Title
Implementing Innovative Technology to Support K-12 Public School Learning During COVID-19

Author
Harris, Stanley

Publication Date
2020

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

Los Angeles

Implementing Innovative Technology to Support K-12 Public School Learning During COVID-19

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Education

by

Stanley Orlando Harris

2020

ABSTRACT OF THE DISSERTATION

Implementing Innovative Technology to Support K-12 Public School Learning

During COVID-19

by

Stanley Orlando Harris

Doctor of Education

University of California, Los Angeles, 2020

Professor Christina Christie, Chair

This study examines the factors that impact the implementation of innovative technology during a time of crisis in K-12 public school districts during a time of crisis. The sample comprised 10,620 participants in teaching, staff, administrator, and other roles. The research design applied quantitative methods to obtain data to study the implementation of distance learning during the COVID-19 pandemic in a large, urban city through the lens of a program designed to prepare participants to deliver or support engaging, student-focused online instruction. Once data were collected, analysis of the program's impact on participants' belief in and factors that relate to their ability to implement innovative technology to deliver engaging, student-focused online instruction was conducted. Findings indicate that district leaders can increase district employees' confidence and proficiency in implementing innovative technology by considering influential factors that impact the alignment of technology and pedagogy.

This dissertation of Stanley Orlando Harris is approved.

Kimberly Gomez

Mark Hansen

Christina Rohanna

Christina Christie, Committee Chair

University of California, Los Angeles

2020

DEDICATION PAGE

I dedicate this manuscript to my mother and father, Jetta Ballard Harris and Andrew Harris Jr., who instilled in me the value of perseverance and education. My mother instilled in me an adventurous and curious spirit. My father provided an aspirational exemplar of manhood and fatherhood. They expected excellence in all endeavors. My parents provided love, guidance, and opportunities that shaped the man I am today and whom I wish to become.

Table of Contents

ACKNOWLEDGMENTS

First, I would like to thank my committee members, Dr. Kimberly Gomez and Dr. Mark Hansen, and Dr. Kristen Rohanna, for their support during the process of conducting my research and completing this paper. I would also like to thank my committee chair, Dr. Christina Christie, for her generous assistance with revisions and suggestions as I worked on this culminating project for over two years in the Educational Leadership Program at UCLA. I owe much gratitude to Dr. Linda Rose's guidance, Dr. Cindy Kratzer's substantial help in reviewing methodology and her eye for data analysis, Dr. Diane Durkin's editing, Dr. Pedro Noguera's initial assistance with the formulation my study, and Shan Boggs's and Judy Miyoshi's considerable support. Additionally, I would like to thank Dr. Jayson Richardson for his guidance in the field of educational technology. I could not have completed this work without the support of these professors, staff, and mentors.

Finally, I must thank my wife, Jessica Che-Mponda, and my son, Stanley O. Harris II. Their unwavering support and understanding helped pushed me to complete my study. With this paper, I give you back the time you so deserve. I love you.

VITA

1994	B.A. Marketing Morehouse College Atlanta, Georgia
1998	M.B.A. Business Administration Robert H. Smith School of Business, University of Maryland, College Park College Park, Maryland
1998	M.S.I.S. Information Systems Robert H. Smith School of Business, University of Maryland, College Park College Park, Maryland
2016	M.S.Ed. Special Education Hunter College New York City, New York
2016	Students with Disabilities - Grades 7-12 - Generalist, Initial Certificate

Chapter One

Introduction

Technological innovation has created changes in the education sector that require effective leadership to successfully implement innovative technology initiatives that are both academically and financially responsible for society, especially during times of crisis. The COVID-19 pandemic (the coronavirus disease of 2019 that primarily affects the lungs caused by the severe acute respiratory syndrome coronavirus) triggered a worldwide crisis and was declared a Public Health Emergency of International Concern by the World Health Organization (WHO) on January 30, 2020 (*Coronavirus Disease (COVID-19) - Events as They Happen*, 2020). Countries adopted stay-at-home policies resulting in the use of innovative technology to combat the crisis and provide a continuation of life activities. The problem faced by the education sector is that although district leadership may mandate the implementation of innovative technology as a response to a crisis, external and internal factors impact the professional development of district employees to implement innovative technology.

One aspect of the problem that organizations confront is the implementation of mandated technological innovations. Technological innovations are products, processes, strategies, or approaches that change the status quo with the potential to reach scale (Culatta, 2012). Research into status quo disruption by Emerson and Surry (2008) indicate that 33% of business sector change efforts are successful, less than 50% of executives report successful change efforts, and 75% of companies fail to see an innovation initiative return on investment (ROI). A meta-analysis conducted by Delgado et al. (2015) on the integration and effectiveness of technology in K-12 classrooms found that although the U.S. Government spent $718 billion on K-12 education with approximately a 1:1 ratio of students to computers, only 40% of students reportedly use computers often during instructional time. Even in the best of times, innovative technology implementations on an organizational level are challenging.

Innovative technology implementations in the education sector are constrained by access to resources not only in school but also, as the COVID-19 pandemic illuminates, in the students' homes. Although digital equity was a concern before the COVID-19 pandemic, the pandemic has highlighted the disparities in access and use of technology in society. Before COVID-19, the Digital Equity Act of 2019 was introduced by U.S. Senator Patty Murray (WA) to authorize more than $1 billion Federal dollars to address not only the lack of access to technology but to promote training in the effective use of technology (Digital Equity Act of 2019, 2019). One rationale for the Act is that although the U.S. population of offline adults has dropped from 48% in 2000 to 10% in 2019, 32% of the offline population stated that the Internet was too challenging to use, and 19% identified Internet-related costs as an obstacle (M. Anderson et al., 2019). As a result of COVID-19, schools within the LAUSD distributed Chromebooks as one way to address digital equity (Clover Avenue Elementary School, personal communication, March 23, 2020). Similarly, the Beaverton School District, South Bend Community School Corporation, Austin Independent School District, and other school districts distributed Wi-Fi hotspots via school buses or devices where students may not have had Internet access (Beaverton School District, 2020; T. Hannon, 2020). The COVID-19 pandemic served as a notice of not only the importance of implementing innovative technology in schools but of the possible impact of those initiatives in students' homes. Consequently, the education sector is not resistant to the challenges of implementing change and innovation when adopting new technologies.

A second aspect of the problem that educational organizations face is the identification and mitigation (using professional development) of factors that impact the implementation of mandated innovative technology adoption by schools. One possible factor in the success or failure of technology initiatives is leadership. In 2016, Northouse provided an underlying definition of leadership as “a process whereby an individual influences a group of individuals to achieve a common goal” (p. 6). Leadership’s attention to the relationship between people, process, and technology is essential. Although leadership may mandate new processes and technology, it is the people that are responsible for the implementation of initiatives and require the support of leadership. The support of leadership is critical for the successful adoption of innovative technologies. A key to addressing the technology adoption—and a determinant to the success or failure of any district-wide technology initiative—is leadership and its influence on factors that impact technology implementation (Bennett & Thompson, 2011; Crawford et al., 2003; McLeod et al., 2015; Research Scholar, Liberty University. & Brown, 2014; Richardson & Sterrett, 2018; Sterrett & Richardson, 2017). In 2010, the National Center for Education Statistics (NCES) reported that 14% of school-level administrators and 24% of district-level technology staff helped to integrate technology into instruction in public schools to a significant extent. District leadership allocates funding for technology initiatives and must examine budgets to optimize spending to pay for educational technology and professional development (U.S. Department of Education, Office of Educational Technology, 2017). Effective professional development in the education sector is necessary to support the people affected by new processes and technology by aligning pedagogy with educational technology to increase the likelihood of success of technology initiatives (Blanchard et al., 2016; Darling-Hammond et al., 2017).

Leaders can mitigate the influential factors that impact the implementation of innovative technology with professional development. Factors include, but are not limited to, performance expectancy, facilitating conditions, technology adoption, and demographics (Avolio & Bass, 2002; Rogers, 2003; Venkatesh et al., 2003). Professional development to support the implementation of innovative technology can set expectations for performance while optimizing facilitating conditions. Leaders must have a sense of how technology is diffused in their organization and utilize professional development to encourage technology adoption aligned with pedagogy. Professional development must accommodate the demographic composition of its audience to tailor the delivery of content. Consequently, education leaders must effectively use professional development to mitigate influential implementation factors.

As the implementation of innovative technology and identifying success or failure factors are problematic, the final aspect of the problem is that educational organizations are not immune to unforeseen crises. The U.S. Depart of Education, Office of Safe and Drug-Free Schools (2003), tasked with responses to crises, defines a crisis as "a situation where schools could be faced with inadequate information, not enough time, and insufficient resources, but in which leaders must make one or many crucial decisions" (p. 5). K-12 school districts across the country were taken off-guard by the crisis created by the COVID-19 pandemic on instruction. As a response to the situation, school districts across the country implemented distance learning. For example, the LAUSD implemented the @ Home Continuity of Learning policy to execute distance learning until a return to in-person instruction in K-12 public schools (Garcetti, 2020; Los Angeles School District, 2020). Due to the policy, the LAUSD incurred initial costs of $23 million to address the digital divide and $31 million in educator training (Austin Beutner, 2020). Similarly, the NYDOE spent over $32 million for COVID-19 related expenses since March 10, 2020 (Independent Budget Office of the City of New York, 2020). While school funding poses challenges in the best of times, funding during a crisis may create unforeseen expenditures.

Educational leaders must respond to academic responsibilities and execute fiscal accountability when implementing technological innovations during a crisis. Technology oriented academic responsibility is supporting the use of technology in education to increase academic achievement (Ege University, Turkey & Uslu, 2018). Fiscal responsibility is defined as a detailed analysis of technology implementation component costs (e.g., training, equipment, and maintenance) to determine the optimal financing strategies or options (Pelavin Research Institute, 1997). Consequently, leadership has the responsibility to manage crises in an academic and fiscally responsible manner.

Since crises that impact the educational sector are likely to recur, best practices must be established for there to be a systemic improvement in innovative technology implementation. Best practices are methods or approaches that are better than alternatives when striving for desired results (Urban, 2018). Identifying best practices in innovative technology adoption during a time of crisis is the central focus of this study. For instance, best practices must preserve essential core values while creating an environment conducive to implementing innovative technologies and overcome the undesirable outcomes of a crisis (Owen & Demb, 2004; U.S. Department of Education, Office of Safe and Drug-Free Schools, 2003). Successful organizational change and innovation occur when leaders align initiatives with institutional missions and goals and work with stakeholders before financial commitments. Monahan (2004) investigated the adoption of new technologies in the Los Angeles Unified School District (LAUSD) and found that technologies operate within a more extensive ideological system; thus, requiring pedagogical wisdom and leadership in pedagogical practices. Furthermore, Lee and Lind (2011) researched the linkage between organizational IT adoption and student achievement and note that fundamental changes are necessary for organizations to allow for the adoption of new technologies that positively impact student achievement. Therefore, it is imperative to understand the internal and external factors leaders face so that they can provide professional development to facilitate innovative technology adoption during a time of crisis.

Background

Education Policy and Technology

The proliferation of innovative technology has impacted education policy. The National Education Technology Plan (NETP), established in 2010 and recently updated in 2017, and the Every Student Succeeds Act (ESSA), established in 2015, are the policy and law set by the Obama Administration that supports leaders in adopting cost-effective new technology (U.S. Department of Education, Office of Educational Technology, 2017). The purpose of the NETP is to provide a national vision and plan for technology-enhanced learning. While the NETP provides the strategic vision, the ESSA offers funding streams for the use of technology in education and empowers states to create and implement accountability systems that drive continuous improvement for all students (Adams et al., 2017). District leaders can use both the NETP and ESSA as guidance and support for adopting innovative technologies. For example, the U.S. Department of Education has proposed a methodology of accelerating the pace of educational technology innovation by creating an educational innovation cluster ecosystem built on stakeholder partnerships (*Education Innovation Clusters: Accelerating the Pace of Innovation*, 2015). Similarly, Kerchner (2013) notes that proponents of technology change and innovation in California promote efforts to build a new learning environment infrastructure. It will require that organizations form non-traditional partnerships and make changes to the policy. The desired result of that environment is a positive impact on academic achievement. That effort will require embracing change and innovation in educational organizations.

Leaders in school districts could embrace the National Educational Technology Plan (NETP), which promotes technology diffusion of innovative technology by providing professional development opportunities and funding. That would promote preferred organizational practices and provide the resources that are conducive to technology adoption that is academically and fiscally responsible.

To be effective, leadership must be fiscally responsible for the diffusion of technological innovations. Nationwide school system investment in instructional technology amounted to over $8 billion in 2011, with expected yearly increases of 4.5% (Schipper & Yocum, 2016). Leaders can identify technologies that improve processes and render old methods obsolete, freeing funds to pay for technology (U.S. Department of Education, Office of Educational Technology, 2017). Also, Philip (2017) found that LAUSD leaders believe that to increase the chances of success, there should be effective leadership in creating comprehensive proposals for managing resources in the technology adoption process. There is an urgency for leadership in responsible resource allocation that will enable effective diffusion of technology innovation.

The adoption of technology innovation impacts academic achievement. A study on student-centered pedagogical beliefs and technology integration’s impact on student achievement produced insightful findings. It found that students who received student-centered, technology-integrated instruction performed better in language, math, and science Criterion Reference Tests (CRTs) than students who received teacher-centered, non-technology integrated instruction (Glassett & Schrum, 2009). Likewise, in a mixed-methods, three-year study of technology-enhanced professional development with participants of 20 middle school teachers and 2,320 students, Blanchard, LePrevost, Tolin, and Gutierrez (2016) determined that technology integration had a positive impact on end-of-grade assessment data for mathematics (Grades 6–8) and science (Grade 8). There is growing evidence that when the implementation of innovative technology aligns with student-focused pedagogy, there is a positive impact on student achievement.

Health Crises, the Education Sector, and Innovative Technology Adoption

The COVID-19 pandemic is not the first health crisis to attack the United States and have an impact on the education sector. The Spanish influenza of 1918-1919 (claiming the lives of approximately 670,000 Americans) caused the closure of society, including schools (Greenberger, 2018; Ott et al., 2007; Schwartz, 2018). Similarly, the poliomyelitis (Polio) outbreak of 1946 impacted students with the delay of school openings. Past pandemics prompted crisis management plans that included the possibility of a worldwide health crisis.

Unlike previous pandemics, the crisis management response to COVID-19 formed a concerted effort to utilize technology to continue work and learning in the United States during the stay at home orders. The COVID-19 pandemic has had a devastating impact on societies across the world. The World Health Organization (2020) reported a cluster of pneumonia cases (later identified as a novel coronavirus, also known as COVD-19) in Wuhan, China, on December 31, 2019 (*WHO Timeline - COVID-19*, 2020). The first reported case outside of China occurred in Thailand on January 13, 2020. Unfortunately, COVID-19 spread worldwide, sparking a declaration of local emergencies worldwide.

As the emergency spread worldwide, the United States reported its first case of the novel coronavirus on January 20, 2020, and recognized it as a national emergency beginning on March 1, 2020 (Holshue et al., 2020; Trump, 2020). A sample of 250 school districts (including 10,289 schools) reported that 100 percent of schools had closed by March 27, 2020, and 43 percent of schools were in districts that offered distance learning (Malkus et al., 2020). An example of a response to the COVID-19 pandemic on K-12 public schools is that of Los Angeles, CA. The COVID-19 has had a devastating impact on LAUSD schools. A State of Emergency for the state of California and a local emergency in Los Angeles were both declared on March 4, 2020, by Governor Gavin Newsom and Mayor Eric Garcetti, respectively (Garcetti, 2020; Newsom, 2020). On March 13, 2020, Superintendent Austin Beutner announced the closure of schools for two weeks beginning the following Monday (Clover Avenue Elementary School, personal communication, March 13, 2020). Ten days later, Beutner released the Policy for @Home Continuity of Learning to guide distance learning, which would mandate the use of innovative technology (Los Angeles School District, 2020). As a result, LAUSD incurred unexpected expenditures to acquire and distribute resources and services to the school community. Those actions were an acknowledgment that a segment of the population does not have adequate access to technology or reliable Internet connectivity (e.g., more than 15,000 high school students were not connected to the Internet at the beginning of the policy). Leadership and institutional practices were critical to the response to COVID-19.

Although research on the impact of leadership and practices on innovative technology implementation would yield insights on its own, adding the phenomenon of the COVID-19 pandemic provides a unique research opportunity. Additionally, research within the context of a large, urban school districts' professional development certification program response offers the opportunity to examine the real-time implementation of innovative technology adoption. A study of this phenomenon within its context will add to the body of knowledge.

Best Practices

Determining best practices is a universal challenge, especially in response to a pandemic. Effective leadership and the identification of factors that influence the implementation of innovative technology is essential for the diffusion of technology innovation. Therefore, it is imperative to identify best practices in leadership related to technology advancement and aligning pedagogy with technology adoption.

Identifying best practices can mitigate disastrous technology implementations or increase the likelihood of implementations viewed as successful. For example, the failure of the Los Angeles Unified School's (LAUSD) systems attempt in 2004 to implement a $95 million payroll system is primarily blamed on dysfunctional management. District leadership reportedly did not provide adequate professional development to school staff, and there was a lack of accountability when problems arose. Best practices could also have helped LAUSD leadership avoid the controversial 2013 program that sought to enhance learning through the allocation of $1.3 billion of infrastructure upgrades to provide 700,000 iPads for students and teachers (Gilbertson, 2014). Despite these past failures, the LAUSD has a current standing as a model of integrating technology while leading with instruction (Snelling, 2018). As a response to past failures, district leadership created a diverse task force to learn about best practices around instructional technology for application in the LAUSD. The effect of leadership and other factors that enable technology adoption must be studied to gain insights into best practices to identify successful roadmaps and avoid failures.

This project is needed to determine the best practices necessary to promote the efficient and effective implementation of technology innovation in the education sector that positively impacts academic achievement. The extant literature does not sufficiently address the intersectionality of leadership support for the diffusion of innovative technologies, academic responsibility, and fiscal responsibility during a time of crisis. This project will add to the body of knowledge by examining the response of leadership and factors that influence the implementation of innovative technology during a time of crisis.

Factors Influence the Innovative Technology Adoption Process

This project will investigate the actions of district leadership and factors that district leaders and school personnel believe impact the implementation of innovative technology in the education sector. Leadership affects the implementation of mandated, innovative technology adoption during times of crisis. As a response to the COVID-19 pandemic and the subsequent rise of distance learning, district leadership provided professional development to those that support or deliver engaging, student-focused online instruction. This study used data from participants' involvement with a professional development certification program to gain insight into the factors that impact the implementation of innovative technology. Ultimately, the research questions will investigate the factors that impact the implementation of innovative technology during a crisis.

Research Questions

This project will study three central research questions:

1. To what extent did the program increase participants' confidence in their ability to deliver engaging, student-focused online instruction?
2. To what extent, if any, did program participants change in their use of technology necessary for delivering engaging, student-focused online instruction after program completion?
3. What factors are related to program participants' ability to deliver engaging, student-focused online instruction?

For Research Question 3, I specifically examined the following null and alternative hypotheses concerning the relationship between the participants and the factors that are related to their implementation of innovative technology in the form of engaging, student-focused online instruction:

H1o: Implementation factors are not predictive of program participants' belief in their ability to deliver engaging, student-focused online instruction.

H1a: Implementation factors are predictive of program participants' belief in their ability to deliver engaging, student-focused online instruction.

H2o: Participants' technology adoption proclivities are not predictive of program participants' belief in their ability to deliver engaging, student-focused online instruction.

H2a: Participants' technology adoption proclivities are predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

H3o: Participants' gender, race, years of experience, position, and serviced grade level are not predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

H3a: Participants' gender, race, years of experience, position, and serviced grade level are predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

H4o: Participants' location of service is not predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

H4a: Participants' location of service is predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

Overview of Research Design

An online, voluntary questionnaire was administered to district leaders and school personnel work in a large urban district and participated in a program to prepare district employees to implement or support the use of innovative technology to deliver engaging, student-focused online instruction. The sizeable urban district covers a significant landmass with over half-a-million students. The participation of 10,620 respondents within a large urban district provided an adequate sample size with a variety of responses about the implementation of innovative technologies as a response to the COVID-19 pandemic.

Research Design

A quantitative analysis of survey data provided insight into perceptions about the implementation of innovative technology during a crisis. It provided an understanding of influential factors when implementing change on both the macro and micro levels (Brinkerhoff, 2003; Yin, 2018). A survey collected quantitative data. The quantitative analysis provided the "what" was happening in the relationship between influential implementation factors and the participants' ability to implement innovative technology. The district and its employees are a microcosm of the diversity of the United States, which made it attractive for a research study.

The Significance of the Research

Identifying factors that facilitate or impede the diffusion of technological innovation in educational organizations successfully during a time of crisis will have a profound effect on technology adoption, financial expenditures, and academic achievement. Further, the identification of best practices that lead to the successful implementation of innovative technology can reduce costs and increase academic achievement (Owen & Demb, 2004; Ensminger & Surry, 2008; Lee & Lind, 2011). As technology becomes increasingly ingrained in society and its use mandated by district leaders, organizations must find cost-effective and efficient methods to embrace change and innovation.

District Leadership Mandating Innovative Technology Initiatives

District leadership must address both the digital divide and digital use divide when mandating innovative technology adoption, especially in the face of a crisis that expedites the need to leverage technology to provide instruction. For instance, the COVID-19 pandemic necessitated the implementation of distance learning. Although the NETP suggests that district leaders prepare various learner pathways, there was a rush to provide mandated distance learning resources during the COVID-19 pandemic (City News Service, 2020; *Reimagining the Role of Technology in Education: 2017 National Education Technology Plan Update*, 2017; Richards, 2020). As a result, many districts implemented professional development to support distance learning mandates.

While leaders in districts across the country provided professional development opportunities to support distance learning mandates, the difference between schools within a district varied wildly, which requires leaders to develop strategies that leverage technology equitably. While the NETP recommends providing technology accessibility and physical spaces and technology-enabled learning, the implementation of such recommendations are left to district leaders to implement (*Reimagining the Role of Technology in Education: 2017 National Education Technology Plan Update*, 2017). It is imperative to understand how education sector district leaders apply those recommendations when mandating innovative technology adoption initiatives and why district technology initiatives are successful or unsuccessful in varying school environments.

Organization of the Dissertation

There are four remaining chapters. Chapter 2 presents a review of the literature related to innovative technology adoption and factors that influence its implementation. Chapter 3 describes the study's methods, including data collection and analysis procedures. Next, in Chapter 4, the findings, organized according to the three research questions, are reviewed. Finally, in Chapter 5, the summary of key findings, interpretation of results, implications, recommendations, limitations, and suggestions for future research are presented.

Chapter Two

As with other sectors of society, technology has become widely available in the education sector. Technology availability is the opportunity to access technology materially. According to the 2008 Fast Response Survey System's survey of 2,005 public schools in 50 states and the District of Columbia, 100% of the public schools had computers with Internet access, 97% had computers in classrooms, 97% had LCD and DLP projectors, and 73% had interactive whiteboards available for instruction (Gray et al., 2010). However, technology availability does not guarantee effective and efficient implementation, nor does it equate to technology integration and adoption into practice. The transition from technology availability to technology integration and adoption requires effective leadership, professional development, and identification of factors that impact technology implementation.

This chapter opens with a brief discussion of the history of technology adoption in society in general and then in the education sector. Second, it will consider the impact of accountability on technology adoption. Third, it will review influential factors of technology adoption with an exploration of the value of identifying best practices. Finally, it will examine the positioning of this study at the intersection of the User Acceptance of Information Technology (UTAUT), Diffusion of Innovation (DoI), and Full Range Leadership Model (FRLM) theories to research the factors that impact the implementation of innovative technology in the education sector.

History of Implementation of Technology Initiatives in the Education Sector

The development and use of technology have been essential to the rise of human civilization. Technology can be thought of as tools, skills, or procedures that are necessary to use those tools and has been used to reshape our environment and fulfill social needs (Mutekwe, 2012; Thohari et al., 2013). The importance of technology goes beyond the tool itself. Technology impacts society. From technological developments that have elevated humans from hunting and gathering to developing spacecraft that have left our solar system, technology has revolutionized how we view and interact with each other and the world around us, making us the dominant species on the planet.

While technology has made humans the dominant species on the planet, each country has its policy on the integration of technology in its society. The U.S. technology policy's goals since its inception have focused on capability-enhancing while increasing innovative capacity (Branscomb, 1992). The U.S. technology policy's strategy is to focus public attention on aggressive technical goals and implement seismic improvements in technology. Since 1983, the United States has recognized the importance of technology in the education sector with the publishing of the federal report *A Nation at Risk* (Culp et al., 2005). The U.S. educational technology policy is the National Education Technology Plan (NETP) (U.S. Department of Education, Office of Educational Technology, 2017). It is aligned to the U.S. technology policy as written in the Activities to Support the Effective Use of Technology (Title IV) Part A of the ESEA, as amended by ESSA (U.S. Department of Education, Office of Educational Technology, 2017). The first iteration of NETP began in 1996, entitled as *Getting America's Students Ready for the 21st Century: Meeting the Technology Literacy Challenge*. It has evolved into its present NETP form with a 2017 update. The NETP synthesizes research and practice on effective technology leadership that identified focus areas of collaborative leadership, personalized student and professional learning, and robust infrastructure. The NETP is a response to the rise of technology in society, its impact on the education sector, and the need for leadership in fiscal responsibility and improving the learning environment.

Technology Integration in Education

Although technology is ubiquitous today, its integration and adoption vary in the education sector. Technology integration is the process of using technology to support 21st-century teaching and learning (Tondeur et al., 2017). The National Center for Education Statistics (2010), in a study using a four-point scale ranging from not at all to a major extent, reported that 20% of teachers integrated technology into instruction to a major extent. Acknowledging a need to increase technology integration, the U.S. Department of Education, Office of Educational Technology, mandated an increase in technology integration in the school system (Tondeur et al., 2017).

Technology integration does not equate to technology adoption. Technology adoption is sustainable technology integration in which technology use embeds in culture (Copland, 2003). For technology adoption to occur, teachers must receive leadership support to increase their understanding that their pedagogical beliefs impact technology adoption, which in turn impacts student achievement (An & Reigeluth, 2012; Blanchard et al., 2016; Glassett & Schrum, 2009; Kara & Cagiltay, 2017). Leadership support for teachers often takes the form of professional development. Professional development is useful in addressing changes in policy that result in initiatives upon which success is subject to factors that impact technology adoption (Darling-Hammond et al., 2017; Hardy et al., 2010; Ming et al., 2010). Leadership has played a role in obtaining the promise of technology in the education sector by facilitating efforts to not only integrate technology into schools but by supporting its adoption into culture using professional development.

The Promise of Technology in Education

The promise of integrating digital technology into the education sector has met high expectations. As with other sectors in society, technology in the education sector confronted the expectation that it would extend services, improve performance, or reduce costs, causing an evolution in the learning model (Westera, 2004). One of the first major shifts in education was the classroom lecture, teacher-focused model replacement of the one-on-one apprentice model as the process to pass on information and skills evolved. Increased connectedness and access to information afforded by technology are creating another shift in the education model that is adjusting to societal demands. A successful shift in the education model is dependent on implementation (Ensminger & Surry, 2008). Ham and Cha (2009) look beyond successful implementation contained within the organization and investigated the impact of social changes associated with educational technology. Those social changes came with an expectation of improved student outcomes. Although billions of dollars enable various educational technology initiatives, there is an opportunity for improvement in student outcomes (Bailey et al., 2011). With proper leadership, attaining the promise of technology is possible, and the process of technology adoption can be efficient and effective with the potential to enhance instruction and learning.

The promise of technology is a promise to solve not only societal but institutional problems as well (Hung et al., 2017; Morgan & Dean, 2016). Technology must address institutional and academic plans to meet their needs and resolve problems faced by institutions. Therefore, technology should be used to enhance education and transform it into what it should be to fulfill its promise (Rivero, 2018). Successful technology initiatives enable the proliferation of education through accessibility, resources, and connectivity (U.S. Department of Education, Office of Educational Technology, 2017).

The Impact of Accountability in Innovative Technology Adoption

The promise of education has necessitated a rise in accountability. The Cambridge English Dictionary defines accountability as the act of being responsible for situations and the ability to provide a satisfactory reason for them ("Accountability," n.d.). Bathgate, Colvin, and Silva (2011) noted that accountability in the education sector is essential and contains four elements of: (1) a vision of student success; (2) objectives, metrics, and performance targets aligned with the vision; (3) a system of collecting, analyzing, and communicating outcomes; and (4) strong leadership. Other researchers have affirmed the importance of accountability by uncovering a societal demand for increased educational accountability in K-12 education over the past 30 years due to public opinion, interest groups, and an increasing proportion of education expenditures in state spending (Finch, 2012; Mehta, 2013).

Various government legislation and initiatives that impact innovative technology adoption have attempted to address the demands of accountability. Hardy et al. (2010) found that professional development aligned with policies leads to the accountability of performance and appropriate measurements of success. Professional development for school personnel and district leadership is an opportunity to meet accountability expectations and measure results. For example, in California, the ESSA empowered Local Control and Accountability Plan (LCAP), along with President Obama's ConnectED initiative, provides guidance and support for technology use in the classroom (Tarbutton, 2018). COVID-19 created a nationwide need for school district initiatives to support remote learning, such as plans to implement learning through synchronous instruction supplemented by asynchronous instruction (Malkus et al., 2020). As a result, school districts rushed to provide professional development opportunities and adjust accountability measures to manage the impact of the crisis. Consequently, educational leaders are tasked with accountability when implementing innovative technology not only in times of relative normality but also in times of crisis.

Accountability for Technology Investments

Measurements by which leaders are held accountable are essential. While return-on-investment (ROI) is a business sector decision-making tool that measures financial benefits, the education sector's measurement of benefits from investments is challenging to evaluate (Krueger, 2013; Moonen, 2003; Jack J. Phillips & Phillips, 2008; J.J. Phillips, 1996). One solution is to use a simplified ROI by deciding which benefits substantially differentiate a new situation compared to current practice (Moonen, 2003). In this case, leaders would decide the criteria to evaluate innovative technology adoption. However, Forsstrom and Ham (2007) studied the use of both traditional ROI and value of investment (VOI) to measure the success of technology initiatives. Similarly, Krueger (2013) suggests a VOI evaluation that measures investments against a district's strategic plan, such as engaging parents and communities or innovative technology adoption, in which the activities with the highest VOI also offer the highest ROI. Consequently, leaders must have the best practices to deliberately choose criteria to choose, implement, and evaluate innovative technology adoption.

Accountability Measures

A method to measure technology leadership decisions is by the school's goal attainment and the level of technology integration in the district and school (R. E. Anderson & Dexter, 2005). Examples of measurable criteria are user involvement, stakeholder engagement, technology staff, simplified ROI, and adoption rate (Kirschner et al., 2004; Moonen, 2003; U.S.

Department of Education, Office of Educational Technology, 2017). Most measurements of effective leadership in technology adoption involve academic achievement and fiscal responsibility (Kelly, 2011; McLeod et al., 2015; Petersen, 2005; Research Scholar, Liberty University. & Brown, 2014; Richardson & Sterrett, 2018; Sterrett & Richardson, 2017).

Academic Achievement. How teachers use technology as part of pedagogy will influence student achievement (An & Reigeluth, 2012; Blanchard et al., 2016; Glassett & Schrum, 2009). Snider and Roehl (2007) state that not only do pedagogical beliefs influence classroom practice, but they also influence expectations for student achievement. In a study on a professional development program (known as MINTY), which collected two years of qualitative data and one year of Criterion Reference Test (CRT) data, Glassett and Schrum (2009) researched student-centered pedagogical beliefs and technology integration's impact on student achievement. The study showed that the positive influence of technology integration improved teachers' attitudes toward teaching and learning, student achievement, and conceptual understanding. The study found that leadership that supports technology-infused pedagogy has a positive impact on student achievement, especially with ethnically diverse students, requiring the need for support of technology integration in the classroom. Also, research indicates that well-funded focused technology adoption initiatives supported by leadership have a positive impact on student achievement (Lee & Lind, 2011). Lee and Lind (2011) found that the E-Rate program, which funds IT infrastructure programs, narrowed the achievement gap between poor and affluent schools in 94 urban school districts. Consequently, leaders must have support in how to lead their organization's technology initiatives to improve academic achievement.

The COVID-19 pandemic will negatively impact academic achievement. Before COVID-19, a survey of 7,233 students by the ACT Research and Center for Equity in Learning found that

85% of respondents reported access from two to five devices at home, and 68% of those students use those devices for homework (Moore et al., 2018a). Conversely, 17% of respondents only have access to a smartphone, and 48% of those students use those devices for homework. Due to COVID-19, an analysis of 1.6 million students predicts that the achievement gap could increase by approximately 18% between low- and high-income students (Moore et al., 2018b). Consequently, district leadership must allocate the proper resources to ensure that access to resources is not a hindrance to academic achievement.

Fiscal Responsibility. District leadership is not only responsible for leading technology implementation efforts to improve academic achievement but also for the allocation of resources and funding. In other words, technology adoption initiatives have a profound impact on district spending and require fiscal responsibility. Many states have accountability standards that require technology integration (Yu, 2013). For some leaders, this is a challenging situation as they do not have the technical background to implement successful technology adoption initiatives. Business and government provide 90% paid time training in comparison to 39% of teacher training. A Congressional report suggests that at least 30% of technology budgets should fund training and support (2000). The school system must allocate adequate resources to support technology adoption.

Aligning fiscal and academic responsibilities is challenging enough during times of normalcy but is further complicated in a time of crisis. In response to COVID-19, school districts incurred unexpected expenditures to provide the technology to facilitate distance learning environments for students and professional development for school personnel and district leadership. The U.S. Department of Education, Office of Safe and Drug-Free Schools (2003) provides guidance to track expenditures related to the crisis but not a way to mitigate or pay for accrued expenses. Therefore, district leadership must increase their skill set to lead in the creation of environments conducive to technology integration while maintaining fiscal responsibility during a time of crisis.

District leaders must consider factors that influence technology adoption into the classroom. Compensation structures must be adapted to encourage training that will enhance pedagogical beliefs in technology adoption and implementation. Compensation structures must be accompanied by a full-time staff to assist with implementing innovative technology. The NCES (2010) reported that 31% of all public schools have full-time staff responsible for technical support and integration. Of all public schools, 29% of school-level technology staff provides technology integration support for instruction to a major extent, on a 4-point scale ranging from not at all to a major extent. School systems should provide reliable technical support. Teachers should be included in technology integration planning to help assist in adoption. An and Reigeluth (2012) state that institutions must: (1) provide equipment, technology, or funding; (2) facility training, workshops, models, and examples; (3) focus more on student-centered instruction; and (4) focus less on state test scores. Likewise, Kara and Cagiltay (2017) state that teachers expect to not only be equipped with effective technologies but also supported by curriculum and several programs focused on enhancing their technology use skills. Teachers' expectations require that school districts must have leadership that aligns fiscal and academic responsibilities while addressing factors that influence innovative technology adoption.

The Role of Leadership in Technology Adoption

Leaders are accountable for setting a vision for their innovations, including technology adoption and communicating, monitoring, evaluating, and sustaining the implementation of that vision (Bolman & Deal, 2013; Lambert, 1995; Northouse, 2016; Schlechty, 2001). Leaders must engage people in the processes that create conditions that are conducive to collaboration and to make effective organizations (Lambert, 1995). Organizations comprise people, processes, and technology. Leaders must ensure that there is collaboration within their organizations for the proper alignment of those three aspects. Adding to the role of leadership in creating an effective organization, Schlechty (2001) notes that leaders must ensure that their followers know how to meet the expectations of technological change.

Technological changes, referring to the process of technology adoption, affect organizations and impact leadership behaviors (Schlechty, 2001). Bolman and Deal (2013) suggest that leaders use frames or lenses to strengthen their analysis of the challenges of their organizations in order to respond with the appropriate action. While Bolman and Deal focus on the interaction between leadership and the organization, Northouse (2016) focuses on the traits and behaviors of leadership. Despite the different approaches to analyzing leadership, there is a consensus that leadership significantly impacts decisions made within organizations; therefore, leadership will have a profound impact on implementing innovative technology.

Best Practices in Leadership

According to Bolman and Deal (2013), effective leaders require training, and anyone can improve their leadership skills, abilities, timing, and style. Implementing leadership best practices that are evidence-based is one way to improve leadership (Dappolone, 2013; Kelly, 2011; McLeod et al., 2015; Research Scholar, Liberty University. & Brown, 2014; U.S. Department of Education, Office of Educational Technology, 2017).

Evidence-based leadership best practices, as determined by the analysis of data using measurable criteria, is not the status quo (López, 2014). Using measurable criteria as the basis for data collection would allow for the identification and comparison of evidence-based best practices in leadership. Measurability is the byproduct of accountability. Measurable criteria can be used to exceed accountability as the expectation and could set expectations to not only to meet requirements but to improve toward best in class status continuously.

The Education Sector and Crisis Management

Educational leaders must use best practices gathered from across the nation to guide in times of crisis (Gainey, 2009; Kano & Bourque, 2007). The No Child Left Behind Act of 2001 is the root of the U.S. education system's modern response to crises (No Child Left Behind Act of 2001, 2002). As a result, the creation of the Office of Safe and Drug-Free Schools (OSDFS) (currently known as the Office of Safe and Healthy Students (OSHS)) serves to provide services and programs to access to education, improve school conditions for learning, and the utilization of technology to improve academic achievement and digital literacy for the health and safety of students (Lloyd J. Kolbe, 2002). In adherence to its responsibilities, the OSDFS created a brochure as a guide for schools and communities in times of crisis, which acknowledges explicitly the possibility of a global pandemic that could occur within a short time (U.S. Department of Education, Office of Safe and Drug-Free Schools, 2003).

While the federal government has guided crisis planning, local administrations have created policies for crisis management. For instance, the California Department of Health Services and the California Department of education created contingencies for a potential pandemic influenza crisis (Kano & Bourque, 2007). A survey of the emergency preparedness of three schools within Los Angeles County found a lack of preparedness for terrorism or bioterrorism (Kano et al., 2007). Although not classified as bioterrorism, the disruptive outcome between COVID-19 and a health disaster is comparable. Similarly, Gainey (2009) found that while school districts have prepared for prevalent crises (e.g., violence, weapons, illegal substances, student discipline, inclement weather), responses to new dangers such as pandemics requires additional research. Likewise, Greenberger found that despite advances since the outbreak of the Spanish influenza of 1918-1919, the United States lacks adequate preparation for a large-scale pandemic. However, the education sector's response to the COVID-19 pandemic with the mandated implementation of innovative technology is a novel response requiring research as to its efficiency and effectiveness.

Conceptual Framework

The conceptual framework guiding this study is a synthesis of the Unified Theory of Acceptance and Use of Information Technology (UTAUT), Diffusion of Innovation (DoI), and the Full Range Leadership Model (FRLM) theories (Avolio & Bass, 2002; Rogers, 2003; Venkatesh et al., 2003). The compartmentalized literature on the theories of diffusion of innovation, technology acceptance, and leadership does not thoroughly address a relationship among the theories. This study adds to the literature by synthesizing the three theories to gain insight into their potential relationship. The UTAUT examines technology acceptance factors and usage behaviors (Venkatesh et al., 2003). The DoI provides insight into technology users' perception of technology and how that impacts the rate of innovative technology adoption (Rogers, 2003). To supplement the UTAUT and DoI theories, the FRLM provides insight into how leadership style affects internal and external factors that impact the implementation of innovative technology adoption (Avolio & Bass, 2002). Research into the synthesis of the three theories during a crisis will add to the body of knowledge of how to implement innovative technology.

The Unified Theory of Acceptance and Use of Information Technology

In 2003, Venkatesh, Morris, Davis, and Davis proposed a theoretical model with four core determinants (i.e., performance expectancy, effort expectancy, social influence, and facilitating factors) of intention and usage and four moderators (i.e., gender, age, voluntariness, and experience). Among the four core determinants, performance expectancy is the strongest predictor of intention to use technology, whether it is mandated or not. It refers to how the individual expects the technology to increase job performance. Effort expectancy refers to the perceived ease of technology usage. Social influence is the impact of the perceptions of others on an individual's technology use. When innovative technology is mandated, social influence is relatively high but diminishes in influence over time as usage becomes standardized. Facilitating conditions refer to the beliefs an individual holds that their organization can enable their use of technology through supports and infrastructure. The moderators act as influences of the strength of the four core determinants of usage. Compared to other technology acceptance theories and models, the UTAUT identifies the most explained variance (R^2) accounting for 69% of the intent to use technology (Gunawardena, 2014).

Diffusion of Innovation

Research into the diffusion of innovation originated with Tarde (1903), who observed reasons for imitation, which result in the adoption or rejection of innovations. Ryan and Gross (1943) expanded Tarde’s observations by conducting a hybrid corn study that researched the adoption of hybrid seed technology by farming communities. Rogers (2003) expanded the diffusion of innovation research by using it to explain social change. Rogers (2003) defines innovation as an idea, practice, or object that is perceived as new by an individual and diffusion as the process in which social systems communicate an innovation over time.

Rogers (2003) developed a model of the diffusion of innovation that mapped the rate of adoption of innovation through the communication of members in a social system over time. Rogers identified five main stages in the adoption process: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. Another way to view the diffusion of innovation is by plotting the adoption of innovations using a bell curve with divided categories of innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%), and laggards (16%). Rogers plotted the rate of adoption using an S-shaped curve as successful innovation gains market share on a cumulative frequency basis over time. Dearing (2009) supports Rogers's thoughts on the rate of adoption by agreeing that informal opinion leaders impact the rate of adoption. However, what is missing from both researchers' work is the impact of formal leadership on the rate of adoption. While understanding the role of informal leadership is essential, understanding the factors of formal leadership can help the formation of institutionalized best practices (V. Hannon, 2008; Harpell & Andrews, 2010; Müller & Turner, 2007; Owen & Demb, 2004; Schrum et al., 2011).

Full Range Leadership Model

Bruce Avolio and Bernard Bass developed the Full Range Leadership Model (FRLM) to model factors of informal or formal leadership (Avolio & Bass, 2002; Northouse, 2016). They extended the works of James MacGregor Burns and Robert J. House by focusing on the interaction between leaders and followers on a leadership continuum from laissez-fair leadership to transactional leadership to transformational leadership (Burns, 2010; House, 1976; Northouse, 2016). Each category within the spectrum of the FRLM has its characteristics.

The absence of leadership characterizes laissez-faire leadership (Northouse, 2016). While laissez-faire leadership is the absence of leadership, transactional leadership engages followers, focusing on exchanges between leaders and followers (Northouse, 2016). Transactional leadership is the most common leadership style. Additionally, Barnett (2018) states that transactional leadership is mostly based on compensation and monitoring and focuses on contingent rewards and obedience to the organizational policy and rules. Unlike laissez-faire leadership and transactional leadership, a transformational leader not only accepts responsibility for outcomes and engages followers but creates a connection with followers that raises the level of motivation and morality (Northouse, 2016). Transformational leadership encompasses charismatic and visionary leadership that is attentive to the motivation and needs of followers.

The FRLM is used to analyze the effectiveness of a wide range of leadership behaviors and their influence on outcomes. Previous research has used the FRLM to study the use of laissez-faire, transactional, and transformational leadership styles' impact in organizations (Barnett, 2018; Jones & Rudd, 2008). Although there are several leadership behaviors, this study will focus on how district leadership utilized aspects of transactional and transformational leadership behaviors to address a crisis by facilitating the implementation of innovative technology via the professional development of district employees. District leadership provided incentives and a vision for the implementation of innovative technology; therefore, the study of the implementation factors that leadership influences during a crisis is essential.

Synthesizing the UTAUT, DoI, and FRLM Theories

While previous research literature provides a framework for the UTAUT, DoI, or FRLM, this study's conceptual framework considers how the UTAUT, DoI, and FRLM theories connect within the phenomenon of educational technology implementation in the context of a public health crisis. The gap in the literature addressing the relationship between the three theories during a crisis, which, if closed, can elucidate the relationship between leadership and the factors that impact the implementation of innovative technology, demonstrates a need for this study. There is a demand to investigate the influence leadership has on influential factors that impact the implementation of innovative technology (Crawford et al., 2003; Dexter et al., 2016; McLeod et al., 2015; Petersen, 2005; Richardson & Sterrett, 2018; Seyal, 2015; Spector, 2013). Further, examining usage behavior within the context of the education sector, responding to a pandemic, will expand UTAUT research (Venkatesh et al., 2003). Additionally, there is an absence of DoI research examining the implementation of innovative technology (Rogers, 2003). This research will gain insight into the influential factors that impact the implementation of innovative technology through the lens of the UTAUT, DoI, and FRLM theories.

Chapter Three

Introduction

Technological innovations change how people interact and learn within a society, and leaders must have the tools to properly manage those changes (R. E. Anderson & Dexter, 2005; Durand et al., 2016; Goolsbee & Guryan, 2006; Kelly, 2011; Mutekwe, 2012; Richardson & Sterrett, 2018). The education sector is not resistant to the effects of technology encroaching upon all aspects of society. Enhancing the effort to implement innovative technology efficiently and effectively requires that school district leaders use best practices. That effort is further complicated when reacting to a time of crisis as unexpected factors adversely impact technology implementations. The goals of this research were to study the factors and practices that impact the implementation of innovative technology during a time of crisis. This study pursued answers to the following research questions:

1. To what extent did the program increase participants' confidence in their ability to deliver engaging, student-focused online instruction?
2. To what extent, if any, did program participants change in their use of technology necessary for delivering engaging, student-focused online instruction after program completion?
3. What factors are related to program participants' ability to deliver engaging, student-focused online instruction?

Examination of the relationship between factors and implementing innovative technology utilizes the following null and alternative hypotheses:

H1o: Implementation factors are not predictive of program participants' belief in their ability to deliver engaging, student-focused online instruction.

H1a: Implementation factors are predictive of program participants' belief in their ability to deliver engaging, student-focused online instruction.

H2o: Participants' technology adoption proclivities are not predictive of program participants' belief in their ability to deliver engaging, student-focused online instruction.

H2a: Participants' technology adoption proclivities are predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

H3o: Participants' gender, race, years of experience, position, and serviced grade level are not predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

H3a: Participants' gender, race, years of experience, position, and serviced grade level are predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

H4o: Participants' location of service is not predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

H4a: Participants' location of service is predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

Although the hypotheses are stated referring to blocks of variables, each implementation factor, technology adoption category, and the demographic variables are individually examined with its unique null and alternative hypothesis. In other words, each variable is examined controlling for the other variables, whether it does not or does impact the program participants' ability to deliver engaging, student-focused online instruction or contribute to the explained variable.

Research Design and Rationale

This research utilized a quantitative design to study the efforts to support participants' implementation of innovative technology adoption in K-12 schools during a time of crisis. This study provides insight into perceptions of the preparedness of district employees to implement innovative technology as a response to a crisis. Specifically, quantitative analysis was well-suited for examining the impact of a certification program on participants' confidence and the use of innovative technology and if there is a statistically significant relationship between implementation factors and participants' ability to implement innovative technology.

This quantitative study used a survey instrument based on constructs from the conceptual framework of the UTAUT, DoI, or FRLM theories. Various instruments in the form of surveys have captured data used to inform research into those theories (Gunawardena, 2014; Hurt et al., 1977; Savery, 2005; Venkatesh et al., 2003; Venkatesh & Davis, 2000). A protocol using previous instruments as a basis was developed and piloted for this study. In addition to the construct of demographics, the instrument used selected constructs of each conceptual theory and their respective variables. Constructs are the unobservable qualities of a phenomenon, while variables are observable phenomena that can be measured (Reznick, 2017). First, the facilitating conditions construct was measured using variables in the survey to determine the participants' perception of the district's provision of resources and factors that impact innovative technology adoption. Second, the self-efficacy construct was measured using a variable to capture participants' belief in their ability to implement innovative technology. Third, appropriate variables measured performance expectancy to capture participants' beliefs on their confidence, proficiency, and use of innovative technology. The measure of the construct of technology acceptance variables will determine the extent to which leadership has influenced the acceptance of innovative technology and the impact of that influence. Finally, the construct of technology adoption used variables to determine the participants' technology adoption category placement. This study is an investigation into how schools are reacting and adjusting to technological changes forced upon them by the COVID-19 pandemic and the resulting move to online learning that necessitated a professional development program. Statistical analysis in this quantitative study examined participants' confidence, usage, and influential factors that impact the implementation of innovative technology. While a qualitative study would have provided an in-depth look at the details of how individual sites are implementing technology solutions in a time of crisis, the use of quantitative methods provided a potentially statistically significant generalizable analysis.

A survey collected data from employees that either supported or implemented the use of innovative technology in the classrooms of a large, urban school district. The survey was developed by producing questions regarding participants' demographics, the objectives of a preparatory certification program for innovative technology implementation, aspects of the Unified Theory of Acceptance and Use of Technology (UTAUT) to measure the impact of implementation factors, and an individual innovativeness scale to identify respondents' technology adoption category. The purpose of the survey was to capture participants' beliefs on implementing innovative technology and demographics for later analysis.

Site and Population

For this study, participants belonged to a large, urban school district that is representative of the nation at large. The school district contains a variety of racial, socio-economic status (SES), and cultural backgrounds. The school district is in a major metropolitan area within the United States of America.

The large urban school district has had varied outcomes with the adoption of innovative technology. The district has identified a need to have efficient, effective, and systemic use of technology across the district. That need became increasingly evident during the COVID-19 pandemic. The control of district characteristics occurs by the examination of a district-wide certification program offered to all district employees. The analysis of the certification program's participants' beliefs about their ability to deliver engaging, student-focused online instruction will provide rich insights into the relationship between implementation factors and the innovative technology adoption process during a time of crisis.

The purpose of the certification program was to enhance participants' ability to deliver or support the use of digital platforms, online conferencing tools, digital content, and digital tools, apps, and resources. The program provided 30 total hours of synchronous and asynchronous online instruction containing seven modules over seven weeks. Internationally recognized standards for online teaching and learning, National Standards for Quality Online Teaching, and the Online Learning Consortium were used to align certification tasks with recognized standards. It aimed to help district employees with leveraging technology and build leadership to engage students and their families. Further, it intended to provide and develop best practices for distance learning.

The sample population consisted of teaching, staff, administrator, and other roles involved in the certification program aimed at supporting the implementation of innovative technology in response to the distance learning environments during the COVID-19 pandemic. The selection of those groups provided a holistic view of the innovative technology adoption process during a time of crisis.

Construct and Variable Overview

The variables used within this study are derived from the constructs of performance expectancy, facilitating conditions, technology adoption, and demographics from the framework of the UTAUT, DoI, or FRLM theories.

Performance Expectancy

The definition of performance expectancy is “the degree to which an individual believes that using the system will help him or her to attain gains in job performance” and is the strongest predictor or usage intent in both mandatory and voluntary situations (Venkatesh et al., 2003, p. 447). It was essential to capture the performance expectancy of participants in the professional certification program to measure their beliefs in how professional development will impact their job performance. Several variables were used to measure the concept of performance expectancy and captured participants' beliefs of “Strongly Disagree,” “Disagree,” “Neutral,” “Agree,” or “Strongly Agree.” One measured whether the program content aligned with stated goals and objectives. Others measured participants’ confidence in their ability to apply what they learned, confidence, whether they would recommend the certification program on a scale from one to ten, what participants liked about the program, and what could be improved or if they had questions about the program. The effectiveness of the certification program to prepare participants to conduct work in an online environment was measured as either “Ineffective,” Slightly effective,” “Neutral,” “Effective,” or “Highly effective.” Participants were asked to detail the impact of the certification program on their professional practice. Participants’ beliefs in their preparedness to implement innovative technology were examined by measuring the increase in confidence as either “No Increase,” “Small Increase,” “Moderate Increase,” or “Large Increase.” Details for the rationale for either a “Moderate Increase” or “Large Increase” was requested from participants.

The proficiency of participants' current use of innovative technology compared to the start of the program was measured as either "Poor," "Average," "Good," or "Excellent." Also, there was a comparison of the usage of innovative technology before the start of the program to during the program as either "Never," "Sometimes," "Fairly Often," or "Frequently, If Not Always."

Facilitating conditions

Along with performance expectancy, facilitating conditions is a construct that was measured by several variables. The definition of facilitating conditions is "the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system" (Venkatesh et al., 2003, p. 453). The measuring of variables of facilitating conditions provided insight into the alignment of pedagogy and implementing innovative technology. Participants' were asked not only if they believed the professional development facilitator was knowledgeable and could answer questions but if they made connections between the content and their job role and differentiated instruction to meet their needs by indicating if they of "Strongly Disagree," "Disagree," "Neutral," "Agree," or "Strongly Agree" with applicable statements.

Facilitating conditions include not only beliefs about the facilitator but other factors that influence the implementation of innovative technology to which participants indicated as either "Not At All Influential," "Slightly Influential," "Very Influential," or "Extremely Influential." The influence of the availability of technical support, professional development, time to implement technology, cost to implement, ease of use, and the technology infrastructure of schools were measured. Participants' belief in the influence of the support of leadership and the coordination between stakeholders when implementing innovative technology was measured.

Also, participants were asked to detail any other influences on the implementation of innovative technology.

Technology Adoption

Along with expectancy and facilitating conditions, technology adoption is another construct measured by variables to determine the technology adoption category of participants. The survey asked participants 20 questions to which they responded that they either “Strongly Disagree,” “Disagree,” “Neutral,” “Agree,” or “Strongly Agree” (Hurt et al., 1977). Each question was awarded one point. An equation was used to group the answers into one of two groups; the difference between the two groups was calculated to which 42 points were added for a final score. The final score indicated the participants’ technology adoption category as either an innovator, early adopter, early majority, late majority, or laggard.

Demographics

As with performance expectancy, facilitating conditions, and technology adoption, demographics were measure with a series of variables. The participants' gender, race, years of experience, position, grade level serviced, and regional location were examined. Demographics were necessary for a nuanced examination of other measured variables.

Data Collection Methods and Analysis

Involvement in district and site initiatives allowed access for a macro and micro view of the technology adoption process. The establishment of professional networks with district leaders facilitated access to participants. The specific inclusion criteria for participation in this study were district employees that wished to obtain innovative technology certification with exposure to district-mandated education technology initiatives due to the COVID-19 pandemic. The participants in the district shared commonalities that made them attractive for a research study.

As district employees in the same district, they shared direction from the district's leaders and its goals and purpose.

The data provided a holistic view from the perspective of district leadership and school personnel of the possible influential factors and their preparedness in the implementation of the innovative technology. Both provided their insight into their perception of the impact of factors that influence the implementation of innovative technology. The survey contained questions to determine the technology adoption practices of participants, influential implementation factors, and demographic data that provided insight into best practices when implementing innovative technology during a crisis.

The Survey

Piloting the survey. An instrument was required to capture demographic data, factors that influence innovative technology implementation, and diffusion of innovation categorization data; therefore, a pilot of the survey instrument was administered electronically to a small group for feedback. The small group consisted of a blend of district leaders and school personnel that reflected the make-up of the target population. Pilot survey participants from district leaders and school personnel populations were administered their respective versions of the survey due to variations in the wording of some questions to ensure the consistent meaning of the terminology and to determine the correct wording of questions to enhance reliability (Fowler, 2014). The feedback was analyzed and appropriately incorporated to produce a work-in-progress (WIP) survey instrument. The WIP survey instrument was administered again to the small group and additional participants for comparison purposes. The feedback from the WIP survey instrument was incorporated to produce a final survey instrument that was administered, with no difference in questions, to all participants. The pilot survey established the content validity of scores of the instrument and improved the instrument's design (Creswell, 2014).

Survey and instruments. A 27-item survey instrument was electronically administered to capture numeric and textual descriptions of attitudes and opinions of the sample population to make inferences on a population (Creswell, 2014). Additionally, the survey was digital for ease of turnaround and economies of distribution. Data from the survey of district leaders and school personnel were used to answer the research questions. There was no difference in survey questions for participants. The survey used five-point and four-point Likert scales, multiple-choice selections, and open-ended questions to capture data.

The UTAUT, DoI, and FRLM theories that form the conceptual framework of this study use different instruments to measure their concepts. Along with demographic data, this study used an instrument combining modified versions of a UTAUT survey, Individual Innovativeness surveys, and crafted questions to capture innovative technology perceptions and took approximately 20 minutes to complete (Gunawardena, 2014; Hurt et al., 1977; Venkatesh et al., 2003; Venkatesh & Davis, 2000).

SurveyGizmo (an online platform used to create and act as a data repository for surveys) was used to distribute the instrument electronically and output data in MS Excel format. IBM SPSS Statistics 26 (an online platform used for statistical analysis) was used to import and analyze the data. Statistical analysis used in this quantitative study examined participants' beliefs in proficiency, usage, and the influence of implementation factors.

UTAUT and Individual Innovativeness. The UTAUT portion of the survey assessed the factors that influence technology use and acceptance, while the Individual Innovativeness survey measured the diffusion of innovations (Hurt et al., 1977; Rahman et al., 2017). UTAUT surveys are used to measure user acceptance and usage behavior of technology (Venkatesh et al., 2003). Gunawardena (2014) conducted a study comparing the existing nine technology acceptance theories and models and found that the UTAUT accounts for the highest explained variance (0.69) of behavioral intention.

In addition to the modified UTAUT instrument, the instrument used to gather participants' perceptions of the diffusion of innovations in their environment was a modification of the Individual Innovativeness (II) survey (Hurt et al., 1977). The II survey determines the adoption categories of participants. The II portion of the instrument associated with the DoI theory assesses the innovative technology adoption inclinations of participants in their educational environment as impacted by leaders. Twenty questions determined the participant's technology adoption category (i.e., innovator, early adopter, early majority, late majority, or laggard) on the diffusion of innovation scale. Fowler (2014) notes that quality questions augment the link between the data gathered and what the researcher is trying to measure. As such, the survey's questions that directly link to adoption categories increase the validity of the instrument.

Survey Participants

District leaders and school personnel were administered the survey instrument electronically via SurveyGizmo. The participants in this survey were a representative subset of the district. Each participant group provided insight into their beliefs on the influences on their ability to implement innovative technology. The survey questions remained the same for all groups.

Analysis

The analysis began with running descriptive statistics to determine consent to participate in the survey and the number of responses for each question. Individuals who did not consent to participation in the survey were removed from further analysis. Next, the frequency of demographic characteristics of the remaining participants was analyzed, noting the number of participants per category and associated percentages.

Following the analysis of participants, descriptive statistics to determine frequencies (number of responses, associated percentages, mean, and standard deviation) were run to answer RQ1 using participants' confidence in their ability to apply what they learned and the ability to meet the certification program's objects as variables. Additionally, a random sample of 5% was selected as representative of the group. The random sample was used to gain insight into the cause of a moderate to a large increase in participants' confidence in meeting the objectives of the certification program. Themes were identified, and responses were coded according to themes. The number and associated percentages of responses in each theme were examined, and example quotes selected embodied the sentiment for each theme.

As with RQ1, descriptive statistics to determine frequencies (number of responses, associated percentages, mean, and standard deviation) were run to answer RQ2 using participants' belief in their current proficiency and change in the use of innovative technology throughout the certification program.

Hierarchical multiple regression was run to answer RQ3. The dependent variable was the mean score of five survey questions that measured participants' beliefs in proficiency in using innovative technology. Independent variables were entered into four blocks. Each model was evaluated based on the proportion of variance explained (R^2) and the increase in the proportion of explained (ΔR^2) with each additional block (relative to the prior model). An F-test was used to evaluate the statistical significance of ΔR^2.

Once explained variance and statistical significance of each model were determined, I selected a final model and examined the coefficients for the independent variables included in that model. I examined both the magnitude of each slope coefficients and its statistical significance (using t-tests), controlling for (or holding constant) the other independent variables in the model.

Ethical Issues

The ethical issues I considered in conducting this study included participants' confidentiality, obtaining informed consent, and data source authenticity (Merriam & Tisdell, 2016). Actions were taken to safeguard the anonymity of responses and the use of credible data. The use of pseudonyms will protect the names of the district and subdistricts. Additionally, expectations were managed regarding the outcome of the study by informing participants that although the goal of the study is to provide best practices for adopting innovative technology, it is still up to the district leaders to take advantage of the findings. The district will receive an Executive Summary.

Another ethical issue was the background and beliefs in technology adoption of the principal investigator, which created a personal bias. The principal investigator has a background in leading technology initiatives that have generated a belief on how to adopt innovative technologies effectively and efficiently. Likewise, the interest in gaining different perspectives on how to adopt innovative technologies best was the driving force of this research. Additionally, the principal investigator is a parent with a child impacted by the implementation of innovative technology to deliver instruction. Using a protocol to capture various beliefs toward implementing innovative technology will act as a control for bias. The data collection method mitigated bias (Maxwell, 2013). Additionally, piloting the protocol with a small representative group checked any bias in wording.

Reliability and Validity

This study took measures to address the issues of reliability and validity. First, an audit trail of methods, procedures, and decisions established reliability. Second, Cronbach's alpha was computed in SPSS Statistics using the reliability analysis. Cronbach's alpha is a measure of internal consistency. Given that the survey included multiple Likert questions that form a scale, Cronbach's alpha was employed as it is the most common measure of reliability.

SPSS Statistics was used to calculate Cronbach's alpha to measure internal consistency (i.e., reliability). Cronbach's alpha was used on each grouping of questions that utilized the same Likert scale (e.g., "Strongly Disagree" to Strongly Agree," "Ineffective" to "Highly effective," "No Increase" to "Large Increase," "Poor" to "Average," "Never" to "Frequently, If Not Always," and "Not At All Influential" to "Extremely Influential"). Precisely, Cronbach's alpha was calculated and indicated a high level of internal consistency for each subscale of facilitating conditions ($\alpha = .889$), increase in confidence of meeting program objectives ($\alpha = .955$), increase in resource and tool usage before and after the certification program ($\alpha = .854$), and diffusion of innovations ($\alpha =.881$). Cronbach's alpha was run on a sample size of 10,620.

Validity is a measure of the degree of authenticity of a research instrument (Fowler, 2014). If the instrument measures what is to be measured, then it is considered valid. Although a specific test for validity was not run on the survey, the survey derived its constructs from the UTAUT, DoI, and FRLM theories that have been tested and noted as valid. A pretest of the survey added to validity by incorporating the feedback of the questions into the final survey. The survey pretest served to examine the wording and clarity of questions and determine differences in instructions and questions between district leaders and school personnel. Due to feedback from the pretest, all respondents received the same questions. Privacy concerns of respondents were addressed to guarantee privacy, which might have encouraged increased honesty in responses.

Chapter Four

The Study

This quantitative study examined the impact of factors on implementing innovative technology in K-12 public schools during a time of crisis. The impact of the COVID-19 pandemic on the education sector could not be understated. In the spring of 2020, localities instituted stay-at-home measures. As a response, districts across the country implemented distance learning. Many districts crafted professional development certification programs aimed at enhancing the skills of teachers and staff to implement innovative technology for continuity of learning during the pandemic and beyond. Participants in a large, urban district's spring 2020 certification program that had the goal of preparing participants to deliver engaging, student-focused online instruction were surveyed for this study. Data gathered from the survey was analyzed using IBM SPSS Statistics 26. The analysis of the data provided insight into the factors that impact the implementation of innovative technology during a crisis.

Research Questions and Hypotheses

This study's purpose was to examine the relationship, if any, between factors and the implementation of innovative technology in K-12 public schools. As a solution, this study sought to answer the following research questions:

1. To what extent did the program increase participants' confidence in their ability to deliver engaging, student-focused online instruction?
2. To what extent, if any, did program participants change in their use of technology necessary for delivering engaging, student-focused online instruction after program completion?

3. What factors are related to program participants' ability to deliver engaging, student-focused online instruction?

The following null and alternative hypothesis examine the relationship between the participants and the factors that are related to their implementation of innovative technology in the form of engaging, student-focused online instruction:

H1o: Implementation factors are not predictive of program participants' belief in their ability to deliver engaging, student-focused online instruction.

H1a: Implementation factors are predictive of program participants' belief in their ability to deliver engaging, student-focused online instruction.

H2o: Participants’ technology adoption proclivities are not predictive of program participants' belief in their ability to deliver engaging, student-focused online instruction.

H2a: Participants’ technology adoption proclivities are predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

H3o: Participants’ gender, race, years of experience, position, and serviced grade level are not predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

H3a: Participants’ gender, race, years of experience, position, and serviced grade level are predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

H4o: Participants’ location of service is not predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

H4a: Participants’ location of service is predictive of the program participants' belief in their ability to deliver engaging, student-focused online instruction.

Although the hypotheses are stated at a macro level, each implementation factor, technology adoption category, and demographic characteristic is examined with its own unique null and alternative hypothesis. In other words, each variable is examined controlling for the other variables, whether it does not or does impact the program participants' ability to deliver engaging, student-focused online instruction or contribute to the explained variable.

Description of Participants

The survey was administered to 13,000 participants in a certification program. Of the 13,000 participants, 11,036 participated in the survey and either fully completed the survey (*n* = 9,442) or partially completed the survey (*n* = 1594). Of the 11,3036, 86 participants either did not consent (*n* = 76) or did not choose a consent choice (*n* = 11) leaving a total of 10,949 responses. Of the remaining 10,949 responses, 329 responses provided insufficient data for analysis (i.e., the system indicated that participants logged into the survey but did not answer any questions or did not answer a sufficient amount of questions), leaving a sample size of 10,620 responses (*N* = 10620).

Demographics

Outlined in Table 4.1 are the descriptive statistics for the gender, race, years of experience, position in the district, grade level of support, and the region of employment. While participants' response to gender was consistent with the education sector employees at large, the other responses differed (U.S. Department of Education. Institute of Education Sciences, National Center for Education Statistics, 2019). The statistics reveal that there are more females (65.2%; *n* = 6,929) than male (21.1%; *n* = 2,246) respondents. Hispanics or Latinos (36.5%; *n* = 3,850), the largest racial group, along with White (non-Hispanic) respondents (24.1%, 2,561), comprised most of the respondents. Most respondents had over 21 years of experience (29%; *n* =

3,079) and were classroom teachers (61.9%; *n* = 6,570). While most respondents did not report to fall within a grade level grouping (29.8%; *n* = 3,164), the majority of those that did fell within the high school band of 9th to 12th grades (23.3%; *n* =2,479). Apart from the central office, respondents were nearly evenly distributed amongst the six regions.

Table 4.1

Demographic Characteristics of Participants

Baseline characteristic	Frequency	
	n	%
Gender		
Female	6929	65.2
Gender Variant/Non-Conforming	20	.2
Male	2246	21.1
Prefer not to answer	1433	13.5
Race		
Asian/Pacific Islander	1061	10
Black or African American (non-Hispanic)	865	8.1
Hispanic or Latino	3850	36.3
Native American or American Indian	38	.4
White (non-Hispanic)	2561	24.1
Other - Write In (Required)	364	3.4
Prefer not to answer	1881	17.7
Experience		
0-5 years	1821	17.1
6-10 years	910	8.6
11-15 years	1482	14.0
16-20 years	1996	18.0
21+ years	3079	29.0
Prefer not to answer	1332	12.5

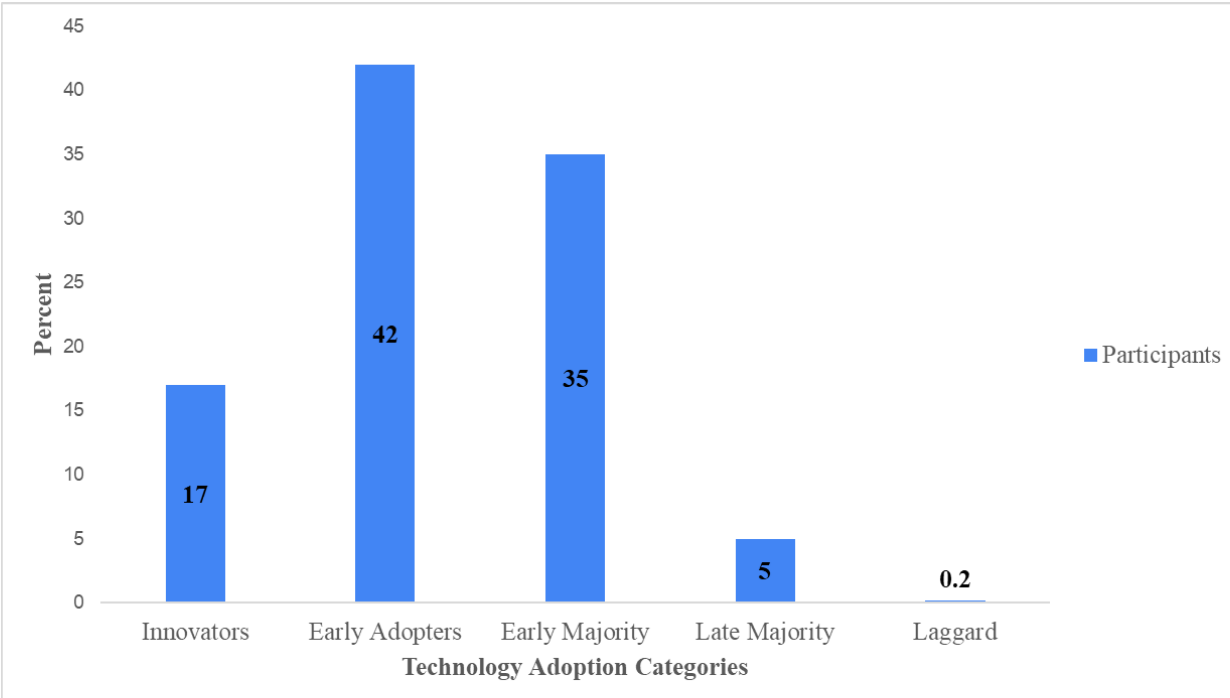
Position		
Central office staff	201	1.9
Classroom teacher	6570	61.9
Region staff	212	2.0
School-based administrator	689	6.5
School-based non-classroom personnel	1299	12.1
Other - Write In (Required)	430	4.0
Prefer not to answer	1219	11.5
Grade Level		
Early elementary (TK-2nd grade)	1230	11.6
Late elementary (3rd-5th grade)	1911	18.0
Middle (6th-8th grade)	1836	17.3
High (9th-12th grade)	2479	23.3
Other	3164	29.8
Region		
Region A	195	1.8
Region B	1567	14.8
Region C	1561	14.7
Region D	1413	13.3
Region E	1549	14.6
Region F	1411	13.3
Region G	1601	15.1
Other Region	1323	12.5

Note. N = 10,620.

Technology Adoption Categories

The self-reported technology adoption categories of participants are illustrated in Figure 4.1. Early adopters (42%) consisted of the most sizable number of participants. The early majority (35%) followed by innovators (17%) consisted of the respective next populous number of participants. The late majority (5%) and laggards (0.2%) respectively comprised the smallest number of participants.

Figure 4.1 Participants' Technology Adoption Categories



Note. n = 9,516.

Research Question 1: Confidence Implementing Innovative Technology

In this section, presented are the quantitative findings examining participants' confidence in their ability to implement or support the use of innovative technology in their respective roles because of the certification program. Participants' confidence was examined using two aspects. First, participants reported on their confidence in their ability to apply what they learned in the certification program. Participants' confidence was self-reported using a 5-point Likert scale from "Strongly Disagree" to "Strongly Agree." Participants' confidence in their ability to apply certification program learning reflected their perceived ability to implement innovative technology. Second, participants reported whether their confidence has increased or stayed the same compared to the start of the certification program. Participants' confidence was self-reported using a 5-point Likert scale from "No Increase" to "Large Increase."

Confidence in Applying Learning

Given that the purpose of the certification program was to prepare participants to implement innovative technology, the confidence variable was measured. On average, participants were confident in their ability to apply certification learning to their job, as indicated in Table 4.2. Further, 85% of respondents "Agree" to "Strongly Agree" that they were confident in their ability to apply learnings about implementing innovative technology in their job roles. Conversely, approximately 5.1% of respondents "Disagree" to "Strongly Disagree," indicating that they were not confident in their ability to apply learnings. The remainder of participants' responses for confidence in applying learning from "Disagree" to "Strongly Disagree" fell within a span between the largest and smallest percentages.

Table 4.2

Descriptive Statistics for Confidence

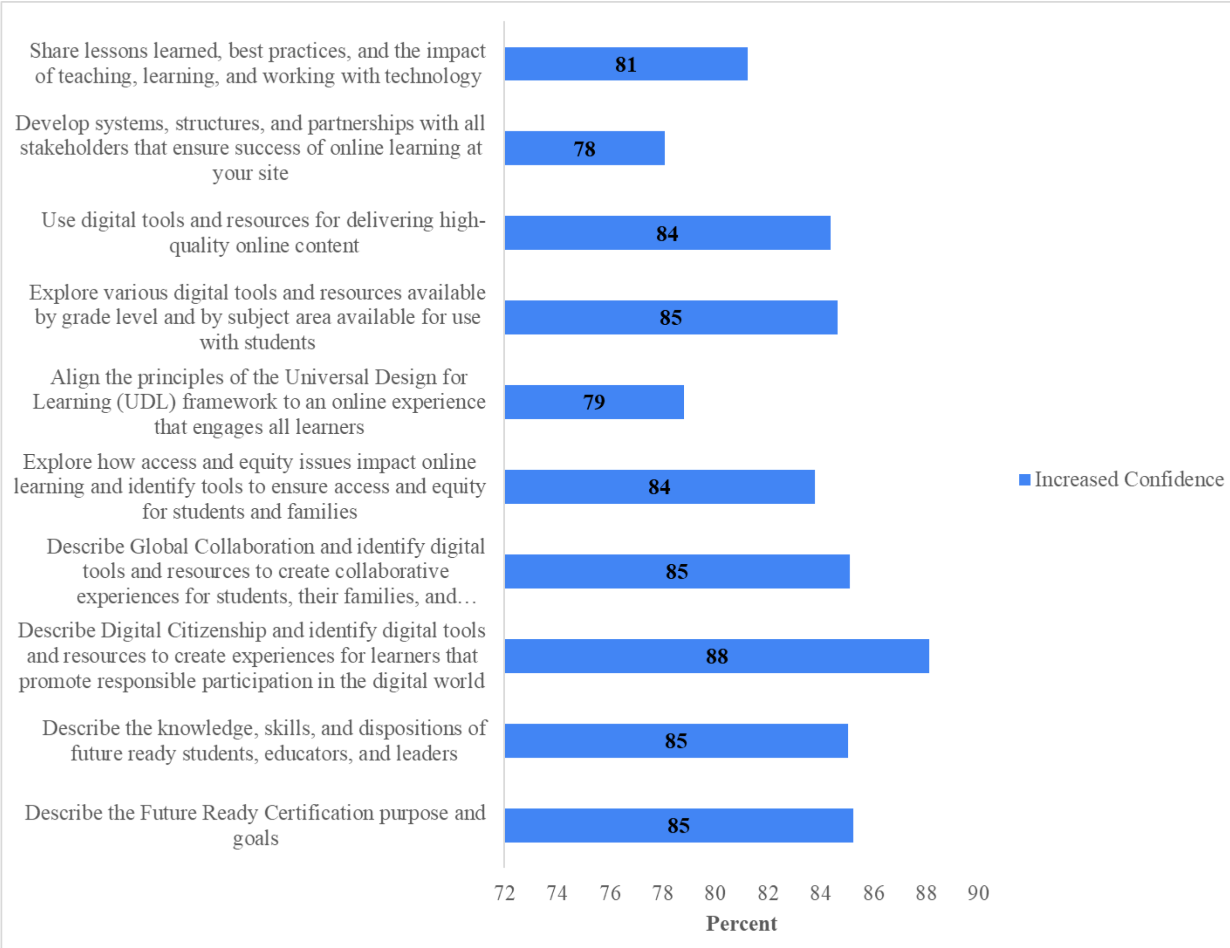
Measure	Frequency			
	n	%	M	SD
Confidence (I'm confident in my ability to apply what I learned in my job role.)			4.03	.860
1 - Strongly Disagree	363	3.4		
2 - Disagree	1777	1.7		
3 - Neutral	1054	9.9		
4 - Agree	6189	58.3		
5 - Strongly Agree	2837	26.7		

Note. N = 10,620.

Increase in Confidence

Figure 4.2 outlines the statistics for self-reported beliefs in a change in their performance expectations related to meeting the certifications programs objectives ranging from “No Increase” to “Large Increase” on a 4-point Likert scale for each question. The largest reported increase of “Moderate Increase” and Large Increase” (88%) indicated the participants’ increase in confidence in their ability to describe digital citizenship and identify digital tools and resources to create experiences for learners that promote responsible participation in the digital world. Alternatively, the lowest reported increase of “Moderate Increase” and Large Increase” indicated an increase in respondents’ belief (78%) in their ability to develop systems, structures, and partnerships with all stakeholders that ensure the success of online learning at their work location. The remainder of participants’ responses for meeting the certifications programs objectives of “Moderate Increase” and “Large Increase” fell within a span between the largest and smallest percentages.

Figure 4.2 Moderate to Large Increase in Confidence in Meeting Program Objectives



Note. Sample sizes vary by item (n = 10,063-10,080).

Increase in Confidence Rationale

To gain an understanding of the moderate to large increase gains in meeting the objective, respondents shared what they thought caused the increase in knowledge compared to the start of the certification program. Respondents' thoughts are summarized in Table 4.3. The most common response for an increase in knowledge was exposure to new knowledge of tools and resources (35.6%; n = 185). Respondents were concerned about their ability to engage students productively in an online environment. They indicated that new knowledge of tools and resources alleviated those fears. The second most common response was program delivery

(18.3%; n = 95), with respondents noting the facilitator guided synchronous learning coupled with asynchronous learning that allowed them to research and complete tasks at their own pace increased their confidence. Knowledge with the ability to apply the knowledge through practice (13.1%; n = 68) was the third common response. The next common response identified by respondents was the ability to collaborate with their peers (5.2%; n = 27). Participants indicated that the ability to share what they have learned and work together to build understanding supported their increase in meeting the objectives of the program. The least common response was respondents that indicated previous exposure to the concept of implementing innovative technology, but the certification program enhanced their knowledge by either increasing their knowledge base or modeling usage of tools and resources (3.3%; n = 17).

Table 4.3 Increase Rationale

Q13: If you said "moderate increase" or "large increase" to any of the questions above, please tell us what you think caused your increase in knowledge in that area compared to May 1, 2020.

Theme	n	%	Example quote
New knowledge of tools and resources	185	35.6	I was just unsure and skeptical of what to expect when I first started back in early May. I became more open-minded and actually spent the time exploring the different resources and tools presented.
No response	127	24.5	N/A
Program delivery	95	18.3	I feel like the process of doing the modules both synchronously and asynchronously gave me time to really grow in all of the areas.
Knowledge and practice	68	13.1	My increase in knowledge was due to the chance to tinker with the various tools. After determining my plan of action, I was able to try out several tools before the end of the school year. I will be prepping over the summer to start the year off organized and encouraging blended teaching/learning for itinerant teacher group.
Collaborative learning	27	5.2	Being able to have discussions with educators where we share our resources as well as our struggles with distance learning.
Enhanced knowledge of	17	3.3	I think their are two things that lead to the increase. One was seeing some of the tools I already use, used more

tools and resources	effectively. Two was learning about new tools and resources.

Note. *n* = 519. Missing response data (*n* = 127) is included in the 5% random selection.

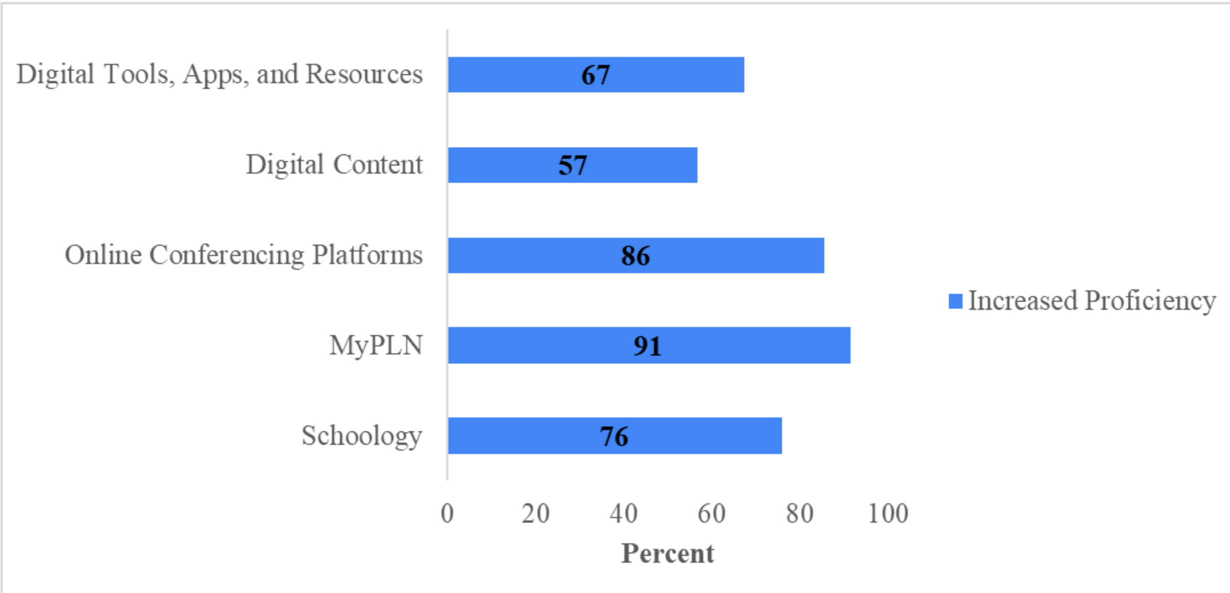
Research Question 2: Innovative Technology Implementation

In this section, participants' proficiency is explored concerning their proficiency in the use of innovative technology and changes in their usage of innovative technology from prior to the certification program to during the certification program.

Resource and Tool Proficiency

First, participants reported on their proficiency in their use of innovative technology due to the certification program. Participants compared their current proficiency in resources and tools to the start of the certification program ranging from "Poor" to "Excellent" on a 4-point Likert scale for each question. The largest increases in the proficiency of "Good" to "Excellent" in Figure 4.3 were that of the use of the MyPLN (91%), online conferencing platforms (86%), and Schoology (76%), which represented communication or reporting tools. The smallest increases in proficiency were that of the use of digital tools, apps, and resources (68%) and digital content (57%), which represented instructional content and tools.

Figure 4.3 Comparison of Resource and Tool Proficiency to the Start of the Certification Program

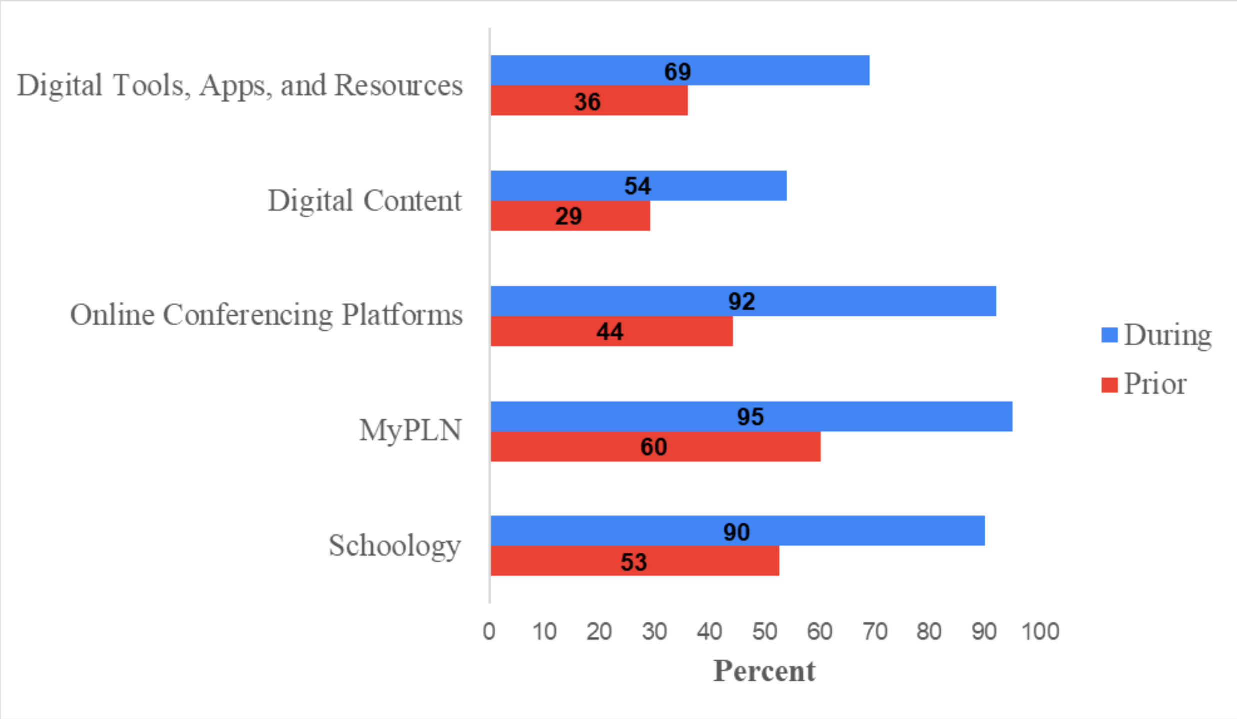


Note. Sample sizes vary by item (*n* = 10,063-10,067).

Resource and Tool Usage

Second, participants reported on changes in their usage of innovative technology due to the certification program. Participants compared their current usage of resources and tools to the start of the certification program ranging from "Never" to "Frequently, If Not Always" on a 4-point Likert scale for each question. On average, participants indicated an increase in the usage of innovative technology. The most considerable change on average of usage in Figure 4.4 was that of online conference platforms from "Fairly Often" and "Frequently, If Not Always" of 44% prior to the certification program to 92% during the certification program. The least amount of change was the use of digital content of 29% prior to 51% during which is consistent with participants' belief in their current proficiency in the use of digital content in Figure 4.4. In general, the increase in participants' belief in their current proficiency mirrored their increase in usage. Consequently, Figure 4.4 indicates that as the certification program progressed, so did the usage of innovative technology.

Figure 4.4 Usage of Resources and Tools Prior to and During Certification Program



Note. Sample sizes vary by item *(n* = 10,056 - 10,067*)*.

Research Question 3: Factors that Influence Innovative Technology Implementation

In this section, the participants' belief in their proficiency in using innovative technology is explored. A hierarchical multiple regression analysis was run with the dependent variable represented by the mean score of participants' beliefs in their current proficiency in the use of resources and tools. The independent variables in the hierarchical multiple regression analysis consisted of the implementation factors and technology adoption as well as the demographic attributes of gender, race, experience, position, supported grade level, and regional location.

Assumptions underlying the linear multiple regression analysis were examined (Field, 2013). Specifically, I inspected the scatter diagrams of residuals versus predicted residuals, as well as normal probability plots. Linearity was assessed by partial regression plots and a plot of studentized residuals against the predicted values. The Durbin-Watson statistic assessed the independence of residuals. Homoscedasticity was assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. Multicollinearity was assessed by examination of tolerance values. I inspected the dataset for outliers and influential cases by examining of studentized deleted residuals, leverage values, and Cook's distance values. Normality was assessed using a Q-Q Plot. From these various checks, I identified no violations of assumptions. The equations for the four regression models can be found in Appendix A. Regression coefficients, and standard errors for all four regression models can be found in Appendix B.

Four regressions models were run to predict participants' perception of proficiency from implementation factors, technology adoption categories, and five covariates (i.e., gender, race, experience, position, serviced grade level, and region). In the regression models, dichotomous "dummy" variables (i.e., yes or no) were created for categorical severities of implementation factors, nominal categories of gender, race, position, and grade level, and ordinal categories of experience and technology adoption. Control variables of implementation factors were entered in Model 1, followed by technology adoption categories in Model 2. Gender, race, years of experience, employment position, and serviced grade level were entered in Model 3, and finally, the region of employment in Model 4. Table 4.4 is a regression model partial summary of the four models.

Table 4.4 Regression Model Partial Summary

Model	R	R^2	ΔR^2	$F\Delta$	df1	df2	p
1	.287	.083	.083	106.947	8	9507	$.000^{*}$
2	.360	.130	.047	128.383	4	9503	$.000^{*}$
3	.397	.157	.028	15.644	20	9483	$.000^{*}$
4	.399	.159	.002	2.926	7	9476	$.005^{**}$

Note: $^{*}p < .001$. $^{**}p < .05$.

The entry of the implementation factors in Model 1 significantly predicted participants' belief in their current proficiency in the use of resources and tools ($R^2 = .083$). The entry of participants' technology adoption category designation in Model 2 significantly increased explained variance ($\Delta R^2 = .047$), as did the entries of gender, race, years of experience, employment position, and serviced grade level in Model 3 ($\Delta R^2 = .028$). In contrast, the regions in Model 4 did not contribute to a noteworthy understanding of a change in variance ($\Delta R^2 = .002$), with a final $R^2 = .159$. Given the lack of noteworthy additional added understanding of variance in Model 4, the results will focus on the last model to add noteworthy significance, Model 3.

The null hypothesis for each multiple regression model was evaluated. In Model 1, the null hypothesis that implementation factors are not predictive of participants' belief in increased proficiency in the use of innovative technology was rejected. The eight implementation factors explain 8.3% ($R^2 = .083$) of the variance in the participants' belief in proficiency and was statistically significant ($F(8, 9507) = 106{,}957$, $p <.0005$). Likewise, in Model 2, the null hypothesis that the addition of participants technology adoption proclivities is not predictive of increased proficiency beliefs was rejected. The addition of four adoption categories resulted in an increase in R^2 of .047, from $R^2 = .083$ for model 1 to $R^2 = .130$ for model 2. This increase is statistically significant ($F(4, 9503) = 128.3$, $p < .0005$). Similarly, the addition of 20 respondent demographic variables resulted in an increase in R^2 of .028, from R^2 = .130 for Model 2 to R^2 =.157 for Model 3. This increase is statistically significant (F(20, 9483) = 15.644, p < .0005). Therefore, the null hypothesis that the addition of participants' gender, race, years of experience, position, and serviced grade level are not predictive of increased proficiency beliefs was rejected. The addition of seven region variables resulted in an increase in R^2 of .002, from R^2 = .157 for Model 3 to R^2 = .159 for Model 4. This increase is statistically significant (F(7, 9476) = 2.926, p = .005), but represents such a small increase that we might view the increase as having little practical importance. However, the null hypothesis that participants' location of service does not additionally contribute to the explained variance in the program participants' ability to deliver engaging, student-focused online instruction is rejected in Model 4. Consequently, when evaluating the null hypotheses for each model, all four were rejected.

Table 4.5 Model 3 Multiple Regression Analysis for Predicting Proficiency

			95% C.I.		t-test	
	B	*SE*	lower	upper	*t*	*p*
Intercept	2.967	0.029	2.910	3.025		
Factors Supporting Implementation						
Tech Support VI	0.046	0.015	0.016	0.076	3.028	0.002
Professional Development VI	0.140	0.019	0.102	0.177	7.288	0.000
Time to Implement VI	0.057	0.020	0.018	0.096	2.854	0.004
Cost to Implement VI	0.093	0.016	0.062	0.123	5.953	0.000
Ease of Use VI	0.082	0.021	0.041	0.123	3.955	0.000
School's Technology Infrastructure VI	-0.018	0.020	-0.058	0.022	-0.890	0.373
Leadership Support VI	0.048	0.020	0.008	0.088	2.352	0.019
Technology Implementation Coordination VI	0.090	0.021	0.048	0.132	4.212	0.000
Adoption Categories (Reference Group = Innovators)						
Laggard	-0.959	0.139	-1.231	-0.687	-6.902	0.000
Late Majority	-0.635	0.033	-0.699	-0.570	-19.300	0.000
Early Majority	-0.363	0.019	-0.400	-0.326	-19.218	0.000
Early Adopters	-0.248	0.018	-0.284	-0.213	-13.695	0.000
Gender (Reference = Female)						
Gender Variant/Non-Conforming	0.097	0.138	-0.174	0.369	0.703	0.482
Male	0.080	0.016	0.048	0.110	5.066	0.000
Prefer not to answer	-0.128	0.056	-0.216	-0.015	-2.263	0.024
Race/Ethnicity (Reference = Hispanic or Latino)						
Asian/Pacific Islander	0.002	0.022	-0.040	0.044	0.082	0.935
Black or African American (non-Hispanic)	-0.039	0.023	-0.085	0.007	-1.647	0.100
Native American or American Indian	-0.092	0.101	-0.289	0.106	-0.910	0.363
Other Race	-0.048	0.034	-0.114	0.019	-1.401	0.161
Prefer not to answer	-0.080	0.030	-0.138	-0.023	-2.724	0.006
White (non-Hispanic)	-0.059	0.016	-0.090	-0.027	-3.642	0.000
Years of Experience (Reference Group = More than 20 Years)						
0-5 years	0.117	0.019	0.080	0.154	6.272	0.000
6-10 years	0.080	0.024	0.033	0.126	3.380	0.001
11-15 years	0.058	0.020	0.019	0.097	2.912	0.004
16-20 years	0.030	0.018	-0.005	0.065	1.693	0.090
Prefer not to answer	0.056	0.065	-0.073	0.184	0.851	0.395
Position (Reference = School Personnel)						

District Leadership	0.011	0.032	-0.053	0.074	0.327	0.743
Prefer not to answer	0.192	0.084	0.028	0.357	2.290	0.022
Grade Level (Reference = High School)						
EarlyElem (TK-2)	-0.166	0.022	-0.210	-0.122	-7.443	0.000
LateElem (3-5)	-0.125	0.019	-0.163	-0.088	-6.534	0.000
Middle (6-8)	0.012	0.019	-0.026	0.049	0.614	0.539
Other Grade Level	-0.177	0.019	-0.215	-0.139	-9.127	0.000

Note: N = 10,620. $p < .05$.

The results from Model 3 show that the addition of participants' technology adoption category designation, and demographics (excluding district location) to implementation factors, influenced participants' belief in their current proficiency in the use of resources and tools with a statistically significant increase in R^2 of .028, $F(20, 9{,}483) = 15{,}644$, $p <.001$. Of the implementation factors, professional development ($B = .140$, $p < .001$), cost to implement by ($B = .093$, $p < .001$), and technology implementation coordination ($B = .090$, $p < .001$) on average, had the greatest influence on a change in participants' proficiency beliefs, controlling for adoption categories and demographics. The school's infrastructure by ($B = -.018$, $p = .373$), and tech support ($B = .046$, $p = .002$) had the least influence on change in participants' proficiency beliefs on average, controlling for adoption categories and demographics. Of all the implementation factors, only school technology infrastructure was not statistically significant (p = .373).

Compared to innovators, participants designated as early adopters, early majority, late majority, and laggards were viewed themselves as progressively less proficient. Specifically, laggards were perceived themselves as less proficient with implementing innovative technology ($B = -.959$, $p < .001$) on average compared to innovators, controlling for implementation factors and demographics. The remaining technology adoption categories of late majority ($B = -.635$, p

< .001), early majority (*B* = -.363, *p* < .001), and early adopters (*B* = -.248, *p* < .001) are lower in descending order on average when compared to innovators.

Compared to female participants, except for those who did not identify gender, non-female participants held greater beliefs in their proficiency, while controlling for adoption categories, implementation factors, and non-gender demographics. Specifically, of the participants that provided a gender identity, males who were not statistically different from females (*B* = .080, *p* < .001) and gender variant/non-conforming participants who were statistically different from females (*B* =.097, *p* = .482) held higher proficiency beliefs on average than female participants. Of the identified racial identities, Asian/Pacific Islanders were the only group with higher belief on average in their proficiency by (*B* = .002, *p* = .935) than the reference group (i.e., Hispanic or Latino). They were not statistically different from the reference group while controlling for adoption categories, implementation factors, and non-racial identity demographics. Other racial identities, Black or African American (non-Hispanic) ((*B* = -.039, p = .100*),* Native American or American Indian (*B* = -.092, *p* = .363), other race (*B* = -.048, *p* = .161), held lower beliefs in their proficiency held higher beliefs on average in proficiency but were not statistically significantly different from Hispanics or Latinos. However, those who preferred not to answer (*B* = -.080, *p* =.006), and those who identified as White (*B* -.059, *p* < .001), held lower beliefs on average in their proficiency and were statistically significantly different from Hispanics or Latinos. All participants with 20 years of experience or less held higher beliefs on average in their proficiency those with 21 or more years by an average of .071, while controlling for adoption categories, implementation factors, and other demographics. Compared to participants with more than 20 years of experience, those with 0 – 5 years of experience held higher proficiency beliefs on average (*B* = .117, *p* < .001) and were statistically different from the reference group. Of those who preferred to answer, district leadership held slightly higher proficiency beliefs on average ($B = .011$, $p = .743$) in their proficiency than classroom personnel. Additionally, they were not statistically different from the reference group while controlling for adoption categories, implementation factors, and other demographics. Only those who serviced middle school held higher proficiency beliefs on average and were not statistically different from those who serviced high school ($B = .012$, $p = .539$). Those who serviced early elementary ($B = -.166$, $p < .001$), late elementary ($B =- .125$, $p < .001$), and other grade levels ($B = -.177$, $p < .001$) were statistically different and held lower beliefs in proficiency on average when compared to those who serviced high school.

Summary

This chapter detailed the major findings from quantitative data analysis and connected the analysis back to the research questions. Responses were gathered via digital survey from 10,620 participants in a certification program meant to prepare school personnel and district leadership to implement innovative technology during a time of crisis.

Participants' confidence in their ability to apply what they learned from the certification program was analyzed. Most respondents (85%) indicated that they were confident in their ability to apply what they learned during the certification program in their job roles. Next, participants' increase, if any, in their confidence that they can meet the program objectives were analyzed. The largest reported increase in participants' confidence was related to their ability to describe digital citizenship and identify digital tools and resources to create collaborative experiences for students, their families, and colleagues (88%). Five themes were identified to gain insight into the "Moderate Increase" to the "Large Increase" in participants' perceived ability to meet program objectives toward implementing innovative technology: (1) new knowledge of tools and resources; (2) program delivery; (3) knowledge and practice; (4) collaborative learning; and, (5) enhanced knowledge of tools and resources. Responses from a random sample of participants (n = 519) revealed that exposure to new knowledge of tools and resources (35.6%; 185) was the highest reported source of their moderate to a large increase in meeting program objectives.

Participants' perceptions in an increase, if any, in their proficiency and usage of resources and tools from before the start of the certification program to the completion of the program were analyzed. The use of MyPLN (91%), a professional learning management system, was reported to have the largest increase in the proficiency of its use with the use of online conferencing platforms (86%) as a close second. Of note, the use of digital content (used for instruction) had the lowest reported proficiency increase of 57%.

Hierarchical multiple regression analysis predicted participants' belief in their current increase in proficiency with resources and tools from implementation factors, technology adoption categories, and demographics while controlling appropriately for each group of independent variables in a series of models. The results indicated that the current increase in proficiency could be predicted ($R^2 = .159$) with greater degrees by sequentially adding independent variables (with the region not contributing to a remarkable degree ($\Delta R^2 = .002$)). Professional development ($B = .140$, $p < .001$), cost to implement by ($B = .093$, $p < .001$), and technology implementation coordination ($B = .090$, $p < .001$) on average had the greatest influence on a change in participants' proficiency beliefs. When compared to innovators, participants belonging to the other technology adoption categories of early adopters ($B = .248$, $p < .001$), early majority ($B = .363$, $p < .001$), late majority ($B = .635$, $p < .001$), and laggards ($B = .959$, $p < .001$) viewed themselves on average as progressively less proficient reflecting their general technology adoption proclivities. Both those that identify as males (B = .080, p < .001) and gender variant/non-conforming participants (B = .097, p = .482) held higher proficiency beliefs on average than female participants. Participants with 0 – 5 years of experience held the highest proficiency beliefs on average (B = .117, p < .001) when compared to those with more than 21 years of experience. Of the respondents, district leadership, excepting those who preferred not to answer, held slightly higher proficiency beliefs on average (B = .011, p = .743) in their proficiency than classroom personnel. Factors included in Model 3 (implementation factors, technology adoption proclivities, and demographics) elicited a statistically significant impact on the program participants' ability to deliver engaging, student-focused online instruction, $F(17,9258) = 17.831$, p < .0005). The evaluation of the null hypothesis, that implementation factors, technology adoption proclivities, and demographics do not predict participants' proficiency beliefs for each model resulted in its rejection.

The following chapter will discuss the implications and limitations of these results, as well as provide recommendations for the District and future research.

Chapter Five

Introduction

The purpose of this quantitative study was to examine factors that impact innovative technology during a time of crisis. Implementing innovative technology effectively and efficiently is a challenge that is complicated in a time of crisis. Literature regarding the implementation of innovative technology in a school setting suggests that leadership must provide a vision and facilitate the alignment of technology with educators' pedagogy (Avolio & Bass, 2002; Crawford et al., 2003; McLeod et al., 2015; Monahan, 2004; Richardson & Sterrett, 2018; Rogers, 2003; Sterrett & Richardson, 2017). While the literature from previous research provides a framework for acceptance and use of technology, diffusion of innovations, or leadership, the theoretical perspective of this study considers the intersection of all three theories.

Unlike most UTAUT, DoI, or FRLM research, which examined technology adoption post-implementation or leadership in technology adoption in times of normalcy, this study examined district leadership mandated technology adoption as it relates to influential factors in the implementation phase during a time of crisis. The COVID-19 pandemic was an unforeseen crisis that adversely impacted societies across the world. Many districts reluctantly rushed to embrace technology that could be used as a solution to the inability for students to return to class for the foreseeable future (Malkus & Christensen, 2020). There was no choice but to use innovative technology to deliver instruction. This study examines the leadership of a school district's response to the crisis of providing a certification program to prepare educators to implement innovative technology through the following research questions:

1. To what extent did the program increase participants' confidence in their ability to deliver engaging, student-focused online instruction?

2. To what extent, if any, did program participants change in their use of technology necessary for delivering engaging, student-focused online instruction after program completion?
3. What factors are related to program participants' ability to deliver engaging, student-focused online instruction?

The null and alternative hypothesis examined the relationship between the participants and the factors that are related to the implementation of innovative technology in the form of engaging, student-focused online instruction on a hierarchical multiple regression model level. In addition to examining the hypotheses at a model level containing groups of independent variables, each implementation factor, technology adoption category, and demographic characteristic was examined with its unique null and alternative hypothesis. Precisely, each variable was examined controlling for the other variables on whether it does not or does impact the program participants' ability to deliver engaging, student-focused online instruction or contribute to the explained variable.

This chapter includes a summary of key findings and an interpretation of major findings as related to the theories and literature on leadership and the diffusion, acceptance, and use of innovative technology. Also included is a discussion on implications and recommendations that may be valuable for use by district leadership who plan to implement innovative technology both during and outside of a crisis. The chapter concludes with a discussion of the limitations of the study, areas for future research, and a conclusion.

Summary of Key Findings

Evidence gathered in this study reveals that several factors are related to an increase in participants' confidence, use, and proficiency of innovative technology to deliver engaging, student-focused online instruction. Although there were limitations to the study, the data indicate that with leadership support and effective professional development, those who deliver or support the delivery of instruction using innovative technology can increase their confidence, usage, and proficiency in its use. Given that the professional development certification program that this study examined was conducted during the COVID-19 pandemic, there is the probability that under less stressful and time-constrained circumstances, more time could be allocated to increase program effectiveness. Therefore, it is imperative that factors that impact the implementation of innovative technology be examined as it may impact the allocation of resources and academic achievement to which leaders are held accountable.

Interpretation of Results

While leadership may mandate the adoption of innovative technology, they must also account for factors that influence confidence and proficiency to see an increase in usage. That effort was complicated during the COVID-19 pandemic and emphasized the difficulties of aligning teacher pedagogy with implementing innovative technology. Previous research has noted that if district employees do not have the support of leadership, technology usage will be negatively impacted (Research Scholar, Liberty University. & Brown, 2014; Richardson & Sterrett, 2018; Schrum et al., 2011). The findings of this study suggest confidence and proficiency in implementing innovative technology increases with usage during professional development if district leadership facilitates influential positive factors.

Confidence in Applying Learning

The findings from this study that confidence in using innovative technology aligns with the preponderance of evidence from the literature that professional development enhances confidence in the use of technology (Blanchard et al., 2016; Darling-Hammond et al., 2017;

Delgado et al., 2015; Hardy et al., 2010; Ming et al., 2010). Explicitly, the finding of this study that 85% of participants agreed that they could confidently apply what they learned during the certification program mirrors previous findings in the literature.

The district's certification program was a form of professional development to increase participants' ability to deliver engaging, student-focused online instruction. The findings of this study support those of Delgado et al. (2015) that found that 80% of teachers surveyed reported an increase in attitudes about teaching using technology from participation in a professional development program. Although there may be a difference between attitudes and confidence in using technology, this study highlights the importance of guided exposure of participants to the use of technology to increase confidence. Similarly, Blanchard et al. (2016) found that professional development programs significantly increased the comfort of teachers using technology, which led to all of the teachers in the study integrating the use of technology in instruction. While previous studies examined confidence as a monolithic concept, this study examined individual aspects of confidence in the form of confidence related to meeting certification program objectives.

The largest reported increase of "Moderate Increase" to "Large Increase" (88%) in the ability to meet program objectives reflected the participants' increase in confidence in their ability to describe digital citizenship and identify digital tools and resources to create experiences for learners that promote responsible participation in the digital world. This finding is in line with the rise of the use of the Internet in classrooms and the extension of the role of education to teach students how to be good citizens not only in the physical world but in the digital world as well (Hoffman et al., 2019; Mitchell, 2016; Ohler, 2011). It should be noted that the outcome of this ability is the responsible participation in the digital world, which would imply the necessity of positive collaborative experiences. Collaboration is vital as the diffusion of innovation research considers technology adoption as more of a social phenomenon than that of a technological phenomenon (Rogers, 2003). Therefore, the role of collaboration should not be underestimated as it contributes to socialization and the adoption of innovative technology. The prominence of digital citizenship may reflect a student-focus and a need for responsible participation in a collaborative environment for educational stakeholders.

While collaborative learning ranked fourth in the rationale for increased abilities to reach program objectives in Table 4.3, its importance is supported by the literature. Williams, Atkinsos, Cate, and O'Hair (2008) found in a study of learning community development and technology integration that to combat isolation, inflexibility, and resistance to change, that leadership capacity can be increased through collaboration via professional development. Similarly, Hamlin and Leslie (2019), in a study that examines increasing teacher effectiveness, recommend a collaborative environment where students can reflect on learnings and co-create knowledge with others. This study's data add to the literature by providing evidence that leadership should facilitate the creation of collaborative environments where participants can support each other may lead to an increase in confidence in applying learnings.

Although participants had an increase in their ability to describe digital citizenship and identify digital tools and resources to create experiences for learners that promote responsible participation in the digital world (88%), they did not report an equivalent gain in the delivery of developing systems, structures, and partnerships with all stakeholders that ensure the success of online learning at their work location (78%). In other words, participants could describe resources and tools but did not feel equally confident in their use.

Practice Promotes Proficiency and Usage

Although confidence in applying knowledge can be increased through professional development, an increase in confidence is not equivalent to an increase in proficiency. The findings of this study suggest that increased usage in innovative technology (both guided and unguided) leads to an increased perception of proficiency in its use. There is an adage that "practice makes perfect." The extant literature and the findings of this study support that maxim. Delgado et al. (2015) noted a strong positive association between teacher's proficiency with computers and the time for them to learn and practice. The findings of this study suggest that increased guided and unguided practice will increase the perception of proficiency.

The findings of this study support the work of Batane and Ngwako (2016). Their research into UTAUT of pre-service teachers found that although participants reported high competency levels in the use of technology resources, their use did not mirror their confidence. Their findings, along with those of this study, suggest that if innovative technology adoption is not aligned with pedagogy, there is a diminished likelihood of increased usage without intervention. Previous research discovered that although the participants believed that technology could improve student's learning, they did not feel compelled to use technology, nor did they in general (Batane & Ngwako, 2016). This study differs situationally in that during the COVID-19 pandemic, the use of technology to deliver instruction became ubiquitous due to a mandate from district leadership. In other words, there was not an alternative to using technology to instruct students, which changed the dynamics of technology use. The data supports that the use of communication and reporting tools had the highest reported increase in proficiency and usage due to the crisis as there was an increased need to utilize those tools in response to the crisis.

The most considerable increases in the proficiency of “Good” to “Excellent” in Figure 4.5 was that of the use of the MyPLN (91%), online conferencing platforms (86%), and Schoology (76%), which represented communication or reporting tools. Likewise, the largest change on average of the frequency of usage was that of online conference platforms from 44% prior to the certification program to 92% during the certification program. The increased frequency of the usage of online conference platforms was expected as society implemented “stay-at-home” orders. The least change was the use of digital content of 29% prior to 51% during which is consistent with participants’ belief in their current proficiency in the use of digital content. Given that Lee and Lind (2011), in a DoI study of the relationship between technology funding and its impact on student achievement, found that technology, in general, improves student achievement. The increased use of technology is promising; however, the smallest comparable increase in proficiency in the use of digital content is a cause for concern. Specifically, there appears to be more of a focus on how content is delivered over what content is delivered. The alignment of focus between how and what content is delivered is necessary and is suggestive of the need to align technology use with pedagogy (Monahan, 2004).

The examination of the proficiency beliefs, prior technology use, and during technology use distribution curves suggest that the program served to enhance proficiency and usage of implementation of innovative technology aligned with pedagogy. In other words, the pattern of usage of the innovative technology remained consistent prior to and during the program suggesting that the program enhanced the usage of innovative technology that matched the beliefs in practice before the program. The pattern of usage mirrored that of proficiency. That suggests that the program served to enhance participants' usage and beliefs in their proficiency in innovative technology that supported previously held beliefs.

Factors that Influence Implementation

While taking steps to increase confidence and proficiency in implementing innovative technology through professional development, district leadership must consider influential implementation factors. Given that the study surveyed participants near the end of the certification program, the highly predictive impact of professional development (B = .140, $p < .001$) was not unexpected. Although it appeared as if school districts spared no expense to equip district employees and students with equipment to enable distance learning, the cost to implement (B = .093, $p < .001$) held high predictive value. This could be interpreted as the influence of the cost to implement increased, so too did their belief in proficiency. Assuming that training is bundled with the costs, that is logical. Additionally, technology implementation coordination (B = .090, $p < .001$) held a highly predictive impact on perceived proficiency. The COVID-19 pandemic caused district leadership to coordinate the efforts of stakeholders to facilitate distance learning. Although leadership support (B = .048, $p = .019$) held a lower predictive value on proficiency than technology implementation coordination, technology implementation coordination can be viewed as an output of leadership since it is leadership's responsibility to coordinate the implementation of innovative technology. Consequently, it is of little surprise that professional development, cost to implement, and technology implementation coordination are highly predictive of participants' proficiency beliefs. However, what is not as obvious is the impact of other factors.

While taking steps to increase confidence and proficiency in implementing innovative technology through professional development, district leadership must consider influential implementation factors. Given that the study surveyed participants near the end of the certification program, the highly predictive impact of professional development was not

unexpected. However, what is not as obvious is the impact of other factors. Although many factors besides professional development influence the implementation of innovative technology, participants' technology adoption proclivities, years of experience, and grade level service provided the most influence on proficiency.

Technology Adoption Proclivities. The technology adoption proclivities of participants impacted participants' beliefs in their proficiency. Rogers's (2003) research found a normal distribution of innovativeness as a human trait. Although the normal distribution curve of innovative technology adoption was right-skewed in this study, the differences among the categories were consistent with the literature (Rogers, 2003). More than likely, the difference in skewness is due to the mandated nature of technology adoption during a crisis. Although there is a right-skewness of the distribution curve, the large portion of participants identifying as an early majority (35%), late majority (5%), or laggard (0.2%) does indicate that despite innovative technology mandates, intervention by district leadership is necessary to increase the rate of adoption.

Compared to innovators of technology adoption, participants designated as early adopters (B = -.248, $p < .001$), early majority (B = -.363, $p < .001$), late majority (B = -.635, $p < .001$), and laggards (B = -.959, $p < .001$), viewed themselves as progressively less proficient on average controlling for implementation factors and demographics. In other words, as the participant's tendency to adopt innovative technology decreased, so too did their belief in their proficiency of use. For instance, laggards (B = .959, $p < .001$), who are the least likely to adopt innovative technology, perceived themselves as less proficient with implementing innovative technology on average compared to innovators controlling for other variables. Under normal circumstances, laggards move from initial trial to full-scale use more rapidly than do innovators and early adopters (Rogers, 2003). In contrast, other literature suggests that early adopters are more likely to recognize the potential of innovative technology, thereby may have increased usage, which may lead to increased beliefs in proficiency (Finley, 2004). However, when technology adoption is mandated, the rate of adoption is increased. Due to the difference in how early adopters embrace innovative technology by going beyond baseline use and seeing the possible alignments with pedagogy, their comparatively higher belief in proficiency is expected.

Years of Experience. Along with technology adoption proclivities, participants' years of experience impacted their belief in proficiency when controlling for implementation factors and adoption categories. Compared to the reference group of participants with more than 20 years of experience, those with 0 – 5 years of experience held higher proficiency beliefs on average ($B = .117$, $p < .001$) and were statistically different from the reference group. This is in alignment with the literature. Webster (2017) recognizes Festinger's theory of cognitive dissonance that theorizes that previously held beliefs that are challenged by new information causes unease. Therefore, one can speculate that as one gains years of experience in the education sector, those experiences increasing solidify into static pedagogy. While previous research indicates that age plays a significant role in perceived technology acceptance and usage, for this study, years of experience act as a stand-in (Venkatesh et al., 2003).

Grade Level. This study found a statistical difference between participants who serviced high school and those who service early elementary ($B = -.166$, $p < .001$), late elementary school levels ($B = -.125$, $p < .001$), and other grade levels ($B = -.177$, $p < .001$). In contrast, there was no significant statistical difference between high school and middle school servicing participants who held higher proficiency beliefs ($B = .012$, $p = .539$). The differences are expected, given the structural differences between both high schools and middle schools to elementary schools.

Whereas high schools and middle school classrooms see an influx of different students throughout the day, elementary school students remain within the same classroom for the day with few exceptions. Educators address the needs of primary school students differently than those of middle and high school students. Regarding technology, the differences may be due to primary teachers' reduced use of technology for instruction. For instance, during COVID-19, many school districts have provided research-based guidance on screen time for students, which suggests less screen time for younger children (AAP Council on Communications and Media, 2016; Scoggin & Ark, 2018). The reduction of screen time for younger students will result in less usage of screen-based technology, which in turn may lead to decreased beliefs in proficiency due to decreased usage. Therefore, district leadership must provide appropriate grade level supports that considers the differing use of technology at each grade level.

Implications

This study's findings indicate that short-term guided and unguided collaborative learning professional development opportunities that demonstrate implementing innovative technology into learning environments are promising. Professional development is a method of giving meaning to technological innovation to discover how it can work under one's conditions (Rogers, 2003). Moreover, Professional development is a means to set proficiency expectations, encourage usage, and foster accountability toward academic achievement and fiscal responsibility (Darling-Hammond et al., 2017; Mehta, 2013; Ming et al., 2010; Schmitt, 2002).

Professional development in the use of technology has been shown to increase academic achievement. Using professional development to increase proficiency and usage demonstrates fiscal responsibility in the allocation of resources to train in the use of innovative technology. Although short-term professional development initiatives may provide immediate results, lasting results should be the aim of any educational initiative. The aim of professional development focused on the implementation of innovative technology should be to demonstrate its practical use to encourage sustainability.

Sustainability is key to lasting results. Often, district initiatives, whether technologically related, are not, are short-term, and change with leadership. Therefore, the support provided for initiatives are short-lived, and district employees will attend related professional development but be mindful of the fleeting nature of its support (Batane & Ngwako, 2016). Care must be taken to focus on innovative technologies that are not fleeting but on those that are aligned with pedagogy and can have a lasting impact on academic achievement and foster accountability. To facilitate a sustainable change, the data from this study reveal that high-quality, consistent, and frequent professional development on implementing technology must be established to demonstrate how to align pedagogy with technology usage.

Professional development must include district leaders and school personnel that can demonstrate the efficient and effective implementation of innovative technology. Effective professional development will encourage the adoption of district initiatives but must be done so purposefully (Blanchard et al., 2016; Darling-Hammond et al., 2017; Hardy et al., 2010; Ming et al., 2010). The data from this study suggest that the delivery of new knowledge and the demonstration of technology use led to its increased usage and higher held beliefs in usage proficiency. District leader instructors must demonstrate how to facilitate collaborative learning environments conducive to implementing innovative technology. Kini and Podolsky (2016) note that teachers with 20 years of experience are more effective than the most effective first-year teachers, which supports the idea that trained, experienced school personnel should champion the alignment of technology with pedagogy. Both district and school personnel instructors should have teaching experience to foster respect and the pedagogical wisdom to demonstrate how to use technology to enhance instruction and increase academic achievement.

This study's findings data indicate that instruction should not only occur synchronously (in-person) but utilize asynchronous learning opportunities to enable openly accessed, interactive, collaborative, any-time instruction. While the majority of research is focused on synchronous instruction, Sotiriou et al. (2016) found that the resulting online communities from asynchronous instruction can be used as a basis for sharing best practices. This study supports those findings and recommends the establishment of collaborative online communities at the local, state, and national levels to share best practices. The sharing of best practices can be used to foster collaboration toward the common goal of educating students that reflect the specific needs of the community at each level. In both synchronous and asynchronous instruction, feedback should be gathered to monitor and continuously improve program offerings and identify the need for new content. Professional development must not only be flexible, consistent, and frequent but continually improving as technology evolves.

District leadership must also leverage the use of collaborative learning environments when providing professional development. The diffusion of innovations is not only about informing about the technical aspects of technology but also its social impact (Rogers, 2003; Venkatesh et al., 2003). Previous research has shown that opinion leaders have an impact on technology adoption (Rogers, 2003). This study expands the literature by highlighting the need to leverage collaborative learning environments to facilitate implementing innovative technology. The data indicate that participants benefited from the opportunity to share and hear from other participants how innovative technology was integrated into their practice. That allowed for the organic development of the sharing of best practices for the efficient and effective use of innovative technology.

District leadership should provide incentives for the efficient and effective voluntary use of technology and set proficiency expectations. Batane and Ngawako (2016) noted in their study of pre-service teachers that technology use was not expected nor evaluated, thus hampering its usage. This study suggests that educators want to perfect their craft and will conduct unguided research to improve their instructional capabilities. Such efforts should be promoted by district leadership by its incentivization through financial and evaluation methods.

District leadership must use pragmatic best practices to facilitate the conditions to implement innovative technology. The preponderance of research literature has indicated that the support of leadership through the provision of professional development and collaborative environments increases the rate of adoption (Abrego & Pankake, 2010; Hamlin & Leslie, 2019; Lowther et al., 2008; Niederhauser et al., 2018; Rogers, 2003). Niederhauser et al. (2018) support the concept that leadership, along with necessary supports, impact not only the rate of adoption but the sustainability of technology initiatives. This study's data suggests leadership must reflect on the implementation factors, supports to increase the usage and proficiency, and the demographic characteristics of district employees when planning to implement innovative technology.

Recommendations

While the implications reflect the practical significance of the findings, the recommendations reflect the meaningful significance using a pragmatic, actionable approach. The following recommendations are best practices based on the implications of this study:

- Provide synchronous and asynchronous collaborative learning professional development opportunities that demonstrate implementing innovative technology into learning environments.
- Establish high-quality, consistent, and frequent professional development on implementing technology that demonstrates how to align pedagogy with technology usage.
- Provide incentives for the efficient and effective voluntary use of technology and set proficiency expectations.
- Use pragmatic best practices to facilitate the conditions to implement innovative technology.

Synchronous and Asynchronous Professional Development

The COVID-19 pandemic has infused synchronous and asynchronous terminology into the cultural lexicon when referring to guided and unguided learning in the new distance learning environment. Based on the data, it is recommended that leaders take advantage of synchronous and asynchronous learning opportunities. Synchronous learning should be used to provide guided instruction that precisely demonstrates how to use innovative technology. It should be used to demonstrate the expectations for the effective use of technology. Asynchronous learning should be used as an opportunity to allow learners to deepen understanding and use of technology at their own pace and with collaboration with others. It could involve the creation of collaborative communities in which learners share their understandings and provide insights into technology usage. The collaborative learning communities could be broadened to include other stakeholders such as parents, community members, and politicians to increase the understanding of the effort required to implement innovative technology and gain widespread support.

Align Pedagogy and Technology

Synchronous and asynchronous professional development must also demonstrate how to align pedagogy with technology. Although one can conceptually understand the use of technology, it is entirely different to integrate the use of technology with pedagogy. Professional development must utilize the pedagogical wisdom of instructors that can demonstrate how to use innovative technology to enhance instruction. District employees with years of experience that have effectively aligned pedagogy with technology can be used as champions and instruct others. Those district employees are best suited to account for the beliefs that participants hold regarding the execution of the instruction and use professional development to show how innovative technology should not run in contradiction to those beliefs but can be used to enhance their means of instruction delivery.

Instruction delivery should focus on the structures in place to deliver content and the content itself. The data indicated an opportunity to increase confidence in developing systems, structures, and partnerships with stakeholders and creating a universally engaging learning environment. Also, it indicated an opportunity to increase proficiency in the use of digital content. The COVID-19 pandemic shed light on the structure in place, or lack thereof, in the delivery of instruction. Content is key to engaging learners, and professional development must provide instruction on how to find and use digital content. Professional development in how to develop systems, structures, and cultivate partnerships to provide an online experience that is universally applicable to all learners must be developed.

Incentivize Voluntary Technology Use and Set Proficiency Expectations

District employees should be compensated for the voluntary improvement of their practice. This study indicated that a significant number of district employees would take the opportunity to improve their practice, especially when provided with incentives. The provision of incentives may increase the rate of adoption and encourage training in technology use. With the incentive to promote technology use, there must also be expectations set for proficiency. In other words, there must be accountability in the form of performance measurements that are tied to incentives. Incentives, along with proficiency expectations, should be used to facilitate the successful and sustainable use of innovative technology.

Use Pragmatic Best Practices to Implement Innovative Technology

The implementation of innovative technology must be based on pragmatic best practices to increase the chances of sustainability and success. Before the implementation of innovative technology, district leaders should research the successes and failures of other districts and determine their applicability to their situation. Even with the speed of technology adoption of educational technology during the COVID-19 pandemic, some districts fared better than others when implementing innovative technology. Those experiences should be examined and cataloged to produce best practices with contextual data so that districts can determine if they are applicable and what adjustments must be made to increase the chances of success when implementing the best practices.

Limitations

This study was conducted during the COVID-19 pandemic. While it provided an opportunity to examine a school district's reaction to a crisis in real-time, the fast pace of development of the school district's reaction to the crisis may have impacted the quality of the certification program. Although valuable data was gathered via open-ended questions, more robust data could have been gathered via interviews. However, given the nature of the data collection arraignment, that was not possible. Additionally, the instruments previously used were not administered during a pandemic or to the same population.

Due to the nature of self-reported surveys, respondents may interpret questions and response options differently, may not know the answer to all questions asked, or might be reluctant to share honestly. Respondents might not give the same answers to questions depending on the day they are asked. Additionally, a different researcher might have identified different themes and classified responses differently during the analysis of the open-ended questions.

Future Research

Future research can expand upon this study through an examination of implementing innovative technology during a crisis through a qualitative, longitudinal study with a different sample population. A qualitative study would expand upon the rationale behind the quantitative findings of this study. Also, it delves into the difference in grade level use of technology. A longitudinal study of implementing innovative technology could monitor the development of accountability measures and academic and financial outcomes, which is beyond the scope of this study. Further, it would allow for the analysis of additional implementation activities, the impact of various degrees of access to resources among schools, and continuous improvement processes. A longitudinal study could examine the lasting academic, infrastructural, organizational, and financial impact of distance learning during and after a crisis. Additionally, future research could examine the relationship between technology usage and beliefs in proficiency. Data from this study suggests that as proficiency increased, so did usage. Further examination of that phenomenon would add to the body of knowledge.

Conclusions

This study is meant as a guide to educational leaders when in the process of identifying factors that may influence the implementation of innovative technology. Leadership is central to people, processes, and technology (Crawford et al., 2003). Best practices in aligning pedagogy to technology by well respected, experienced leadership supported district employees with pedagogical wisdom in using technology to enhance their duties is key to the successful implementation of innovative technology. Complementarily, the education sector should focus on scalable, research-supported best practices that focus on impact rather than fleeting politically-driven policy initiatives (Niederhauser et al., 2018).

The expected long-lasted impact of COVID-19 can be leveraged as an opportunity to create continually improving, sustainable systems to implement innovative technology. It is an opportunity to turn a tragedy of epic proportions to an unforeseen opening to prepare the education sector to embrace technology that aligns with pedagogy and to increase accountability and academic achievement. The data from this study suggest that district leadership should provide ongoing professional development of implementing innovative technology that disseminates and demonstrates the practical use of new knowledge in a collaborative learning environment.

This study's findings either support or expand upon previous research by uncovering new insights and addressing implementing innovative technology during a time of crisis. It is time for educational leaders to consolidate the findings of this research and previous research to produce a pragmatic strategy to produce a scalable methodology of implementing innovative technology. In times of crisis or not, district leaders must be aware of how to implement pedagogically aligned, innovative technology to enhance instruction, address accountability, and increase academic achievement.

APPENDICES

Appendix A

Figure 4.5. The Equations for the Multiple Regression Models Predicting Proficiency in the Use of Innovative Technology

Model 1

$y = \beta_o + \beta_1$*(Tech Support is Influential)* + β_2*(Professional Development is Influential)* + β_3*(Time to Implement is Influential)* + β_4*(Cost to Implement is Influential)* + β_5*(Ease of Use is Influential)* + β_6*(School's Technology Infrastructure is Influential)* + β_7*(Leadership Support is Influential)* + β_8*(Technology Implementation Coordination is Influential)*

y *is the predicted proficiency in the use of innovative technology.*

β_o *is the intercept or constant (tech support is not influential, professional development is not influential, time to implement is influential, cost to implement is influential, ease of use is influential, school's technology infrastructure is not influential, leadership support is not influential, and technology implementation coordination is not influential).*

β_1 *through* β_8 *are the expected coefficients for the corresponding variables.*

Model 2

$y = \beta_o + \beta_1$*(Tech Support is Influential)* + β_2*(Professional Development is Influential)* + β_3*(Time to Implement is Influential)* + β_4*(Cost to Implement is Influential)* + β_5*(Ease of Use is Influential)* + β_6*(School's Technology Infrastructure is Influential)* + β_7*(Leadership Support is Influential)* + β_8*(Technology Implementation Coordination is Influential)* + β_9*(Laggard)* + β_{10}*(Late Majority)* + β_{11}*(Early Majority)* + β_{12}*(Early Adopters)*

y *is the predicted proficiency in the use of innovative technology.*

β_o *is the intercept or constant (tech support is not influential, professional development is not* *influential, time to implement is influential, cost to implement is influential, ease of use is influential, school's technology infrastructure is not influential, leadership support is not influential, technology implementation coordination is not influential, and innovators).*

β_1 *through* β_{12} *are the expected coefficients for the corresponding variables.*

Model 3

$y = \beta_o + \beta_1$*(Tech Support is Influential)* + β_2*(Professional Development is Influential)* + β_3*(Time to Implement is Influential)* + β_4*(Cost to Implement is Influential)* + β_5*(Ease of Use is Influential)* + β_6*(School's Technology Infrastructure is Influential)* + β_7*(Leadership Support is Influential)* + β_8*(Technology Implementation Coordination is Influential)* + β_9*(Laggard)* + β_{10}*(Late Majority)* + β_{11}*(Early Majority)* + β_{12}*(Early Adopters)* + β_{13}*(Gender Variant/Non-Conforming)* + β_{14}*(Male)* + β_{15}*(Prefer not to answer (Gender))* + β_{16}*(Asian/Pacific Islander)* + β_{17}*(Black or African American (non-Hispanic)* + β_{18}*(Native American or American Indian)* + β_{19}*(Prefer not to answer (Race))* + β_{20}*(White (non-Hispanic))* + β_{21}*(0-5 years)* + β_{22}*(6-10 years)* + β_{23}*(11-15 years)* + β_{24}*(16-20 years)* + β_{25}*(Prefer not to answer (Experience))* + β_{26}*(District Leadership)* + β_{27}*(Prefer not to answer (Position))* + + β_{28}*(EarlyElem (TK-2))* + β_{29}*(LateElem (3-5))* + β_{30}*(Middle (6-8))* + β_{31}*(Other Grade Level)*

y *is the predicted proficiency in the use of innovative technology*.

β_o *is the intercept or constant (tech support is not influential, professional development is not influential, time to implement is influential, cost to implement is influential, ease of use is influential, school's technology infrastructure is not influential, leadership support is not influential, technology implementation coordination is not influential, innovators, females, Hispanic or Latino, more than 20 years of experience, school personnel, and those who service high school).*

β_1 *through* β_{31} *are the expected coefficients for the corresponding variables.*

Model 4

$y = \beta_o + \beta_1$*(Tech Support is Influential)* + β_2*(Professional Development is Influential)* + β_3*(Time to Implement is Influential)* + β_4*(Cost to Implement is Influential)* + β_5*(Ease of Use is Influential)* + β_6*(School's Technology Infrastructure is Influential)* + β_7*(Leadership Support is Influential)* + β_8*(Technology Implementation Coordination is Influential)* + β_9*(Laggard)* + β_{10}*(Late Majority)* + β_{11}*(Early Majority)* + β_{12}*(Early Adopters)* + β_{13}*(Gender Variant/Non-Conforming)* + β_{14}*(Male)* + β_{15}*(Prefer not to answer (Gender))* + β_{16}*(Asian/Pacific Islander)* + β_{17}*(Black or African American (non-Hispanic)* + β_{18}*(Native American or American Indian)* + β_{19}*(Prefer not to answer (Race))* + β_{20}*(White (non-Hispanic))* + β_{21}*(0-5 years)* + β_{22}*(6-10 years)* + β_{23}*(11-15 years)* + β_{24}*(16-20 years)* + β_{25}*(Prefer not to answer (Experience))* + β_{26}*(District Leadership)* + β_{27}*(Prefer not to answer (Position))* + + β_{28}*(EarlyElem (TK-2))* + β_{29}*(LateElem (3-5))* + β_{30}*(Middle (6-8))* + β_{31}*(Other Grade Level)* + β_{32}*(Region A)* + β_{33}*(Region B)* + β_{34}*(Region C)* + β_{35}*(Region D)* + β_{36}*(Region E)* + β_{37}*(Region F)* + β_{38}*(Other Region)*

y *is the predicted proficiency in the use of innovative technology.*

β_o *is the intercept or constant (tech support is not influential, professional development is not influential, time to implement is influential, cost to implement is influential, ease of use is influential, school's technology infrastructure is not influential, leadership support is not influential, technology implementation coordination is not influential, innovators, females, Hispanic or Latino, more than 20 years of experience, school personnel, those who service high school, and LD Central).*

β_1 *through* β_{38} *are the expected coefficients for the corresponding variables.*

Appendix B

Table 4.6. Multiple Regression Models Predicting Proficiency in the Use of Innovative Technology

	Model 1			Model 2			Model 3			Model 4		
	B	SE	p	B	SE	p	B	SE	p	B	SE	p
Intercept	2.614	0.017		2.913	0.022		2.967	0.029		2.958	0.033	
Factors Supporting Implementation												
Tech Support VI	0.015	0.016	0.349	0.040	0.015	0.009	0.046	0.015	0.002	0.045	0.015	0.003
Professional Development VI	0.149	0.020	0.000	0.130	0.019	0.000	0.140	0.019	0.000	0.140	0.019	0.000
Time to Implement VI	0.073	0.021	0.000	0.051	0.020	0.012	0.057	0.020	0.004	0.058	0.020	0.004
Cost to Implement VI	0.102	0.016	0.000	0.106	0.016	0.000	0.093	0.016	0.000	0.093	0.016	0.000
Ease of Use VI	0.089	0.022	0.000	0.081	0.021	0.000	0.082	0.021	0.000	0.082	0.021	0.000
School's Technology Infrastructure VI	-0.006	0.021	0.763	-0.011	0.021	0.600	-0.018	0.020	0.373	-0.019	0.020	0.358
Leadership Support VI	0.049	0.021	0.021	0.044	0.021	0.034	0.048	0.020	0.019	0.049	0.020	0.016
Technology Implementation Coordination VI	0.113	0.022	0.000	0.094	0.022	0.000	0.090	0.021	0.000	0.090	0.021	0.000
Adoption Categories (Reference Group = Innovators)												
Laggard				-0.914	0.141	0.000	-0.959	0.139	0.000	-0.956	0.139	0.000
Late Majority				-0.616	0.033	0.000	-0.635	0.033	0.000	-0.634	0.033	0.000
Early Majority				-0.344	0.019	0.000	-0.363	0.019	0.000	-0.363	0.019	0.000
Early Adopters				-0.240	0.018	0.000	-0.248	0.018	0.000	-0.248	0.018	0.000
Gender (Reference = Female)												
Gender Variant/Non-Conforming							0.097	0.138	0.482	0.100	0.138	0.470
Male							0.080	0.016	0.000	0.080	0.016	0.000
Prefer not to answer (Gender)							-0.128	0.056	0.024	-0.115	0.051	0.024
Race/Ethnicity (Reference = Hispanic or Latino)												
Asian/Pacific Islander							0.002	0.022	0.935	0.002	0.022	0.938
Black or African American (non-Hispanic)							-0.039	0.023	0.100	-0.031	0.024	0.202
Native American or American Indian							-0.092	0.101	0.363	-0.087	0.101	0.386
Other Race							-0.048	0.034	0.161	-0.046	0.034	0.179
Prefer not to answer (Race)							-0.080	0.030	0.006	-0.078	0.030	0.009
White (non-Hispanic)							-0.059	0.016	0.000	-0.059	0.017	0.000
Years of Experience (Reference Group = More than 20 Years)												
0-5 years							0.117	0.019	0.000	0.122	0.019	0.000
6-10 years							0.080	0.024	0.001	0.083	0.024	0.000
11-15 years							0.058	0.020	0.004	0.061	0.020	0.002
16-20 years							0.030	0.018	0.090	0.031	0.018	0.079
Prefer not to answer (Experience)							0.056	0.065	0.395	0.059	0.065	0.371
Position (Reference = School Personnel)												
District Leadership							0.011	0.032	0.743	0.039	0.039	0.322
Prefer not to answer (Position)							0.192	0.084	0.022	0.325	0.103	0.002
Grade Level (Reference = High School)												
EarlyElem (TK-2)							-0.166	0.022	0.000	-0.168	0.022	0.000
LateElem (3-5)							-0.125	0.019	0.000	-0.127	0.019	0.000
Middle (6-8)							0.012	0.019	0.539	0.010	0.019	0.619
Other Grade Level							-0.177	0.019	0.000	-0.176	0.019	0.000
Location (Reference = Region G)												
Region A										-0.054	0.057	0.346
Region B										0.027	0.022	0.221
Region C										-0.020	0.022	0.356
Region D										0.055	0.023	0.017
Region E										-0.007	0.022	0.769
Region F										-0.005	0.023	0.832
Other Region										-0.131	0.063	0.037

Note: Locations were adjusted to maintain anonymity.

Appendix C

Table 4.7 Survey

#	Measure of Instrument	Scale
1	By completing this survey, I consent to take part in the evaluation of the certification program. *	◯ Yes I Consent ◯ No I Do Not Consent
Program Reflection: As you answer these questions, please consider the Program as a whole.		
2	The content of the Program was aligned to the stated goals and objectives. *	◯ Strongly Disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly Agree
3	The Program helped me better understand how to meet the needs of my students including SWD, EL, SEL, Gifted, etc. *	◯ Strongly Disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly Agree
4	The facilitators were knowledgeable about the subject.	◯ Strongly Disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly Agree
4.1	The facilitators made connections between the content and my job/role.	
4.2	The facilitators differentiated to meet the needs of the group.	
4.3	The facilitators responded to my questions.	
5	I'm confident in my ability to apply what I learned in my job role. *	◯ Strongly Disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly Agree
6	I would recommend the certification program to a colleague. *	◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

7	What did you like most about the certification program? *	Open
8	What would have made the certification program better for you? *	Open
9	What do you want to know more about? *	Open
Impact on Practice: This section is used to reflect on the certification program's impact on your practice.		
10	Please rate the effectiveness of the certification program to prepare you to conduct your work in an online environment. *	◯ Ineffective ◯ Slightly effective ◯ Neutral ◯ Effective ◯ Highly effective
11	How has the certification program impacted your professional practice? *	Open
Self-Efficacy: This section is used to capture your thoughts on your preparedness to implement certification practices.		
Compared to the start of the Future Ready Certification program on May 1, 2020, have you increased or stayed the same in your confidence that you can:		
12	Describe the certification purpose and goals	◯ No Increase ◯ Small Increase ◯ Moderate Increase ◯ Large Increase
12.1	Describe the knowledge, skills, and dispositions of future ready students, educators, and leaders	
12.2	Describe Digital Citizenship and identify digital tools and resources to create experiences for learners that promote responsible participation in the digital world	
12.3	Describe Global Collaboration and identify digital tools and resources to create collaborative experiences for students, their families, and colleagues	
12.4	Explore how access and equity issues impact online learning and identify tools to ensure access and equity for students and families	
12.5	Align the principles of the Universal Design for Learning (UDL) framework to an online experience that engages all learners	
12.6	Explore various digital tools and resources available by grade level and by subject area available for use with students	
12.7	Use digital tools and resources for delivering high-quality online content	
12.8	Develop systems, structures, and partnerships with all stakeholders that ensure success of online learning at your site	

12.9	Share lessons learned, best practices, and the impact of teaching, learning, and working with technology	
13	If you said "moderate increase" or "large increase" to any of the questions above, please tell us what you think caused your increase in knowledge in that area compared to May 1, 2020.	Open
Compared to the start of the Future Ready Certification program on May 1, 2020, please rate the extent to which you can currently proficiently use the following:		
14	Schoology	◯ Poor ◯ Average ◯ Good ◯ Excellent
14.1	MyPLN	
14.2	Online Conferencing Platforms (e.g., Zoom, Microsoft Teams Meeting, Schoology Conferences)	
14.3	Digital Content (e.g., Edgenuity, Amplify Reading, ALEKS, ST Math, District Adopted Digital Content)	
14.4	Digital Tools, Apps, and Resources (e.g., Schoology Apps, Microsoft 365, Nearpod, Edpuzzle)	
Before the start of the Future Ready Certification program on May 1, 2020, how often did you use the following:		
15	Schoology	◯ Never ◯ Sometimes ◯ Fairly Often ◯ Frequently, If Not Always
15.1	MyPLN	
15.2	Online Conferencing Platforms (e.g., Zoom, Microsoft Teams Meeting, Schoology Conferences)	
15.3	Digital Content (e.g., Edgenuity, Amplify Reading, ALEKS, ST Math, District Adopted Digital Content)	
15.4	Digital Tools, Apps, and Resources (e.g., Schoology Apps, Microsoft 365, Nearpod, Edpuzzle)	
During the course of the Future Ready Certification program, how often did you use the following:		
16	Schoology	◯ Never ◯ Sometimes ◯ Fairly Often ◯ Frequently, If Not Always
16.1	MyPLN	
16.2	Online Conferencing Platforms (e.g., Zoom, Microsoft Teams Meeting, Schoology Conferences)	
16.3	Digital Content (e.g., Edgenuity, Amplify Reading, ALEKS, ST Math, District Adopted Digital Content)	

16.4	Digital Tools, Apps, and Resources (e.g., Schoology Apps, Microsoft 365, Nearpod, Edpuzzle)	
Implementation Influences: This section of the survey is used to capture your thoughts on influences to your implementation of certification program practices.		
17	Technical support	◯ Not At All Influential ◯ Slightly Influential ◯ Very Influential ◯ Extremely Influential
17.1	Professional development	
17.2	Time to implement	
17.3	Cost to implement	
17.4	Ease of use	
17.5	School's technology infrastructure (e.g., wi-fi availability, laptop availability)	
17.6	Leadership support (school and District)	
17.7	Technology implementation coordination between stakeholders (e.g., between users, school, and District departments)	
18	What are other influences to your implementation of certification program practices that were not listed?	Open
Technology Adoption: People respond to their environment in different ways. The statements below refer to some of the ways people can respond. Please indicate the degree to which each statement applies to you. Please work quickly, there are no right or wrong answers, just record your first impression.		
19	My peers often ask me for advice or information.	◯ Strongly Disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly Agree
19.1	I enjoy trying new ideas.	
19.2	I seek out new ways to do things.	
19.3	I am generally cautious about accepting new ideas.	
19.4	I frequently improvise methods for solving a problem when an answer is not apparent.	
19.5	I am suspicious of new inventions and new ways of thinking.	
19.6	I rarely trust new ideas until I can see whether the vast majority of people around me accept them.	
19.7	I feel that I am an influential member of my peer group.	
19.8	I consider myself to be creative and original in my thinking and behavior.	
19.9	I am aware that I am usually one of the last people in my group to accept something new.	
19.9.1	I am an inventive kind of person.	

19.9.2	I enjoy taking part in the leadership responsibilities of the group I belong to.	
19.9.3	I am reluctant about adopting new ways of doing things until I see them working for people around me.	
19.9.4	I find it stimulating to be original in my thinking and behavior.	
19.9.5	I tend to feel that the old way of living and doing things is the best way.	
19.9.6	I am challenged by ambiguities and unsolved problems.	
19.9.7	I must see other people using new innovations before I will consider them.	
19.9.8	I am receptive to new ideas.	
19.9.9	I am challenged by unanswered questions.	
19.9.10	I often find myself skeptical of new ideas.	
	Demographics	
20	Email Address (Please include full email address, including @lausd. net) *	Open
21	Employee ID Number (your employee number must have 8 digits by adding zeros (where 123456 is 00123456)) *	Open
22	To which gender identity do you most identify? *	◯ Female ◯ Male ◯ Transgender Female ◯ Transgender Male ◯ Gender Variant/Non-Conforming ◯ Prefer not to answer
23	What is your ethnicity? *	◯ White (non-Hispanic) ◯ Hispanic or Latino ◯ Black or African American (non-Hispanic) ◯ Native American or American Indian ◯ Asian/Pacific Islander ◯ Other - Write In (Required) ◯ Prefer not to answer

24	How many years have you worked as an employee? *	◯ Less than one year ◯ 1-2 years ◯ 3-5 years ◯ 6-10 years ◯ 11-15 years ◯ 16-20 years ◯ Over 20 years ◯ Prefer not to answer
25	What is your current role (while participating in certification)? *	◯ Classroom Teacher ◯ School-Based Non-Classroom Personnel (Instructional Coach, Coordinator, Counselor, etc...) ◯ School-Based Administrator (Principal, Assistant Principal) ◯ Region Staff (Director, Coordinator, Specialist, Expert, Advisor, etc...) ◯ Central Office Staff (Director, Coordinator, Specialist, Expert, Advisor, etc...) ◯ Other - Write In (Required)
26	If you are a teacher or instructional leader, what grade level(s) do you currently teach or support?	☐ Early Education (For Children Ages 2-5) ☐ California State Preschool (For Children Ages 3-4) ☐ TK ☐ K ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11

		☐ 12 ☐ Adult and Career Education ☐ Other - Write In (Required)
27	In which Region do you work? *	☐ Region A ☐ Region B ☐ Region C ☐ Region D ☐ Region E ☐ Region F ☐ Region G

Note: Survey items have been adjusted to maintain anonymity.

References

AAP Council on Communications and Media. (2016). Media use in school-aged children and adolescents. *Pediatrics*, *138*(5), e20162592. https://doi.org/10.1542/peds.2016-2592

Abrego, J., & Pankake, A. (2010). PK-12 virtual schools: The challenges and roles of school leaders. *Educational Considerations*, *37*(2). https://doi.org/10.4148/0146-9282.1150

Accountability. (n.d.). In *Cambridge English Dictionary*. Retrieved March 23, 2020, from https://dictionary.cambridge.org/us/dictionary/english/accountability

Adams, C. M., Ford, T. G., Forsyth, P. B., Ware, J. K., Olsen, J. J., Lepine, J. A. S., Barnes, L. L. B., Khojasteh, J., & Mwavita, M. (2017). *Next generation accountability: A vision for school improvement under ESSA*. Learning Policy Institute.

An, Y.-J., & Reigeluth, C. (2012). Creating technology-enhanced, learner-centered classrooms: K–12 teachers' beliefs, perceptions, barriers, and support needs. *Journal of Digital Learning in Teacher Education*, *28*(2), 54–62.

Anderson, M., Perrin, A., & Madhumitha, K. (2019, April 22). 10% of Americans don't use the internet. Who are they? *Pew Research Center*. https://www.pewresearch.org/fact-tank/2019/04/22/some-americans-dont-use-the-internet-who-are-they/

Anderson, R. E., & Dexter, S. (2005). School technology leadership: An empirical investigation of prevalence and effect. *Educational Administration Quarterly*, *41*(1), 49–82. https://doi.org/10.1177/0013161X04269517

Austin Beutner. (2020). *Austin Beutner address to the school community as prepared for delivery—April 20, 2020*.

Avolio, B. J., & Bass, B. M. (Eds.). (2002). *Developing potential across a full range of leadership: Cases on transactional and transformational leadership*. Lawrence Erlbaum Associates.

Bailey, A., Henry, T., McBride, L., & Puckett, J. (2011). *Unleashing the potential of technology in education* (p. 30).

Barnett, D. E. (2018). Online adjunct faculty: A quantitative examination of the predictive relationship between leadership and job satisfaction. *International Journal of Research in Education and Science*, 226–236. https://doi.org/10.21890/ijres.383159

Batane, T., & Ngwako, A. (2016). Technology use by pre-service teachers during teaching practice: Are new teachers embracing technology right away in their first teaching experience? *Australasian Journal of Educational Technology*. https://doi.org/10.14742/ajet.2299

Bathgate, K., Colvin, R. L., & Silva, E. (2011). Striving for student success: A model of shared accountability. *Washington, DC: Education Sector*. https://www.strivetogether.org/

Beaverton School District. (2020). *Sprint 1million project: Free hotspots for high schools - Beaverton School District*. https://www.beaverton.k12.or.us/departments/information-technology/sprint-1million

Bennett, J. V., & Thompson, H. C. (2011). Changing district priorities for school–business collaboration: Superintendent agency and capacity for institutionalization. *Educational Administration Quarterly*, *47*(5), 826–868. https://doi.org/10.1177/0013161X11417125

Blanchard, M. R., LePrevost, C. E., Tolin, A. D., & Gutierrez, K. S. (2016). Investigating technology-enhanced teacher professional development in rural, high-poverty middle schools. *Educational Researcher*, *45*(3), 207–220. https://doi.org/10.3102/0013189X16644602

Bolman, L. G., & Deal, T. E. (2013). *Reframing organizations: Artistry, choice, and leadership* (5. ed). Jossey-Bass.

Branscomb, L. M. (1992). U.S. scientific and technical information policy in the context of a diffusion-oriented national technology policy. *Government Publications Review*, *19*(5), 469–482. https://doi.org/10.1016/0277-9390(92)90050-L

Brinkerhoff, R. O. (2003). *The success case method: Find out quickly what's working and what's not*. Berrett-Koehler.

Burns, J. M. (2010). *Leadership* (1. Harper Perennial political classics ed). Harper Perennial.

City News Service. (2020, March 30). *Roughly 15,000 LAUSD students fail to take part in online classes*. KPBS Public Media. https://www.kpbs.org/news/2020/mar/30/roughly-15000-lausd-students-failing-take-part-onl/

Clover Avenue Elementary School. (2020, March 13). *School closure* [Personal communication].

Clover Avenue Elementary School. (2020, March 23). *Devices available* [Personal communication].

Copland, M. A. (2003). Leadership of inquiry: Building and sustaining capacity for school improvement. *Educational Evaluation and Policy Analysis*, *25*(4), 375–395. https://doi.org/10.3102/01623737025004375

Coronavirus Disease (COVID-19)—Events as they happen. (2020, May 11). https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen

Crawford, C. B., Gould, L. V., Street, P., & Scott, R. F. (2003). Transformational leader as champion and techie: Implications for leadership educators. *Journal of Leadership Education*, *2*(1), 17.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed). SAGE Publications.

Culatta, R. (2012, August 8). *Education innovation clusters: Accelerating innovation through interdisciplinary partnerships*. EDUCAUSE Live! Webinars, Webinars. https://library.educause.edu/resources/2012/8/education-innovation-clusters-accelerating-innovation-through-interdisciplinary-partnerships

Culp, K. M., Honey, M., & Mandinach, E. (2005). A retrospective on twenty years of education technology policy. *Journal of Educational Computing Research*, *32*(3), 279–307. https://doi.org/10.2190/7W71-QVT2-PAP2-UDX7

Dappolone, M. (2013). Making best practices better. *Educational Leadership*, *70*(6), 69–72.

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Learning Policy Institute.

Dearing, J. W. (2009). Applying diffusion of innovation theory to intervention development. *Research on Social Work Practice*, *19*(5), 503–518. https://doi.org/10.1177/1049731509335569

Delgado, A., Wardlow, L., O'Malley, K., & McKnight, K. (2015). Educational technology: A review of the integration, resources, and effectiveness of technology in k-12 classrooms. *Journal of Information Technology Education: Research*, *14*, 397–416. https://doi.org/10.28945/2298

Dexter, S., Nash, J. B., & Richardson, J. W. (2016). *Leadership for technology use, integration, and innovation*.

Durand, F. T., Lawson, H. A., Wilcox, K. C., & Schiller, K. S. (2016). The role of district office leaders in the adoption and implementation of the common core state standards in elementary schools. *Educational Administration Quarterly*, *52*(1), 45–74. https://doi.org/10.1177/0013161X15615391

Education innovation clusters: Accelerating the pace of innovation. (2015). U.S. Department of Education, Office of Educational Technology.

Ege University, Turkey, & Uslu, O. (2018). Factors associated with technology integration to improve instructional abilities: A path model. *Australian Journal of Teacher Education*, *43*(4), 31–50. https://doi.org/10.14221/ajte.2018v43n4.3

Ensminger, D. C., & Surry, D. W. (2008). Relative ranking of conditions that facilitate innovation implementation in the USA. *Australasian Journal of Educational Technology*, 17.

Field, A. P. (2013). *Discovering statistics using IBM SPSS statistics: And sex and drugs and rock "n" roll* (4th edition). Sage.

Finch, M. A. (2012). Precursors to policy innovation: How Tennessee entered race to the top. *Peabody Journal of Education*, *87*(5), 576–592. https://doi.org/10.1080/0161956X.2012.723499

Finley, L. (2004). Institutional change and resistance: Teacher preparatory faculty and technology integration. *Journal of Technology and Teacher Education*, *12*(3), 319–337.

Forsstrom, J., & Ham, G. (2007). An integrated digital campus delivers ROI and VOI. *EDUCAUSE Quarterly*, *30*(1), 49–53.

Fowler, F. J. (2014). *Survey research methods* (Fifth edition). SAGE.

Gainey, B. S. (2009). Crisis management's new role in educational settings. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *82*(6), 267–274. https://doi.org/10.3200/TCHS.82.6.267-274

Garcetti, E. (2020). *Declaration of local emergency*.

Gilbertson, A. (2014, August 27). *The LA school iPad scandal: What you need to know*. NprEd How Learning Happens. https://www.npr.org/sections/ed/2014/08/27/343549939/the-l-a-school-ipad-scandal-what-you-need-to-know

Glassett, K., & Schrum, L. (2009). Teacher beliefs and student achievement in technology-rich classroom environments. *International Journal of Technology in Teaching and Learning*, *5*(2), 138–153.

Goolsbee, A., & Guryan, J. (2006). *World wide wonder?* Education Next.

Gray, L., Thomas, N., & Lewis, L. (2010). *Educational technology in U.S. public schools: Fall 2008 (NCES 2010–034)* (NCES 2010–034; p. 66). U.S. Department of Education, National Center for Education Statistics.

Greenberger, M. (2018). Better prepare than react: Reordering public health priorities 100 years after the Spanish Flu epidemic. *American Journal of Public Health*, *108*(11), 1465–1468. https://doi.org/10.2105/AJPH.2018.304682

Gunawardena, C. G. (2014). *Comparison of existing technology acceptance theories and models to suggest a well improved theory/model*. 16.

Ham, S., & Cha, Y. (2009). Positioning education in the information society: The transnational diffusion of the information and communication technology curriculum. *Comparative Education Review*, *53*(4), 535–557. https://doi.org/10.1086/603584

Hamlin, J. B., & Leslie, J. (2019). Old dogs and new tricks: Facilitating implementation of Contemporary academic technology with an aging teaching population. *Journal of Higher Education Theory and Practice*, *19*(8). https://doi.org/10.33423/jhetp.v19i8.2668

Hannon, T. (2020, April 8). *School bus wi-fi hotspots aide student learning during COVID-19 closures*. STN Media. https://stnonline.com/special-reports/school-bus-wi-fi-hotspots-aide-student-learning-during-covid-19-closures/

Hannon, V. (2008). Should educational leadership focus on 'best practice' or 'next practice'? *Journal of Educational Change*, *9*(1), 77–81. https://doi.org/10.1007/s10833-007-9056-4

Hardy, I., Rönnerman, K., Moksnes Furu, E., Salo, P., & Forsman, L. (2010). Professional development policy and politics across international contexts: From mutuality to measurability? *Pedagogy, Culture & Society*, *18*(1), 81–92. https://doi.org/10.1080/14681360903556871

Harpell, J. V., & Andrews, J. J. W. (2010). Administrative leadership in the age of inclusion: Promoting best practices and teacher empowerment. *The Journal of Educational Thought (JET) / Revue De La Pensée Éducative*, *44*(2), 189–210.

Hoffman, S., Shaw, E., & Loyless, S. (2019). Ensuring ethics and equity: Policy, planning, and digital citizenship. *Education*, *140*(2), 87–99.

Holshue, M. L., DeBolt, C., Lindquist, S., Lofy, K. H., Wiesman, J., Bruce, H., Spitters, C., Ericson, K., Wilkerson, S., Tural, A., Diaz, G., Cohn, A., Fox, L., Patel, A., Gerber, S. I., Kim, L., Tong, S., Lu, X., Lindstrom, S., … Pillai, S. K. (2020). First case of 2019 novel coronavirus in the United States. *New England Journal of Medicine*, *382*(10), 929–936. https://doi.org/10.1056/NEJMoa2001191

House, R. J. (1976). *A 1976 theory of charismatic leadership. Working paper series 76-06.*

Hung, D., Toh, Y., Jamaludin, A., & So, H.-J. (2017). Innovation becoming trajectories: Leveraging lateral and vertical moves for collaborative diffusion of twenty-first century learning practices. *Asia Pacific Journal of Education*, *37*(4), 582–600. https://doi.org/10.1080/02188791.2017.1388213

Hurt, H. T., Joseph, K., & Cook, C. D. (1977). Scales for the measurement of innovativeness. *Human Communication Research*, *4*(1), 58–65. https://doi.org/10.1111/j.1468-2958.1977.tb00597.x

Independent Budget Office of the City of New York. (2020, May 20). *COVID-19 spending tracker*. https://ibo.nyc.ny.us/covid-19-city-spending-tracker.html

Jones, D., & Rudd, R. (2008). Transactional, transformational, or laissez-faire leadership: An assessment of college of agriculture academic program leaders' (deans) leadership styles. *Journal of Agricultural Education*, *49*(2), 88–97. https://doi.org/10.5032/jae.2008.02088

Kano, M., & Bourque, L. B. (2007). Experiences with and preparedness for emergencies and disasters among public schools in California. *NASSP Bulletin*, *91*(3), 201–218. https://doi.org/10.1177/0192636507305102

Kano, M., Ramirez, M., Ybarra, W. J., Frias, G., & Bourque, L. B. (2007). Are schools prepared for emergencies? A baseline assessment of emergency preparedness at school sites in three Los Angeles County school districts. *Education and Urban Society*, *39*(3), 399–422. https://doi.org/10.1177/0013124506298130

Kara, N., & Cagiltay, K. (2017). *In-service preschool teachers' thoughts about technology and technology use in early educational settings*. 24.

Kelly, T. F. (2011). Educational leadership is not about money. *Contemporary Issues in Education Research (CIER)*, *4*(4), 13. https://doi.org/10.19030/cier.v4i4.4163

Kerchner, C. T. (2013). *Education technology policy for a 21st century learning system* (p. 16). Policy Analysis for California Education, PACE.

Kini, T., & Podolsky, A. (2016). *Does teaching experience increase teacher effectiveness?* (p. 72). Learning Policy Institute.

Kirschner, P. A., Hendriks, M., Paas, F., Wopereis, I., & Cordewener, B. (2004). Determinants for failure and success of innovation projects: The road to sustainable educational innovation. *Association for Educational Communications and Technology*, 10.

Krueger, K. R. (2013). *Forget ROI, the future of technology investment is all about value*. 5.

Lambert, L. (1995). Toward a theory of constructivist leadership. In *The constructivist leader* (pp. 28–51). Teachers College Press, Teachers College, Columbia University.

Lee, G. M., & Lind, M. L. (2011). Information technology diffusion: Impact on student achievement. *Information Systems Education Journal*, *9*(3), 35–49.

Lloyd J. Kolbe. (2002). Education reform {& the goals of modern school health programs}. *The State Education Standard*.

López, O. S. (2014). Beyond community college accountability: Using data to investigate best practices for institutional improvement. *Community College Journal of Research and Practice*, *38*(1), 86–90. https://doi.org/10.1080/10668926.2012.762592

Los Angeles School District. (2020). *Policy for @Home Continuity of Learning*. https://mcusercontent.com/e51f39a03d845e2cafae71eff/files/60b162d9-24a3-4df9-8923-d71514e32837/1_LA_UNIFIED_Home_Continuity_of_Learning_1.pdf

Lowther, D. L., Inan, F. A., Daniel Strahl, J., & Ross, S. M. (2008). Does technology integration “work” when key barriers are removed? *Educational Media International*, *45*(3), 195–213. https://doi.org/10.1080/09523980802284317

Malkus, N., & Christensen, C. (2020). *School district responses to the COVID-19 pandemic: Round 3, plans for a remote finish*. 18.

Malkus, N., Christensen, C., & West, L. (2020). *School district responses to the COVID-19 pandemic: Round 1, districts' initial responses*. American Enterprise Institute.

Maxwell, J. A. (2013). *Qualitative research design: An interactive approach* (3rd ed). SAGE Publications.

McLeod, S., Richardson, J. W., & Sauers, N. J. (2015). Leading technology-rich school districts: Advice from tech-savvy superintendents. *Journal of Research on Leadership Education*, *10*(2), 104–126. https://doi.org/10.1177/1942775115584013

Mehta, J. (2013). When professions shape politics: The case of accountability in K-12 and higher education. *Educational Policy*, *28*(6), 881–915. https://doi.org/10.1177/0895904813492380

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (Fourth edition). Jossey-Bass.

Ming, T. S., Hall, C., Azman, H., & Joyes, G. (2010). Supporting smart school teachers' continuing professional development in and through ICT: A model for change. *International Journal Of Education And Development Using Information And Communication Technology*, *6*(2), 5–20.

Mitchell, L. (2016). *Beyond Digital Citizenship*. *1*, 9.

Monahan, T. (2004). Just another tool? IT pedagogy and the commodification of education. *The Urban Review*, *36*(4), 271–292. https://doi.org/10.1007/s11256-004-2084-y

Moonen, J. (2003). Simplified return-on-investment. *Interactive Learning Environments*, *11*(2), 147–165. https://doi.org/10.1076/ilee.11.2.147.14135

Moore, R., Vitale, D., & Stawinoga, N. (2018a). The digital divide and educational equity: A look at students with very limited access to electronic devices at home. *ACT Research & Center for Equity in Learning*.

Moore, R., Vitale, D., & Stawinoga, N. (2018b). The impact of school closures on student learning: An analysis of real-time data for 1.6 million students using Achieve3000 Literacy. *Insights in Education and Work*.

Morgan, T., & Dean, A. (2016). *Future considerations in the adoption of educational technologies*. 11.

Müller, R., & Turner, J. R. (2007). Matching the project manager's leadership style to project type. *International Journal of Project Management*, *25*(1), 21–32. https://doi.org/10.1016/j.ijproman.2006.04.003

Digital Equity Act of 2019, S.1167, 116th Congress, 1, 61 (2019).

Mutekwe, E. (2012). The impact of technology on social change: A sociological perspective. *Journal of Research in Peace, Gender and Development*, *2*(11), 226–238.

Newsom, G. (2020). *Executive Department of the State of California*.

Niederhauser, D. S., Howard, S. K., Voogt, J., Agyei, D. D., Laferriere, T., Tondeur, J., & Cox, M. J. (2018). Sustainability and scalability in educational technology initiatives: Research-informed practice. *Technology, Knowledge and Learning*, *23*(3), 507–523. https://doi.org/10.1007/s10758-018-9382-z

No Child Left Behind Act of 2001, Pub. L. No. 107–110, United States Code (2002).

Northouse, P. G. (2016). *Leadership: Theory and practice* (Seventh edition, international student edition). Sage.

Ohler, J. (2011). Digital citizenship means character education for the digital age. *Kappa Delta Pi Record*, *47*(sup1), 25–27. https://doi.org/10.1080/00228958.2011.10516720

Ott, M., Shaw, S. F., Danila, R. N., & Lynfield, R. (2007). Lessons learned from the 1918–1919 influenza pandemic in Minneapolis and St. Paul, Minnesota. *Public Health Reports*, *122*, 8.

Owen, P. S., & Demb, A. (2004). Change dynamics and leadership in technology implementation. *Journal Of Higher Education*, *75*(6), 636–666.

Park, S. Y. (n.d.). *An analysis of the technology acceptance model in understanding university students' behavioral intention to use e-learning*. 13.

Pelavin Research Institute. (1997). *Investing in school technology: Strategies to meet the funding challenge*. U.S. Dept. of Education, Office of Educational Technology.

Petersen, G. J. (2005). Demonstrated actions of instructional leaders: An examination of five California superintendents. *Educational Administration Quarterly*, *41*(1), 49–82.

Philip, T. M. (2017). Learning with mobile technologies. *Communications of the ACM*, *60*(3), 34–36. https://doi.org/10.1145/2976735

Phillips, Jack J., & Phillips, P. P. (2008). Distinguishing ROI myths from reality. *Performance Improvement*, *47*(6), 12–17. https://doi.org/10.1002/pfi.20003

Phillips, J.J. (1996). ROI: The search for best practices. *Training and Development*, *50*(2), 42–47.

Rahman, M. M., Lesch, M. F., Horrey, W. J., & Strawderman, L. (2017). Assessing the utility of TAM, TPB, and UTAUT for advanced driver assistance systems. *Accident Analysis & Prevention*, *108*, 361–373. https://doi.org/10.1016/j.aap.2017.09.011

Reimagining the role of technology in education: 2017 national education technology plan update. (2017). U.S. Department of Education, Office of Educational Technology.

Research Scholar, Liberty University., & Brown, L. (2014). Best practices of leadership in educational technology. *I-Manager's Journal of Educational Technology*, *11*(1), 1–6. https://doi.org/10.26634/jet.11.1.2668

Reznick, J. S. (2017). Defining constructs and variables. In *The developmental scientist's companion: Improving research methodology and achieving professional success* (pp. 33–52). Cambridge University Press.

Richards, E. (2020, March 29). *Coronavirus: Closed schools turn to TV, PBS, Fox to teach students*. USA Today. https://www.usatoday.com/story/news/education/2020/03/28/pbs-online-learning-lausd-coronavirus-school-closures-tv-fox/2925962001/

Richardson, J. W., & Sterrett, W. L. (2018). District technology leadership then and now: A comparative study of district technology leadership from 2001 to 2014. *Educational Administration Quarterly*, *54*(4), 589–616. https://doi.org/10.1177/0013161X18769046

Rivero, V. (2018). 2017-2018: The minds behind what's now & what's next. *EDTech Digest*.

Rogers, E. M. (2003). *Diffusion of innovations* (Fifth edition, Free Press trade paperback edition). Free Press.

Ryan, B., & Gross, N. (1943). Acceptance and diffusion of hybrid corn seed in two Iowa communities. *Rural Sociology*, *8*(1), 48.

Savery, C. A. (2005). *Innovators or laggards: Surveying diffusion of innovations by public relations practitioners*.

Schipper, J. M., & Yocum, R. G. (2016). Interactive whiteboard technologies in high school: A comparison of their impact on the levels of measure that determine a return on investment. *Journal of Educational Technology Systems*, *44*(4), 377–403. https://doi.org/10.1177/0047239515615846

Schlechty, P. C. (2001). Leading structural and cultural change. In *Shaking up the schoolhouse: How to support and sustain educational innovation* (1st ed, pp. 159–175). Jossey-Bass.

Schmitt, C. (2002). *Technology in schools*. 175.

Schrum, L., Galizio, L. M., & Ledesma, P. (2011). Educational leadership and technology integration: An investigation into preparation, experiences, and roles. *Journal of School Leadership*, *21*(241–261), 22.

Schwartz, J. L. (2018). The Spanish Flu, epidemics, and the turn to biomedical responses. *American Journal of Public Health*, *108*(11), 1455–1458. https://doi.org/10.2105/AJPH.2018.304581

Scoggin, D., & Ark, T. V. (2018). Putting dialogue over devices shapes mind and character. *Education Next*, *18*(1), 55–63.

Seyal, A. H. (2015). Examining the role of transformational leadership in technology adoption: Evidence from Bruneian technical & vocational establishments (tve). *Journal of Education and Practice*, 13.

Snelling, J. (2018). How LAUSD's troubled rollout became a model for tech success. *Empowered Learner*, 7.

Snider, V. E., & Roehl, R. (2007). Teachers' beliefs about pedagogy and related issues. *Psychology in the Schools*, *44*(8), 873–886. https://doi.org/10.1002/pits.20272

Sotiriou, S., Riviou, K., Cherouvis, S., Chelioti, E., & Bogner, F. X. (2016). Introducing large-scale innovation in schools. *Journal of Science Education and Technology*, *25*(4), 541–549. https://doi.org/10.1007/s10956-016-9611-y

Spector, J. M. (2013). Emerging educational technologies and research directions. *Educational Technology & Society*, *16*(2), 21–30.

Sterrett, W. L., & Richardson, J. W. (2017). Cultivating innovation in an age of accountability: Tech-savvy leadership. *Journal of Cases in Educational Leadership*, *20*(4), 27–41. https://doi.org/10.1177/1555458917700227

Tarbutton, T. (2018). Leveraging 21st century learning & technology to create caring diverse classroom cultures. *Multicultural Education*, *25*(2), 4–6.

Tarde, G. (1903). *The laws of imitation* (E. W. C. Parsons, Trans.). Henry Holt and Company.

The power of the internet for learning: Moving from promise to practice. (2000). Office of Postsecondary Education, E. W. D. O. of P. P. and I.

Thohari, H., Ayu, P., & Indria, T. (2013). *The Development Of Technology For Human Civilization*. 6.

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development*, *65*(3), 555–575. https://doi.org/10.1007/s11423-016-9481-2

Trump, D. J. (2020). *Proclamation on declaring a national emergency concerning the novel coronavirus disease (COVID-19) outbreak*. https://www.whitehouse.gov/presidential-actions/proclamation-declaring-national-emergency-concerning-novel-coronavirus-disease-covid-19-outbreak/

Urban, J. (2018). Possibilities and limits of adopting successful managerial approaches: From "best practice" to "best fit." *Studia Commercialia Bratislavensia*, *11*(39), 118–127.

U.S. Department of Education. Institute of Education Sciences, National Center for Education Statistics. (2019). *Digest of education statistics, 2019*. National Center for Education Statistics. https://nces.ed.gov/programs/digest/d19/tables/dt19_209.10.asp

U.S. Department of Education, Office of Educational Technology. (2017). *Reimagining the role of technology in education: 2017 national education technology plan update*. U.S. Department of Education, Office of Educational Technology.

U.S. Department of Education, Office of Safe and Drug-Free Schools. (2003). *Practical information on crisis planning: A guide for schools and communities*. U.S. Department of Education, Office of Safe and Drug-Free Schools.

Venkatesh, Morris, Davis, & Davis. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425. https://doi.org/10.2307/30036540

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186–204. https://doi.org/10.1287/mnsc.46.2.186.11926

Webster, M. D. (2017). Philosophy of technology assumptions in educational technology leadership. *Educational Technology & Society*, *20*(1), 25–36.

Westera, W. (2004). On strategies of educational innovation: Between substitution and transformation. *Higher Education*, *47*(4), 501–517. https://doi.org/10.1023/B:HIGH.0000020875.72943.a7

WHO Timeline—COVID-19. (2020, April 27). https://www.who.int/news-room/detail/27-04-2020-who-timeline---covid-19

Yin, R. K. (2018). *Case study research and applications: Design and methods* (Sixth edition). SAGE.

Yu, C. (2013). *The integration of technology in the 21st century classroom: Teachers' attitudes and pedagogical beliefs toward emerging technologies*. *5*(1), 5–11.