research question 2 was also answered utilizing responses from the interviews and the survey. Both provided unique insight into the areas of function and purpose. For research question 3, data from both the interviews and the surveys was used to gain insight into how usage was aligned with industry standards.

Addressing Research Question 1

Research question 1 asks, “Which instructional technologies have been adopted by K-12 school districts and what new adoptions have occurred since the start of the COVID-19 pandemic?” The first step in using interview response data to answer research question 1 was to identify which questions from the interview protocol (see Appendix A) provided insight into this question. Research question 1 ultimately addressed two things – the common (older) instructional technology in schools and the new instructional technology adoptions that have taken place since the beginning of the COVID-19 pandemic. One question asked interviewees to talk about what instructional technology has been commonly used by their district over the past many years. Responses to this

Table 2.

Overview of Research Design

	Research Question	**Analytical Approach**	**Data Sources**
Research Question 1	Which instructional technologies have been adopted and/or used by selected K-12 school districts in a Southern U.S. state and what new adoptions and/or changes in use have occurred since the start of the COVID-19 pandemic?	Qualitative: Content analysis	Interviews with key district leadership, surveys completed by key district leadership
Research Question 2	According to district leaders, what is the perceived function of key technology investments and how are these investments thought to be related to core district goals?	Qualitative: Content analysis	Interviews with key district leadership, surveys completed by key district leadership
Research Question 3	According to district leaders, how are districts using these technologies and do district leaders report that district adoption is aligned with ISTE and ITIL standards for technology innovation?	Qualitative: Content analysis	Interviews with key district leadership, surveys completed by key district leadership

question were categorized into types of system based on the technology and system type and the stakeholder group the technology was designed to impact. A list of all responses was made that compiled answers from each of the six district leaders. Each item in the list represented instances of unique combinations of Technology/System Type and Group Served. Frequencies of each were generated and duplicates were removed from this data. All responses referred to software systems (as the focus of this study was on software was on software as opposed to hardware).

Because research question 1 asks about instructional technology that has been commonly adopted but no specific timeframe is provided for answering the question, newer instructional technology used by a district could also be used to help answer the question. In fact, by including responses about both older and newer technologies a more thorough answer to the research question may result. The analysis of newer technologies consisted of the compilation of answers from each district leaders on a question from the interview protocol asking the interviewee to discuss some more recent examples of new investments in technology. Answers from the survey protocol were also considered in this analysis. A list was generated from answers to this question that included New Adoption, Group Served, and Category. Each item in the list reflected a unique combination of New Adoption, Category and Group Served. Frequencies of each item were generated, and duplicates were removed from the list (see Table 2).

To identify what new adoptions and/or changes in the use of instructional technology have occurred since the start of the COVID-19 pandemic, responses to one question in the interview protocol was included. Responses to this question required interviewees to speak about specific examples of new adoptions and/or changes in use and tracking of instructional technology has occurred since the start of the COVID-19 pandemic. Responses from each of the district leaders were categorized by Area of Emphasis, Group Served and Category. Unique combinations of these three areas constituted an item that was listed as being new since COVID.

Addressing Research Question 2

Research question 2 asks, “According to district leaders, what is the perceived function of key technology investments and how are these investments thought to be related to core district goals?” This research question was addressed through analysis of responses to two separate questions from the interview protocol asking about the function/purpose of common and newer instructional technology were categorized by Function/Purpose and Group Served. Additional information was provided by responses to the survey. Each participant was asked to identify specific instructional technology software systems present in their district and for each software system they were asked to identify the software system’s function and/or purpose. Each unique combination of Function/Purpose and Group Served were added as an item to a list. The list of items considered the Function and Purpose by Group Served was examined for frequency of each item.

To help provide more clarity and depth on the function and purpose of instructional technology, an array was generated using data from the same two interview questions from the interview protocol as well as the survey response data. In Table 4, frequencies of each unique combination of Function/Purpose and Group Served were represented. Table 5 was generated to represent the frequency of each Group Served and displays each group and the percentage of all functions/purposes they account for.

Addressing Research Question 3

Research question 3 asks, “According to district leaders, how are districts using these technologies and do district leaders report that district adoption is aligned with ISTE and ITIL standards for technology innovation?” Two separate interview questions (one for each set of industry standards) from the interview protocol address this question directly. One question in the survey also provided helpful insight for answering this question as well. Participants were asked in interviews to talk about what ways their district utilizes each standard. The answers to this question were coded into either a “Yes,” “No” or “Unclear” for *Employs ISTE* and were coded into “Yes,” “No” or “Unclear” for *Employs ITIL* based on the replies provided by participants in interviews. “Unclear” was used as the response if the interviewee did not explicitly confirm the employment of either of the sets of standards/best practices. In the survey, after providing a list of instructional technology software systems and their function and/or purpose, participants were asked, “How often is this list Updated? Please select the answer closest to your district’s process.” The participants could answer “Once monthly”, “As needed”, or “Unsure.” Keeping an inventory of technology can be considered an industry best practice and thus provides additional insight on the degree to which a district employs industry standards and/or best practices.

Strengths of Methods

The most significant strength of the methodology used in this study is reliability/dependability of the study design along with internal validity. Strength through reliability becomes evident when considering some basic tenants of reliability. The research questions are clear, and the features of the study design are congruent with the research questions. Further, the interview protocol was designed to elicit responses that very directly provided insight on each of the research questions. The interviews were each conducted using the same set of questions and were conducted within six months of one another – within the same academic year. Data quality checks were made throughout the data collection and analysis process which removed any potential bias on the part of the interviewer. Finally, throughout the formulation of the interviews, peer review was in place in the form of regular meetings with the research supervisor. In terms of strength through internal validity, this study seemed to do a good job of presenting terms and concepts in a context-rich way. For example, in the interview protocol, questions were asked in a way that removed ambiguity whenever possible. Clarifying statements were made in an effort to give participants ample context for topics they were expected to discuss. Additionally, negative evidence was sought out in the review of literature. Because instructional technology can be suggested by some to not have a positive impact on stakeholders, literature indicating this perspective was included. Finally, in terms of internal validity as a strength of this study, it is important to note that the findings were communicated in a clear and concise way. The results were largely communicated through tables and presented results as frequencies whenever possible.

Methodological Limitations

The methodological approach used here does have its limitations, however. Some of these limitations are time horizon, sample size, time constraints and unforeseen disruptions due to COVID-19. In terms of time horizon, this was a cross-sectional study that could have perhaps provided more in-depth answers to the research questions if it were longitudinal. This might be especially true since some of the topics that the participants discussed, such as newer versus older technologies were time dependent. Although more than one school district was included in this study, the sample size of six districts may not allow the results for this study to be as generalizable as they could have been with a much larger sample size of school districts. Time constraints were also a limitation of this study. Because the study took place as part of completion of an academic program, there were some limitations in terms of time that could have reasonably been allocated to this study. Finally, this study took place throughout the COVID-19 pandemic. Limitations caused by COVID-19 included a delayed start to the overall process, delayed access to some interviewees, and lack of access to some potential interviewees.

Chapter 5: Results

The purpose of this study is to identify which instructional technology software systems urban, suburban, and rural school districts in a Southern U.S state were in use, why they were adopted, and how usage and management of these systems is being handled and tracked by the district - both before and after the COVID-19 pandemic. Literature suggests that it is possible for instructional technology to have a positive impact on student engagement, achievement, and attainment. Using a conceptual framework emphasizing the importance of utilizing and keeping track of instructional technology in ways that align with education and technology industry standards, this study attempts to address some of the gaps that exist in instructional technology research.

To explore this problem of potential gaps in understanding by schools of the instructional technology they adopt and use, this study contributes to the body of research through an interview and follow up survey with district leaders in urban, suburban, and rural K-12 public school districts in a Southern U.S. state. The district leaders involved in the study each oversee aspects of instructional technology adoption and utilization.

Through a series of ten interview questions and a follow up online survey, answers were provided that helped answer the following research questions: 1) Which instructional technologies have been adopted and/or used by selected K-12 school districts in a Southern U.S. state and what new adoptions and/or changes in use have occurred since the start of the COVID-19 pandemic? 2) According to district leaders, what is the perceived function/purpose of key technology investments and how clearly and/or directly do these relate to core district teaching and learning goals? And 3) According to district leaders, how are districts using these technologies and does district adoption and usage align with ISTE and ITIL standards for technology innovation and best practice? Though the district leaders each responded to the interview questions as well as a follow up survey, the interview was designed to and yielded much a more in-depth perspective on this topic. A clear narrative emerged through the interviews with district leaders that provides some valuable perspective on how instructional technology exists in schools.

Which technologies exist?

Common technologies. Key leadership personnel from a sample of urban, suburban, and rural school districts were interviewed about instructional technology. These interviewees were asked to identify some of the common instructional technology that has been in use by schools in their district. The focus of this study is on technology in the form of software. So, they were asked to discuss software, as opposed to hardware, to the greatest extent they could. Following the interviews, these district leaders were asked to complete an online survey where they could provide additional information on specific instructional technology in their district. These interview and survey responses that identified which technologies exist indicated that software systems can be categorized into groups based on the specific type of system, labeled "Technology/System Type" and who the technology is designed for, labeled "Group Served" (see Table 3). The column Technology/System Type shows a variety of different areas of emphasis that instructional technology is designed to address. E-textbooks, for example, are a digital reproduction of traditional, print textbooks with paper pages. One district leader said of e-textbooks, "We don't need a [paper] textbook. The technology is going to be our textbook. And we may adopt a technology or adopt a textbook and have it be in an electronic format." In a separate interview, a district leader also commented on e-textbooks by saying, "So we're still adopting some hardback textbooks, but then there's also the e-books that come with that and there's other types of technology now associated with textbook adoption." Other examples of system type include learning management systems and various curricular software. While interviewees were asked to speak about technology in the form of software, there were some responses that spoke about instructional technology in the form of hardware that also went into the formulation of this list. Most of the comments about hardware were references to student devices.

In total, sixteen different technology/system types were identified throughout the series of interviews and organized in a list along with the intended user. The groups of software system users for common instructional technology include district, community, parent, teacher, and student. So, while some software is intended to be used by the student directly, other software is designed for use by one of many other groups with whom students interact with regularly.

Frequency of each instance in this table comes from unique combinations of Technology/System Type and Group Served. For example, "Devices" shows up two times in the list of Technology/System Type because one reflects devices for the Group Served of *Teacher* and the other for the Group Served of *Student*. This is because, in the interviews, devices were discussed in a way that separated student devices from teacher devices. Interview responses that include, "we've gone from projectors and smartboards to interactive flat panels now" and "So, our pre-kindergarten through second grade students have iPads, and the third through 12th grade students have Chromebooks" from one urban school district help demonstrate the difference between devices acquired for teacher use and those acquired that were intended for use by students.

In other examples, students were indicated to have received a Chromebook while teachers were given some a laptop or other computer for work purposes. Other unique occurrences, student information system for example, are used significantly enough by two user groups that both are listed as the Groups Served. Overall, the district leaders indicated twenty-six unique combinations of Technology/System Type and Group Served. This accounts for systems that primarily serve multiple groups (see Table 3). When speaking about common (older) technology, the software systems themselves were what seemed to come to mind for the interviewees as opposed to how the systems were used or what strategies were considered when managing the systems.

Table 3.

Frequency of Existing Common Technologies by Group Served and Category

Technology/System Type	**Group Served**	**Frequency**
Google Suite	Teacher	2
learning management system	Student	4
student information system	District, Parent	1
projectors	Teacher	1
interactive flat panel TVs	Teacher	1
Devices for teachers	Teacher	1
Devices for students	Student	1
Apple products	Student	1
Google Classroom	Teacher, Student	2
e-book textbooks	Teacher, Student	3
Various curriculum software	Teacher, Student	3
Early childhood learning management system	Teacher, Student	1
Interactive whiteboards	Teacher	1
Software for teacher content creation	Teacher	1
Mobile device management software	District, Student	1
SSO System	Teacher, Student	1
Student assessment system	Teacher	2
Financial literacy system	Student	2
Professional development system	Teacher	1
Positive behavior intervention system	Student	2
	Total	32

Newer technologies. When discussing what newer instructional technologies exist in the district, the responses began to become more nuanced. As opposed to each district leader listing titles or types of software systems, when discussing newer technology, they began to speak more about having added additional types of systems that enhanced technology they had previously been using. For example, one district leader said of a newer technology, “It fits in really well with a one-to-one environment for teachers.” Interviewees also mentioned implementing new strategies and alluded to working towards a more strategic approach to managing instructional technology. They said things like, “it's allowed us to have elementary virtual without increasing class sizes in our face-to-face class.” and, “We saw within the next five years or more getting an LMS.”

Table 4.

Frequency of Existing Newer Technologies by Group Served and Category

New Adoption	**Group Served**	**Category**	**Frequency**
learning management system	Teacher, Student	Software system	3
single sign on system	Teacher, Student	Software system	1
web filtering	Student	Software system	3
various curriculum software	Teacher, Student	Software system	4
Student engagement	Student	Strategy	1
focus on inventory	District	Strategy	1
student device management	Student	Software system	2
Removal of older software systems	District	Strategy	3
Focus on one-to-one computing	Student	Strategy	1
focus on overall technology procedures	District	Strategy	1
voicemail service	Teacher	Software system	1
text messaging	Teacher	Software system	1
New functions of learning management system	Teacher, Student	Strategy	1
		Total	23

Newer technologies are represented by the type of technology/system, labeled as “New Adoption”, by whom the technology is designed to be used, labeled as “Group Served” and by whether the newer technology is a new software system or a new strategy, labeled as "Category" (see Table 4). The new column, Category, emerged because responses to questions about newer adoptions transcended the ability to be organized using the single category of Software System used in Table 3. For discussion on newer instructional technology, district leaders talked a great deal about the enactment of strategies in addition to the implementation of new specific technologies and software systems. So, to illustrate the newer instructional technology adoptions, Table 4 needed to identify the nature of the new technology as a strategy or as a software system.

Table 5.

Common Instructional Technology Across District Types

Urban District A	**Urban District B**	**Suburban District A**	**Suburban District B**	**Rural District A**	**Rural District B**
projectors	Google Suite	Learning Management System (LMS)	Google Classroom	Mobile device management software	Interactive whiteboards
Interactive flat panel TVs	Learning Management System (LMS)	Early childhood LMS	E-book textbooks	SSO System	Software for teacher content creation
Google Suite	Student Information System	Various curriculum software	Various curriculum software		e-book textbooks
Devices for students and teachers		e-book textbooks	LMS		Various curriculum software
Apple products		Google Classroom			LMS

What was learned overall throughout all the interviews is that a wide variety of instructional technology exists across districts. Also, except for more mention of hardware by one urban district, the type of common and new instructional technology in schools did not seem to vary drastically based on whether the district is in a rural, suburban, or urban area (see Tables

5 and 6). For instance, each district in this study referenced the existence of Google Suite products, various curriculum software, and/or a Learning Management System.

Table 6.

Newer Instructional Technology Across District Types

Urban District A	**Urban District B**	**Suburban District A**	**Suburban District B**	**Rural District A**	**Rural District B**
learning management system	focus on inventory	Various curriculum software	focus on technology procedures	Various curriculum software	curriculum software
single sign on system	student device management	Removal of older software systems		removal of older software systems	Removal of older software systems
web filtering		Focus on one-to-one computing			student device management
Various curriculum software					
Student engagement					

What new adoptions and/or changes in the use of instructional technology have occurred since the start of the Covid-19 pandemic?

The COVID-19 pandemic had a significant impact on education and instructional technology use, shifting the focus from common instructional technologies and platforms to newer ones. District leaders were asked to talk about new adoptions and/or changes in the use of instructional technology that has taken place since the start of the COVID-19 pandemic. Not surprisingly, the district leaders had a lot to say. Woven throughout the interview protocol were several questions that addressed new technology adoption and usage that has come about since the start of the COVID-19 pandemic. In fact, many of the interviewees made mention of post-COVID-19 adoptions when talking about instructional technology in general. It seemed as if they struggled thinking of recent changes in instructional technology that *were not* directly related to the COVID-19 pandemic. Some responses on this topic include, like that from a rural district, “We just implemented a learning management system last year.” and, from an urban district, “In 2020 when the pandemic hit, we had to get something that would allow students and teachers to work remotely.”

Data collected on new adoptions that came after the start of the COVID-19 pandemic have been represented in Table 3 using similar characteristics to those used in prior tables. District leaders indicated in their responses several areas of emphasis, labeled “Area of Emphasis” consisting of the general areas that the new adoptions covered. As with previous tables, Table 7 indicates the group, labeled “Group Served,” that the new adoption is intended to be used by or otherwise impact. Items in this list are then identified as being a software system or a strategy in the “Category” column. Finally, a frequency was denoted based on the unique combinations of Area of Emphasis, and Group Served. Overall, Table 7 indicates that sixteen unique new adoptions within ten unique combinations of areas of emphasis, groups served, and categories took place after the start of the COVID-19 pandemic across the sample of urban, suburban, and rural districts included in this study.

Findings in the analysis of the interviews demonstrated that new adoptions in technology following the start of the COVID-19 pandemic included two main areas: 1) technology itself in the form of new software systems and 2) adoption of new technology-related strategies. Further, of the sixteen new adoptions identified through the interviews, seven were new strategies and nine were new software systems (see Table 7). The most frequently identified new software systems were various curriculum software systems used by teachers and students, with four instances. In terms of new strategies adopted since the start of the COVID-19 pandemic, the most frequently indicated was removal of older systems with three. By far, the groups that new adoptions were intended for was students. District leaders made comments in their interviews

Table 7

Frequency of New Adoptions and Changes Since Start of COVID-19 by Group Served and Category

Area of Emphasis	**Group Served**	**Category**	**Frequency**
Implementing a learning management system	Teacher, Student	software system	1
Implementing a single sign on system	Teacher, Student	software system	1
Implementing a web filtering system	Student	software system	1
Implementing various curriculum software	Teacher, Student	software system	4
Focusing on student engagement	Student	strategy	1
Focusing on inventory	District	strategy	1
Student device management	Student	software system	2
Removal of older software systems	District	strategy	3
Focusing on one-to-one computing	Student	strategy	1
Focusing on overall technology procedures	District	strategy	1
		Total	16

that made it clear how important instructional technology's potential positive impact on students was in each interview. For example, one suburban district leader said, "We had a big meeting with all our teachers and students, administrators. Number one thing that came from students is we want a learning management system. We want something like you have in college, Blackboard Canvas, something like that. So, we launched Canvas the next year." A rural district leader commented on the importance of student impact by saying, “our long-term goal has been to increase engagement and to also make sure that we are meeting the needs of every student.” An urban district leader, when commenting on the student-centered nature of their instructional technology, said, “It aligns with allowing the student to be able to set their pathways, using the tool to get things done.” These comments are illustrative of the overall tone set throughout the interviews regarding the relationship between instructional technology and its impact on students. Table 7 also illustrates that of the ten unique new adoptions, seven were either exclusively or partially intended for students. The establishment of what technology is in place – including new adoptions that have occurred since the start of the COVID-19 pandemic can assist in better understanding instructional technology’s function and/or purpose.

Interviews conducted with the district leaders in this study indicate that many of the new adoptions since the start of the COVID-19 pandemic were student-focused and were intended to address some challenges brought on by COVID-19. One district leader said of instructional technology adoptions after the start of the COVID-19 pandemic, “Well, when the pandemic came, we had to invest in some new internet filtering software because our existing solution did not (web) filter off site. So, we did invest in something to allow us to filter student devices even when they went home. Also invested in Canvas… which is a learning management system.”

This phenomenon, of adopting instructional technology to meet student needs, while possibly a result of the COVID-19 pandemic, does not show any signs of slowing down. In addition to the high frequency of new adoptions over this time span, several comments made in the interviews suggest that there is a strong belief by district leaders that instructional technology ought to be adopted with student needs in mind. One suburban district leader said, “We’re really trying to get the students engaged in where they live, and they live in the technology world.”

While an urban district leader commented on the primary reason for all new adoptions as, "Student engagement. It helps the students to be more accountable! (They can) add their own learning and making sure that they get their assignment and upload it. In tools like Canvas, one of the newer ones." In addition to the comments made during the interviews, survey responses to a question asking about the mission and/or vision for instructional technology also included the need to enhance the learning experience for students (see Table 11).

Perceived Function and Purpose

Responses from the interviews and surveys from key district leaders in this study help identify the perceived function and/or purpose of instructional technology in the district. Interviewees were asked to talk about what they believe is the function/purpose of common as well as newer technologies. The answers that identified which technologies exist indicated that software systems can be categorized into groups, labeled in Table 8 as "Group Served" based on who it is designed to use it. These groups of instructional technology users include district, community, parent, teacher, and student. So, while some instructional technology is designed to be used by the student directly, other instructional technology is intended for use by one of many other groups with whom students interact with regularly. Some clearly identified categories for system function/purpose were consistently acknowledged during these conversations. These responses provide insight on why the adoptions of certain technologies were made in the first place. Our interview data indicate there were seventeen different functions/purposes identified by technology leaders in the districts. Some examples of these include software intended to increase teacher efficiency, software intended to improve student access to resources, analytical software used by the school district, or software that allows parents to view student grades and attendance (see Table 8). on the function and or purpose of instructional technology Frequencies of unique

Table 8.

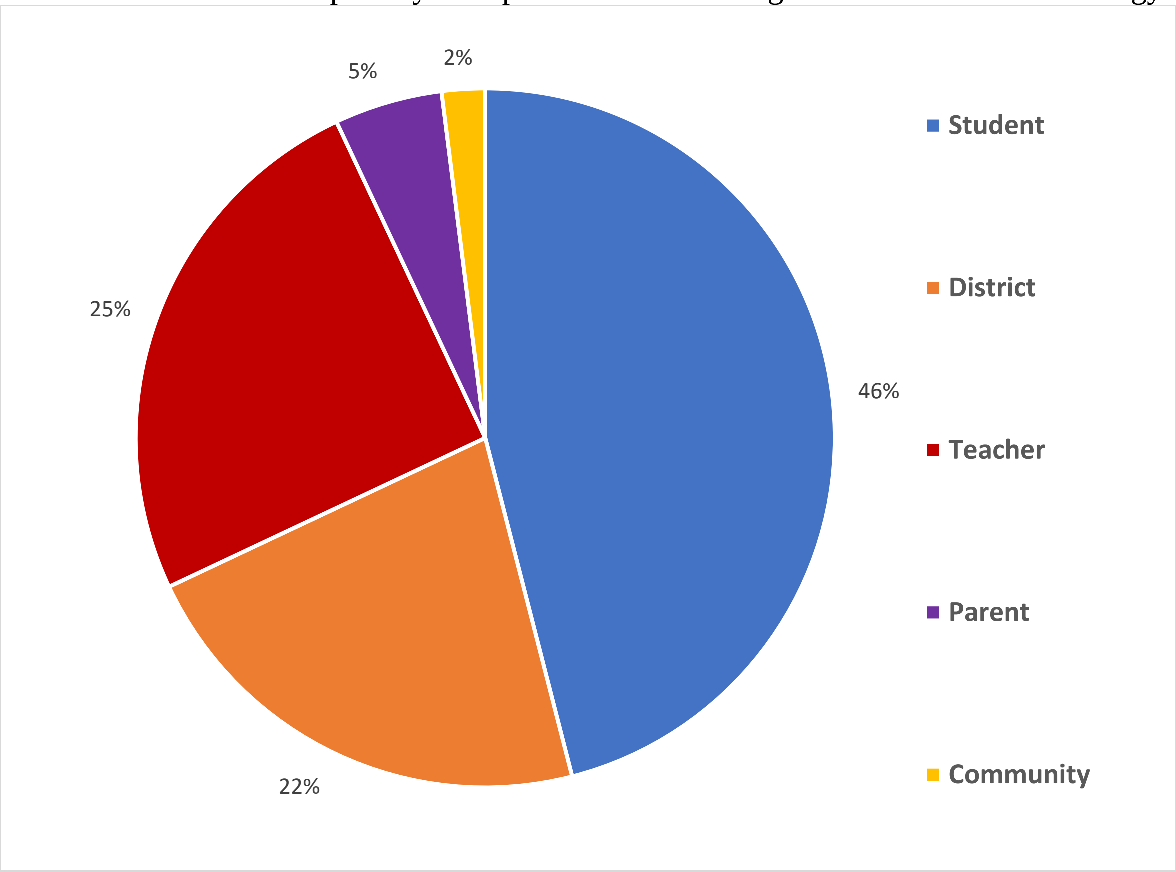
Frequency of Function/Purpose by Group Served and Category

Function/Purpose	**Group Served**	**Frequency**
Improve interaction with students	teacher	1
Improve interaction with teachers	student	1
Grade storing	teacher	1
Increase engagement	parent	2
Increase engagement	student	2
College preparation	student	2
Working independently	student	1
Controlling costs	district	1
Enhance systems cohesiveness	district	2
Increase efficiency	teacher	4
Increase efficiency	student	2
Increase access to resources	student	5
Improve on existing technology	district	2
Supplement teaching efforts	teacher	1
Enhance curriculum	district	1
new learning opportunities	student	1
Enhance communication	district	3
Increase engagement	community	1
Student assessment and progress monitoring	teacher	2
Digital citizenship		1
Social and emotional learning	student	4
Increase access to resources	teacher	1
	Total	41

combinations of function/purpose and group served were identified in Table 8 as well. In total, nineteen unique combinations were acknowledged indicating twenty-one unique functions and/or purposes for instructional technology in the districts included in this study. The group that was identified as being the most frequently reason for having the highest number of functions and/or purposes of instructional technology directly associated with them was students at 46% (see Figure 2).

Figure 2.

Pie Chart of Function/Purpose by Group Served as Percentage of Instructional Technology



Understanding the function and/or purpose of instructional technology establishes a jumping off point for identifying how well the technology aligns with core teaching and learning goals. With respect to the function and/or purpose of instructional technology, one rural district leader may have said it best when they commented that, “It's mainly to make things easier on users, make it easier for users (both students and staff) to access different technology.” This theme for instructional technology as something that enhances teaching and learning was also expressed by one urban school district leader who said, “We had to meet the need we had to find something that would fill in the gap." and a suburban district commented, "It should enhance the curriculum. It should engage students." Perhaps, though, one of the more powerful and representative quotes about instructional technology function/purpose came from a district leader who said, "We want to empower students, teachers, principals, everyone to have the tools they, if they had the tools they need, they're empowered to, to teach and create and engage students and learn, teach and learn, and then inspire, hopefully, get technology in the hands of teachers and administrators. Instructional technology so that they're inspired to take it to the next level to do even more than what we could have ever thought of."

In Alignment with Teaching and Learning Goals?

District leaders discussed how clearly or directly the instructional technology in their district is in alignment with core teaching and learning goals. The interviewees were asked explicitly how clearly and/or directly the older (common) and newer technology investments relate to core district teaching and learning goals. Responses collected from the interviewees, reflected in Table 6, varied slightly in terms of certainty and confidence in claiming alignment. While each interviewee spoke optimistically about instructional technology, not every district leader interviewed for this study said that instructional technology was unquestionably aligned with core district teaching and learning goals (see Table 9). Three of the interviewees answered this with a clear and direct response. Direct answers included, "Very closely related.", "They all relate very closely.", and "Closely aligned." Other responses to the question were not a direct answer but rather were longer descriptions of how instructional technology could/should be aligned with the core district teaching and learning goals (see Table 9). Each of the district leaders acknowledged that all instructional technology *should* be very closely aligned with teaching and learning goals.

Table 9.

Responses to Alignment of Instructional Technology with Core Teaching and Learning Goals

Question	**Urban School A**	**Urban District B**	**Suburban District A**	**Suburban District B**	**Rural District A**	**Rural District B**
How clearly and/or directly do these older and newer investments relate to core district teaching and learning goals?	Provided many students with internet access, Improved (24/7) access to resources	Getting things done, creating a pathway for college, increases student accountability, time management	Investments are always aligned with learning goals, piloted with users, impact of spending is considered, must be useable by many	Very clearly related. Goals are to serve, empower and inspire. Technology is intended to relate to these	Closely aligned. They are not exclusively focused on curriculum, More on accessibility and flexibility	They all relate very directly. Ability to do distance/ blended learning, teacher, parent and student engagement, data collection, engagement

Identification of alignment looked slightly different when considering the emergence of themes that came from the responses to a series of questions from the interviews. Specifically, by examining some of the responses on the perceived function/purpose of instructional technology alongside the responses to alignment with core district teaching and learning goals, some district themes become clearer. In Table 10, some of the statements made by district leaders regarding function and purpose of both common and newer technologies are presented to help illustrate the emerging themes. Some of the responses across all districts in this study regarding common instructional technology strongly suggest the theme of “Enhance existing processes”. For example, one suburban district leader said, “You know, one of the key components of that it's allowed us to have elementary virtual without increasing class sizes in our face-to-face class.” And another district leader commented that adoption of instructional technology is, “also an attempt to move our teachers more toward blended learning experiences for students.”

Similarly, when examining responses relating to newer instructional technology, the theme of "Enhance communication & enhance access to resources" emerges (see Table 10).

Table 10.

Themes of Instructional Technology's Alignment with Core Teaching and Learning Goals

Question	Urban School A	Urban District B	Suburban District A	Suburban District B	Rural District A	Rural District B	Theme
What do you believe has been the function/purpose of using/adopting these common technologies by your district?	controlling costs (spending less), cohesiveness between different software systems, increase efficiency for students and teachers	teacher-student interaction, grade storing, enrollment, parent communication	Student engagement, access to content, leveraging of technology, increase teacher efficiency	Supplement the teacher, open up new opportunities for learning,	Make accessing content using technology easier	Increase student engagement	Enhancing existing processes
What do you believe has been the function/purpose of these key new technology investments by your district?	provide continuity between different technology systems, improve on existing systems	Student engagement, preparation for college, working independently	Engagement, improve ability to teach virtually, prepare students for college, improve communication	To enhance communication for all stakeholders in the district, creating partnerships with parents and community	Reach students anywhere and anytime, enhance the work of teachers	to deal with challenges brought by Covid, to get better analytics, to improve teacher buy-in	Enhance communication, enhance access to resources
How clearly and/or directly do these older and newer investments relate to core district teaching and learning goals?	provided many students with internet access, Improved (24/7) access to resources	getting things done, creating a pathway for college	Investments are always aligned with learning goals	Very clearly related.	Closely aligned.	They all relate very directly	Closely related. By enhancing other areas of emphasis

These emergent themes, both of which are themes of "enhancement" in combination with the answers to how clearly and/or directly instructional technology is aligned with core district teaching and learning goals, which are also mostly related to enhancement, strongly suggests that an overall theme for the alignment between instructional technology and core district teaching and learning goals exists. This theme can be best characterized as "Closely related – by enhancing other important areas of emphasis." In addition to alignment with district teaching and learning goals, it is important that schools employ industry standards in their management of instructional technology.

Identifying an Instructional Technology Mission/Vision

The online survey included a question about the instructional technology mission/vision for the district. The district leaders were asked, "What would you say is the overall mission or vision of the district with respect to educational/instructional technology?" The answer to this question may help provide additional insight into the interview responses regarding perceived function and/or purpose and the degree to which instructional technology is aligned with core teaching and learning goals. The four responses to this survey question reinforce something seen throughout the analysis of the study's research questions – that many adoptions of instructional technology are made with the stakeholders (especially students) in mind (see Table 11).

Table 11.

Instructional Technology Mission/Vision

Respondent 1	All (district) staff are provided with technology-rich learning experiences and resources that enhance the skills and mindsets which are critical for inspiring students to fulfill their unique purpose in a healthy, vibrant community.
Respondent 2	Providing the tools needed to help engage learners in a way that best suits their needs.
Respondent 3	Reimagining, redesigning and redefining education in order to ensure learning and development for all.
Respondent 4	Student engagement.

Presence of Industry Standards

District leaders were asked to talk about industry standards in respect to instructional technology in their schools. Specifically, they were asked to discuss two sets of standards, International Society for Technology in Education (ISTE) standards and Information Technology

Infrastructure Library (ITIL) standards/best practices. ISTE standards refer to the standards of practice that guide learning, teaching, and leading in the digital age (ISTE, 2020, July 31c). These standards are a widely accepted and highly respected set of best practices used in the delivery of education through technological means. ITIL standards can also be considered highly respected and widely accepted best practices. However, ITIL standards are best practices centered around of technology use. ITIL is a library of best practices for managing IT services and improving IT support and service levels. One of the main tenants of ITIL is that the technology in use needs to be well-aligned with the organization or industry it exists within (ibm.com, 2022). In short, ISTE is more education-based while ITIL is more technology-based. The ability for a district leader to identify that their district employs each of these sets of best practices helps identify the level to which the district is implementing and managing instructional technology strategically and with fidelity.

It is important to recognize that any of the methods, procedures, and practices identified by ISTE and/or by ITIL might unintentionally be the part of the way a district manages instructional technology. It is *intentionality,* however, that truly establishes the actions as being aligned with industry standards. In other words, being aligned with best practices requires doing so on purpose. Otherwise, it may only be a process or procedure that is subject to change without consideration of the larger-picture role it plays. Table 12 presents district leaders' answers about whether they were managing instructional technology by *intentionally* using ISTE and/or ITIL best practices. Adherence to ISTE best practices is associated with best practices for adoption and use of instructional technology and ITIL best practices are associated with tracking the utilization of instructional technology. For each set of best practices, the responses indicated that the district did employ them indicated by "Yes", did not employ them, indicated by "No" or that they were not able to confirm the use of the best practices in question “Unclear”. For the interviewees who did not explicitly state the intentional use of a particular set of best practices during their conversation, the response of “Unclear” was assumed (see Table 12).

Table 12.

Employment of Industry Standards/Best Practices

Industry Standard (purpose)	Urban District A	Urban District B	Suburban District A	Suburban District B	Rural District A	Rural District B
Employs ISTE (Adoption, Use):	Yes	Unclear	Yes	Yes	Yes	Yes
Employs ITIL (Tracking):	Unclear	Yes	Unclear	Unclear	Unclear	No

Responses to the presence of best practices, illustrated in Table 12, identify adherence across all districts to ISTE and to ITIL best practices. In terms of employing ISTE best practices, all districts except for one urban district confirmed that they do follow ISTE standards in the management of instructional technology. The urban district leader who did not confirm they intentionally employ ISTE as a strategy did not explicitly deny the adherence to ISTE guidelines and was identified as “Unclear”. Each of the district leaders did explicitly acknowledge an understanding of ISTE’s role in guiding instructional technology in their district. For example, a rural district leader said, “We do try to follow ISTE practices when we research things like the learning management system. So, when we try to integrate recommendations into the curriculum, In my point of view, we've, we've done things like follow ISTE recommendations for things like Internet bandwidth.”. This response suggests an understanding of ISTE standards as the interviewee mentioned specific criteria of ISTE. Another district leader talked about ISTE by saying, “I think like the ISTE standards are much more creative standards. Creativity and more higher-level thinking as far as project-based learning in how they approach their learning with technology. So, we do try to integrate those standards.” Additionally, all of the district leaders included in this study talked about having procedures in place that could support the ability to follow ISTE best practices. When asked about ITIL best practices, only one (urban) district was able to confirm that ITIL best practices were part of the instructional technology strategy. All other districts were unsure of ITIL best practices as a strategy, except for one rural district who confirmed their district did not employ ITIL best practices.

Overall, none of the districts who participated in this study could confirm that they employed both ISTE and ITIL best practices. One urban district leader explained of ISTE best practices that, “this is an important piece of what we do… ISTE standards.” then followed up with, “You know, the big the big piece for us, is that we've never done inventory (tracking) very well in the district. And that had to change.” So, although all districts interviewed indicated that they understood the value of both sets of best practices (see Table 12), none were able to say with confidence that they are intentionally managing instructional technology in terms of industry standard adherence.

The goal of this study was to develop a better understanding of instructional technology in K-12 education. Specifically, this study seeks to identify what instructional technology is being adopted by schools and how it is managed. how school districts. Interviews with district leaders did help shed light on this topic. Through the series of interviews, the study’s research questions were addressed, and a clear narrative emerged. This narrative starts with identification of the instructional technology that exists in schools and is followed by recognizing what new adoptions have taken place since the start of the COVID-19 pandemic. Based on the technologies and technology strategies that were identified, conversations then provided insight into how well instructional technology is in alignment with district teaching and learning goals and the degree to which industry best practices are used in management of the instructional technology. An example of how districts can follow industry standards and/or best practices is by keeping an updated inventory of instructional technology (AXELOS Global Best Practice, 2019).

Frequency of Updating Instructional Technology Inventory

Keeping track of technology inventory can be considered a best practice in both education and technology industries. So, when it comes to identifying the degree to which school districts employ industry standards and/or best practices it can be useful to know how frequently a school district undergoers the process of updating their instructional technology inventory. To provide data for determining this measure, the district leaders in this study were asked in the online survey to indicate what instructional technology software systems are present in their district and to indicate the function and/or purpose of each instructional technology software system. Following the documenting of this list in the survey, the participants were asked, “How often is this list updated? Please select the answer closest to your district’s process.” The answers they could choose from included “Once monthly, “As needed”, and “Unsure”. The responses to this survey question demonstrate that there is knowledge on the part of the district leader as to how well they are keeping track of their instructional technology according to industry standards and/or best practices. Of the four survey responses, none of them indicated that they were unsure as to the frequency of updating the software inventory. In fact, all of the respondents indicated that their district’s frequency of inventory updating is “as needed” (see Table 13).

Table 13.

District Frequency of Instructional Technology Inventory Updating

	Respondent 1	**Respondent 2**	**Respondent 3**	**Respondent 4**
Frequency of inventory updating	As needed	As needed	As needed	As needed

Summary of Findings

A significant amount of money is being spent on instructional technology by K-12 schools, but a clear understanding of what instructional technology is being purchased and how it is being used is not fully understood. This study was conducted to help provide insight on what technology was being purchased in a Southern U.S. state, why it was adopted, and how usage and management of these systems is being handled and tracked by the district—both before and after the COVID-19 pandemic.

In terms of answering the first research question, findings from this study indicate that a wide range of both older and newer instructional technologies are present across different school districts. Each of the systems were identified as having the potential to enhance the experiences of at least one group of stakeholders and a list was formed using data from urban, suburban, and rural districts. It was also shown that adoptions continued to take place after the start of the COVID-19 pandemic in March of 2020. Many of these adoptions were similar to older and newer adoptions that took place prior to March of 2020, but some adoptions were made directly in response to the COVID-19 pandemic. Examples of adoptions that took place after the start of the COVID-19 pandemic include technology that supports the delivery of teaching and learning remotely as well as new strategies for technology use overall. To answer the second research question, data collected in the interviews provided some specific functions and purposes from the sample of districts that resulted in an understanding of common functions and purposes for instructional technology. Again, there were consistencies across the three types of districts in terms of why instructional technology has been adopted. Results from the study did address the third research question. Interview and survey responses help indicate the level at which school districts are utilizing industry standards and/or best practices in their management of instructional technology. These findings help answer the third research question also help provide some insight to the overall purpose of this study. Overall, the findings from the research conducted in this study did help answer each of the three research questions.

This study yielded some important findings. Through interviews with key personnel from a sample of districts across a southern U.S. state, it was found that there are many different types of instructional technology software systems that have commonly been and currently are being adopted by K-12 schools. Though twenty-five different commonly adopted systems were identified, and twenty-three different newer systems were identified, it was the learning management system (LMS) that was identified across all districts in this study as both the most prevalent common/older technology and as the most prevalent newer technology adoption. In terms of function and purpose, there were forty-one different explicitly stated functions and/or purposes discussed. Perhaps the biggest takeaway from this area of the data is that most frequently stated functions and/or purposes were intended to enhance the students' educational experience. This represents the largest percentage in terms of stakeholder group and suggests that of reasons for adopting instructional technology, the potential for positive impact on the student is among the most important. The second research question also asks if the instructional technology being adopted is in alignment with the school district's core teaching and learning goals. Findings from this study indicate that the instructional technology being adopted is in alignment with core teaching and learning goals. Through analysis of the discussions surrounding this topic, some themes began to emerge across the districts. Synthesis of the responses indicate themes surrounding the fact that instructional technology is expected to be something that enhances other areas of education. The district leaders spoke of common/older technology as being in alignment with core teaching and learning goals because it has been something that has *enhanced existing processes.* For newer and newly adopted technology, it is identified as being in alignment with core teaching and learning by enhancing access to resources and by enhancing other areas of emphasis. Findings relating to the third research question indicated that of the two sets of industry standards in question, none of the districts included in this study could say with certainty that they employ both. Each district could, however, confirm that they employ at least one of the sets of industry standards.

Chapter 6: Discussion

Summary of Findings

Findings from this study help address gaps in existing literature. It does so by providing a current list of what kind of instructional technology exists in schools, identifying the perceived purpose of the technology, identifying if instructional technology is in alignment with teaching and learning goals, and developing an understanding of whether if it is being managed using education and technology industry standards and/or best practices. An overall finding of this study is that there are many systems that have commonly been in place in school districts. Because this study took place during the COVID-19 pandemic, additional insight is provided on the nature of instructional technology in schools during that time.

Further, the findings in this study provide information on the reasons why certain instructional technology is being adopted and to some degree, the way it is being managed in a manner consistent with education and technology industry standards and best practices. The district leaders included in this study identified thirty-two unique combinations of common (older) instructional technologies categorized by system type and group served. There were several different types of systems, and each could be identified as serving one or more of stakeholder groups. Perhaps the most revealing data emerging here is that many of the common instructional technology was intended to serve the students.

In addition to identification of the common instructional technology present in schools, the district leaders were asked about the newer instructional technology they have adopted. Results show that in terms of newer instructional technologies, twenty-three unique combinations of new adoption, group served, and category were identified. Again, most adoptions considered newer instructional technology adoptions were adopted with the goal of impacting the student stakeholder group. Analysis of the common and newer instructional technologies shows some similarity across time in that there does not seem to be a drastic difference in commonly adopted instructional technology and newer adoptions of instructional technology. Perhaps the most prominent difference is that newer technology adoptions include not only the technology itself, but they also include technology-related strategies. Additionally, the instructional technology that is being adopted across urban, suburban, and rural districts does not appear to differ based on urbanicity.

The instructional technology adoptions that took place after the March 2020 start of the COVID-19 pandemic revealed a list of adoptions even more complex and strategy-centric. Rather than being able to list items by system type, the label "Area of Interest" was used to capture the types of adoptions taking place more appropriately at this time. District leaders indicated sixteen unique combinations of area of emphasis, group served, and category. While parents, teachers, and the district itself were identified as the target stakeholder group for some these adoptions, findings were consistent with those for common and newer instructional technology in that the student stakeholder group was the primary reason for making the adoptions.

In terms of the function and purpose of common and newer instructional technology, most of the functions and purposes of instructional technology indicated in this study were enhancements and/or improvements to existing technologies and existing strategies. Of the forty-one functions and purposes identified, the majority of these (46 percent) were indicated to be for the betterment of the student stakeholder group. In terms of how well common and newer instructional technology aligns with core teaching and learning goals across all districts, district leaders were mostly very confident that their instructional technology was aligned with core teaching and learning goals. The only exception was that one urban district leader spoke about how instructional technology *could* be aligned with core teaching and learning goals while each of the other district leaders made definitive statements about definite alignment. Furthermore, these themes of alignment represent specifically how the instructional technology ion a district is in alignment with core teaching and learning goals. Recalling that most districts are confident that alignment exists, the themes of alignment are as follows: Enhancing existing processes, enhancing communication, enhancing access to resources, and enhancing other areas of emphasis. Between the direct acknowledgement by district leaders that instructional technology is aligned with core teaching and learning goals and the themes of alignment that emerge across comments as to how instructional technology is *specifically* in alignment with core teaching and learning goals, the findings in this study suggest that alignment likely exists.

In the survey that was provided to the district leaders after completion their interview, the district leaders were asked to indicate the overall mission/vision of the district with respect to educational/instructional technology. Responses to four of the six districts were available and each district leader indicated in their own words that enhancing learning for students is at the center of their mission and vision for instructional technology adoption. None of the districts included in this study could confirm the employment of both education and technology industry standards and best practices. Further, while each of the district leaders indicated some familiarity with ISTE standards and best practices, not all district leaders expressed familiarity with ITIL standards and best practices. Survey responses for four of the district leaders indicated that they update the list as needed.

Overall, findings did show some evidence of consistencies across the districts. Many similar common and newer instructional technologies seem to be adopted; the similarities seem to be consistent before and after the beginning of the COVID-19 pandemic. These instructional technologies seem to have similar desired functions and purposes. Findings in this study suggest that districts might not be employing both technology and education industry best practices.

Discussion and Implications for Policy and Practice

Some of these findings are in alignment with existing literature on instructional technology. In terms of instructional technology and student outcomes, much current literature suggests that instructional technology can *potentially* have a positive impact on student engagement (Harrell & Bynum, 2018; Bruhn et al., 2017; Howard & Howard, 2017; Basham et al., 2016; Clayton & Murphy, 2016;), on student achievement (Callaghan, et al., 2017; Henrie et al., 2015; Wang, 2013; Cheung & Slavin, 2011; Shapely & Sheehan, 2010), and on educational transitions and attainment (Chatterji, 2018; Riegel & Mete, 2017; Roberts, 2018; Beattie et al., 2017; Shing & Yuan, 2017; Magnuson et al., 2016; Wang, 2013). In this study as well as in existing literature, the prevailing point about instructional technology and student outcomes is that there *can* be a positive impact but that there are no guarantees. Some literature suggests that issues related to the design of technology, the availability of technology and the alignment of technology with special education requirements can create situations where instructional technology may not positively impact student outcomes (Marino, et al., 2013; Vitale & Moore, 2018; Wang, 2013). So, perhaps by addressing these and similar concerns with instructional technology could improve the liklihood of technology improving or helping impriove student outcomes. Also, in the literature on current use of instructional technology, there are examples of different software and hardware that, when implemented and managed correctly, can have a positive impact on student outcomes (Beberman, 2020; Lee & Choi, 2017; Niederhauser et al., 2018). The findings of this study suggest that the perception of instructional technology from key district leaders is that technology is being purchased to enhance aspects of education, which is how, in general, instructional technology is viewed in existing literature.

Though there are some similarities, this study may differ from existing literature because of the timing this study took place. Initially, an aim of this study was to identify what instructional technology was currently in use by K-12 schools. This research was ultimately expanded to include timing aspects of the COVID-19 pandemic because the study took place in the year 2021, which was just over a year into the COVID-19 pandemic—a time in which districts were relying more heavily on technology to cope with lockdowns and other distancing situations.

Implications for policy might include development of processes and/or policies that determine what can or should be adopted, including the establishment of functions and purposes that must be considered when adopting new instructional technology; enforcement of strategic alignment with core teaching and learning goals, and enforcement of understanding and employing current technology and education industry standards and best practices in the management of instructional technology.

Instructional technology adoption processes should help ensure that the most appropriate instructional technology is adopted by a school district. Perhaps one way to avoid poor investments in instructional technology is to implement a process that begins with the request for specific instructional technology, and only through the proper vetting of the technology, can the technology be adopted. An example of an adoption process that this study helps inform is for to consider establishing a set of functions and/or purposes that any newly adopted instructional technology must satisfy. While this study did not take a deep dive into all of the impacts brought about through the COVID-19 pandemic, this study does recognize that beginning in March of

2020 education was significantly impacted. Thus, including data on adoptions that took place after the start of the COVID-19 pandemic was included. From a policy standpoint, it might be important for district leaders to implement and communicate policies that will help navigate future events that prove to be significantly disruptive to in-person education. These policies might not be enacted frequently, or perhaps ever, but one lesson learned after March of 2020 is that it might be better to have a plan and never need it than to need a plan and not have it. Another policy consideration is that it might be feasible to require any newly adopted instructional technology to be explicitly aligned with current core teaching and learning goals (Lee & Choi, 2017; Beberman, 2020). While many adoptions might end up aligning with goals in the long run, it may be more advisable to incorporate alignment with core teaching and learning goals into the adoption process.

Other policy considerations brought up by this study is that district leaders may want to require understanding and employment of both technology and education standards and best practices when it comes to the management and oversight of instructional technology. This may require additional training and certification and will require district leaders to understand what the current industry standards are for both education and for technology industries. In terms of practice, accountability, setting expectations of technology, and training staff on industry standards and best practices are some considerations relating to findings from this study. Once policies for adoption are put in place, the expectation is likely going to be that money is being appropriately spent on instructional technology. This means that, as district leaders make instructional technology spending decisions, they will be held to a high level of accountability in terms of justifying the expenditures. What this study indicates is that there are some relatively consistent reasons that districts are investing in some relatively similar types of instructional technologies.

Using that as a jumping off place, policies and procedures can be developed that scaffold the instructional technology adoption process and require very intentional and district-appropriate decisions are made with respect to instructional technology. Implementation of spending justification processes may increase how accountable district leaders will be held in future instructional technology adoptions. Even with a high standard of accountability and scrutiny of newly adopted instructional technology, it will be important for district leaders to temper their expectations for what can truly be accomplished from the adoption and implementation of instructional technology. Responses in this study suggest that instructional technology, while potentially valuable to important aspects of teaching and learning, ought to be seen as supplemental and enhancing in nature rather than something that will fix all problems in education. To make use of this idea, it will be important in practice that as instructional technology is adopted and/or in use, that those who are using it understand the function and purpose and how the technology can meet their teaching and learning goals.

District leaders indicated in this study that there are some very reasonable functions and purposes instructional technology is expected to provide and that overall, the functions and purposes are being provided. District leaders seem tempered in their expectations about instructional technology and seem to understand the supplemental nature of instructional technology. All of this could mean that district leaders are able to make informed decisions when it comes to making spending decisions related to future instructional technology purchases by tempering expectations of the instructional technology they adopt. In terms of managing the technology in the district, this study indicates that there may be additional industry standards and/or best practices that can be employed if needed.

Implications for practice might include the need to incorporate education industry standards training and best practice along with technology industry standards and best practice training and possibly certifications for key district leadership and staff. The industry standards of ISTE for education and ITIL for technology are both common sets of standards and best practices. Both of which have updates to their standards and best practices over time in ways that allow them to evolve as each industry evolves (ISTE, 2020, July 30a; AXELOS Global Best Practice, 2019). That does not mean, however, that the two standards and best practices used in this study will always be the most appropriate over time. It may be important, then, for school districts to include in their practice a desire to employ current education and technology industry best practices as a rule – regardless of which ones.

Limitations and Recommendations for Future Research

This study does have some limitations. Perhaps one of the most significant among these limitations is that the sample size of school districts is small. Though the sample is representative in that it includes multiple districts from each urban, suburban, and rural areas, the sample may not be considered as generalizable to the population as it could have been through a larger study. Another limitation of the study is the fact that this study was not conducted over a longer span of time. By taking a cross-sectional approach, this study may not carry the level of reliability a longitudinal study might have.

The online survey also had some limitations. More questions could have been included to gather more robust data. One example is that the survey could have included questions directly related to how the district employs education and/or technology industry standards or best practices such as ISTE or ITIL. The survey could have asked for more detail about the list of specific software systems, such as how long each has been in the district, and who specifically the intended user group is. The survey could have been improved by including more options for indicating how often the instructional technology inventory is updated. This could mean providing more choices in the multiple-choice format or possibly changing it to an open-ended question. When providing proof of how well a district is employing industry best practices, it can be especially helpful to answer these questions with more specificity. In addition to opportunities for improving the survey, another limitation of the study is that the findings here do identify some of the changes in instructional technology that occurred after the start of the COVID-19 pandemic, but there is no causation indicated in these findings. Overall, the limitations found in the study do not prevent this study from providing value. This study addresses gaps in the literature and provides answers to some important research questions for better understanding instructional technology.

While a burgeoning area of school sector within public and private education, another limitation of this study is the lack of focus on the acquisition and management of instructional technology as it exists in virtual schools, or schools that do not adhere to a traditional brick and mortar format. In a school that relies mostly or entirely on the use of instructional technology for instruction, many aspects of instructional technology utilization and management may differ from traditional brick and mortar schools. So, by excluding these schools from the study, it is possible that some of the most interesting potential findings were not included in the analysis.

Further, though the study was focused on management of technology, this definition did not thoroughly address instructional technology management from the perspective of resources such as professional development provided to instructional technology stakeholders. Even though the concepts of technology management and oversight as they are discussed in this study are assuming teacher training and professional development, it is likely that by discussing aspects of agency and capability more closely, a deeper understanding of instructional technology management could have been ascertained.

Although this study addresses some gaps in the existing body of literature surrounding instructional technology, the need for future studies to build from this research may be needed. Additional studies could answer the same research questions from this study but take a more longitudinal approach and consider including hardware as instructional technology. District leaders included in this study, even when asked to consider software as instructional technology, made comments about the role of hardware as instructional technology. To create any more in-depth version of this study, excluding hardware may be unavoidable. Future research could be conducted with a deeper dive into specific student outcomes because of instructional technology. This study includes a conceptual framework and a review of literature that acknowledges the potential positive impact of instructional technology on student outcomes. In future studies, making a clear connection between specific aspects of instructional technology and student outcomes could be very helpful in providing clarity to that relationship—perhaps even considering causal relationships.

Finally, as instructional technology evolves over time, future iterations of this or a similar study should take place to account for the emergence of new instructional technology and the subsequent need for new strategies for instructional technology management. Future versions of this study could increase the emphasis on the role of education and technology industry standards and best practices as they relate to instructional technology management. Most of the future research opportunities stemming from this study would likely be longer studies with much larger sample sizes and more extensive surveys.

Conclusion

In sum, while future studies should incorporate virtual schools in addition to traditional school districts into an analysis of technology use, management, and integration, in doing so, should also examine more specifically the role of professional development in the overall instructional technology management and oversight process, this qualitative study does provide current and relevant insight on the adoption and management of instructional technology in K-12 schools from urban, suburban, and rural districts in a southern U.S. state. Through research conducted in this study with urban, suburban, and rural district leaders in the form of semi-structured interviews and online surveys, a list of current types of instructional technology has been compiled and is accompanied by data on their functions and purposes and frequencies of each technology adoption. It has been indicated through this study that a wide variety of instructional technology has been commonly and more recently adopted. There seem to be some similarities between common and newer adoptions of instructional technology both in terms of the types of systems and strategies being adopted. Adoptions of instructional technology does not vary greatly between districts of different urbanicity. This seems to be the case both before and after the start of the COVID-19 pandemic in March of 2020. Also common between the districts included in this study is that most instructional technology adoptions are made to have a positive impact on students. Each district was able to identify multiple perceived functions and purposes of the instructional technology being adopted and most district leaders in this study said with certainty that the instructional technology in their district closely aligns with core teaching and learning goals. Themes that emerged throughout the interviews and surveys indicate that instructional technology is adopted as a way to enhance the teaching and learning process and the majority of districts tied their mission/vision for instructional technology to the sustaining of positive learning experiences. All district leaders included in this study indicated that they employ industry best practices for the management of instructional technology in their district. This study considered two different sets of industry standards and best practices – ISTE, education industry-related and ITIL, technology industry-related. None of the districts in this study could confirm the employment of both sets of standards and best practices.

Most districts indicated that they follow ISTE standards and best practices while one district who could not confirm the employment of ISTE standards and best practices could confirm the employment of ITIL standards and best practices in the management of their instructional technology. This data is valuable to many stakeholders in education, and it indicates that the investments in instructional technology by K-12 schools is primarily intended to serve students. This study suggests that leaders in school districts do not seem to overvalue instructional technology but rather they see is as something that has potential to enhance many different aspects of the teaching and learning process. It was indicated through the findings in this study that the prevailing thought on instructional technology is that it is generally in alignment with core teaching and learning goals. This suggests that district leaders feel that in its role as something that enhances teaching and learning, instructional technology might be succeeding.

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Appendix A
Interview Protocol

The goal of this interview is to identify what technology districts have and how they used instructional technology before and after COVID-19.

Instructional Technology is defined for this study **as: the design, development, use, management, and evaluation of digital technology software systems used for the process of teaching and/or learning. Please note that the focus here is not on technology in the form of hardware.**

<u>Interview Protocol for Key District Personnel:</u>

1. What is your current position and what aspects of technology in the district are you responsible for?
2. How much experience do you have working with and managing educational technology?
3. What instructional technology has been commonly used by your school district over the past many years?
4. What do you believe has been the function/purpose of using/adopting these common technologies by your district?
5. What are some more recent examples of new investments in technology?
6. What do you believe has been the function/purpose of these key new technology investments by your district?
7. How clearly and/or directly do these older and newer investments relate to core district teaching and learning goals?
8. Can you talk a little bit about how current industry standards and best practices (ISTE, etc.) are used to help guide the adoption and use of instructional technology in the district?
9. What about instructional technology tracking? To what degree is instructional technology tracked in ways that are consistent with industry best practices?
10. What (if any) new adoptions and/or changes in use and tracking of instructional technology has occurred since the start of the COVID-19 pandemic?

Appendix B
Survey Protocol

The goal of this survey/interview is to identify what technology districts have and how they used instructional technology before and after COVID-19.

Instructional Technology is defined for this study **as: the design, development, use, management, and evaluation of digital technology software systems used for the process of teaching and/or learning. Please note that the focus here is not on technology in the form of hardware.**

Survey

1. What software systems are used by your school district for the purpose of delivering instruction? Please include all software systems that are used by either by teachers or students and the general purpose or function of the instructional technology:

   a. At the elementary (PK-6) level:

      1. ___________________, Purpose: ________________________

      2. ___________________ Purpose: ________________________

      3. ___________________ Purpose: ________________________

      4. ___________________ Purpose: ________________________

      5. ___________________ Purpose: ________________________

      6. ___________________ Purpose: ________________________

      7. ___________________ Purpose: ________________________

      8. ___________________ Purpose: ________________________

      9. ___________________ Purpose: ________________________

   b. At the secondary (5-12) level?

1. ____________________ Purpose: _________________________

2. ____________________ Purpose: _________________________

3. ____________________ Purpose: _________________________

4. ____________________ Purpose: _________________________

5. ____________________ Purpose: _________________________

6. ____________________ Purpose: _________________________

7. ____________________ Purpose: _________________________

8. ____________________ Purpose: _________________________

9. ____________________ Purpose: _________________________

10. ____________________ Purpose: _________________________

2. How often is this list updated? Please select the answer closest to your district's process.

   -Once Monthly

   -As needed

   -Unsure

3. What would you say is the overall mission or vision of the district with respect to educational/instructional technology?

Appendix C

IRB Approval Letter

The UNIVERSITY of OKLAHOMA

Institutional Review Board for the Protection of Human Subjects

Approval of Initial Submission – Exempt from IRB Review – AP01

Date: September 08, 2021 **IRB#:** 13739

Principal Investigator: Christopher Scott Compton **Approval Date:** 09/08/2021

Exempt Category: 2

Study Title: Instructional Technology in Education. What are Oklahoma Districts Spending Money on and How is it Being Managed?

On behalf of the Institutional Review Board (IRB), I have reviewed the above-referenced research study and determined that it meets the criteria for exemption from IRB review. To view the documents approved for this submission, open this study from the *My Studies* option, go to *Submission History*, go to *Completed Submissions* tab and then click the *Details* icon.

Please note, the IRB made the following minor change to the consent form: Added COVID risks section in the event that interviews will take place in-person.

As principal investigator of this research study, you are responsible to:

- Conduct the research study in a manner consistent with the requirements of the IRB and federal regulations 45 CFR 46.
- Request approval from the IRB prior to implementing any/all modifications as changes could affect the exempt status determination.
- Maintain accurate and complete study records for evaluation by the HRPP Quality Improvement Program and, if applicable, inspection by regulatory agencies and/or the study sponsor.
- Notify the IRB at the completion of the project.

If you have questions about this notification or using iRIS, contact the IRB @ 405-325-8110 or irb@ou.edu.

Cordially,

Aimee Franklin, Ph.D.
Chair, Institutional Review Board