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K-12 Educational Technology Implementations: A Delphi Study

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Abstract

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

The use of educational technologies is a key component of education reform. In its current national technology plan, *Future Ready Learning: Reimagining the Role of Technology in Education*, the U.S. Department of Education asserts that educational technologies can transform student learning. Successful integration of educational technology could increase student achievement and transform the setting to bring about positive social change. The purpose of this study was to provide a group of expert panelists an opportunity to identify strategies and guidelines to create an effective educational technology plan. Data were gathered using a modified Delphi technique from 7 teachers, 8 administrators, and 7 policymakers. All had expertise in educational technologies and experience with past state technology implementations, and all used a Delphi instrument to rate statements from current research. Their recommendations confirmed the importance of each stage of Rogers' 5 stages of the innovation-decision process; the panelists also reached consensus about the role of the state and its responsibility to provide support and guidance to districts and schools when implementing educational technology plans. The results showed that an individualized approach to implementation of an educational technology innovation, rather than an organizational approach, may improve the rate of diffusion and adoption of educational technology innovations in this state's K-12 public schools. This shift in how implementations are managed could produce a more efficient and effective way to integrate educational technology innovations in U.S. K-12 schools.

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Chapter 1: Introduction to the Study

Educational technologies such as laptops, tablets, and interactive websites are key components of the K-12 public school educational environment in the United States in the early 21st century. In its current national technology plan *Future Ready Learning: Reimagining the Role of Technology in Education* (2016), the U.S. Department of Education asserts that educational technologies can transform student learning. According to experts in education, these technologies offer students opportunities to be creative and use critical thinking skills (Fullan, 2014; Rothman, 2012; Zhao, 2012). Educational leadership and policymakers see a continuing need to include educational technology innovations in schools and classrooms.

Teachers reason that educational technologies increase student achievement and prepare students for college and career. They find value in using the tools and integrate them in various ways in different grades and subject areas (Ruggiero & Mong, 2015). Although, they struggle to use them in ways "to enhance learning, provide workplace readiness, meet accountability measures, provide classroom differentiation, adhere to curriculum standards, and foster 21st century skills" (Mardis, ElBasri, Norton, & Newsum; 2012, p. 80). And teachers' uses of educational technologies have not produced the changes in education envisioned by education leadership and policymakers (Hazen, Wu, Sankar, & Jones-Farmer, 2012). However, they continue to plan implementations in an effort to successfully integrate educational technologies in the classroom because educational technologies represent powerful tools which can increase students' abilities to communicate, create, and learn.

A comprehensive plan for implementing educational technologies could increase the rate of diffusion and adoption of the innovations. The purpose of this study was to identify strategies and guidelines which could be used to develop an educational technology plan which will increase the rate of diffusion and adoption of educational technologies in K-12 public schools and classrooms. These recommendations may lead to successful integration of educational technologies and transform the environment. Social change occurs when new ideas and tools are successfully implemented.

This chapter includes additional information about the use of educational technologies in U.S. K-12 education. Also discussed is the purpose of the study and the theoretical framework which grounds it. The chapter closes with a review of the research method, including assumptions, limitations, scope, and delimitations and the significance of the study.

Background

Over the past decades, leadership and policymakers have attempted to integrate educational technologies into schools and classrooms to increase student achievement and motivation. Currently, teachers use educational technologies in classroom teaching, but in limited ways. Martin and Carr (2016) point out that PowerPoint presentations and videos are the educational technologies used most in the classroom. Teachers use these multimedia tools to introduce topics and share information with students. The practices do not represent approaches for integrating educational technologies which might change the classroom environment to a student-centered classroom where students direct their own learning and practice communication and collaboration skills. Pohl (2009) contends

that the current use of educational technologies in the classroom has continued a teacher-centered pedagogy where the focus is on the teacher as the leader rather than as a manager of student learning. Teachers are using educational technologies to enhance their traditional role in the classroom.

When teachers attempt to use educational technologies which are more familiar to students, like social media or mobile phones, the educators are often met with resistance. Students do not recognize how the technologies they consume outside the classroom can be used as educational tools (Nowell, 2014). Teachers assume that 'digital natives' or students who have always had access to technologies, are skilled with using them because the technologies have always been available. However, students vary in their contact with smartphones, computers, tablets, the Internet, and social media. Greenhow, Walker, and Kim (2011) urge policymakers and educators to consider that low-income students differ in their access to, and use of, the Internet. Equitable access to educational technologies represents another reason to implement them in the classroom because all students should know how to use technology as learning tools.

Leaders, administrators of schools, and government officials have invested heavily in educational technologies for U.S. K-12 public schools. The educational technologies industry represents an $8 billion-plus annual market (Herold, B., 2016). The Center for Digital Education estimated that in 2013 K-12 public schools in the United States spent $9.7 billion on instructional technologies (Halpin & Codding, 2013). And even with the decreasing cost of technology, spending on educational technologies in the United States is expected to increase (Schaffhauser, 2016).

Technology is everywhere and policymakers and educators realize that students need technology skills to be successful in college and career. But they have not seen change or improvement in either student achievement or motivation. Meanwhile, technologies have increased productivity in business and industry, so there is continued hope that educational technologies can bring improvement to U.S. K-12 public schools. Leaders support the purchase of educational technologies, but there appears to be a lack of comprehensive strategies and guidelines for them to use when creating plans for educational technology implementations which result in successful integration.

Problem Statement

Strategies and guidelines are needed to increase the potential for successful diffusion and adoption of educational technologies in U.S. K-12 classrooms. Educational technologies in classrooms have not produced the expected increases in student achievement. Scholars have identified only modest gains in student scores from the use of educational technologies (see Culp, Honey, & Mandinach, 2005; Magaña & Marzano, 2014; Means, 2010; Tamin, Bernard, Borokhovski, Abrami, & Schmid, 2011). They have not transformed classroom learning in the ways which advocates had hoped.

In addition, the use of educational technologies was expected to improve student motivation and interest. Savage and Brown (2014) reviewed multiple studies which showed mixed results regarding improvement in attitudes about learning, but noted "school is where technology skills are taught and learned so long as the resources and teacher knowledge of its capabilities are available" (p. 20). Technology is a necessary

piece of a complete education and students need access to the technologies and teachers need skills to help students use them in ways which increase achievement.

The continuing desire and need to supply educational technologies for students and develop proficient teachers who can use the tools are relevant to State X. In this study, State X is a pseudonym used to maintain the confidentiality of the participants and the setting. Educators and policymakers of State X have a decades-long record of providing educational technologies to improve learning in K-12 public schools with mixed results (Office of the State Board of Education, 2005, Office of the State Board of Education, 2015).

Starting in the mid-1990s, policymakers in State X implemented a technology initiative designed to meet the need for "interactive, personalized learning that promised to enhance student motivation" (Barr & Thorsen, 2003. p. 1). They placed computers in classrooms, created computer labs, and provided professional development in how to integrate computers into the classroom. Leadership also attempted to create student information systems, provide online resources for teachers, and online coursework for student and teachers. However, these implementations met with limited success (Office of Performance Evaluations, 2005; Office of Performance Evaluations, 2015). A review of past educational technology implementations in State X and the results of reviews of those implementations are included in Chapter 2. State X continues to identify educational technologies as a necessary component of student achievement with the potential to transform the K-12 public education environment (Office of the State Board of Education, 2013).

Advocates of integrating educational technologies which could provide new pedagogies have identified the need for better implementation policies (Cavanaugh, Dawson, & Ritzhaupt, 2011; Kong et al., 2014). Improvement in student achievement which is dependent on teacher skill and available technology requires focused implementation strategies where teachers become comfortable with the educational technologies and know how to use those technologies (Koh & Divaharan, 2011). A new approach to diffusing and implementing educational technologies may improve the diffusion and adoption of educational technologies in State X K-12 public schools.

Purpose of the Study

The purpose of this study was to identify strategies or guidelines which could be used to develop a successful educational technology plan to increase the potential for successful diffusion of educational technologies in State X K-12 public schools. A panel of educational technology experts used a Delphi instrument to provide recommendations.

Research Question

The research question guiding this investigation was, What will a panel of experts identify as the best implementation strategies or guidelines to increase the potential for successful adoption of educational technologies in K-12 public schools in State X?

Theoretical Framework

Rogers' (2003) diffusion of innovation theory as well as group consensus provided the framework to identify strategies for implementing educational technologies as a way of increasing student achievement in State X. Rogers (2003) defined diffusion as "the process in which an innovation is communicated through certain channels over

time among the members of a social system" (p. 11). He identified stages of the innovation-decision process, beginning with becoming aware of available innovations, through making choices about the use or rejection of an innovation, and ending with confirmation that the innovation has been adopted. There are also generalizations within the process which may help increase the rate of diffusion and adoption of an innovation. Innovations are defined as ideas or technologies which are communicated through a social system and promoted to produce positive change.

There is a need for a comprehensive approach for efficient diffusion and adoption of educational technology innovations. Topper & Lancaster (2013) pointed to obstacles which schools have when implementing technologies. These challenges include leadership and vision, teacher professional development, and project evaluation. The diffusion of innovation theory provides a framework which addresses these concerns.

Nature of the Study

A panel of educational technology experts used a Delphi instrument to identify strategies and guidelines which may increase the potential for diffusion and adoption of educational technologies K-12 schools in State X. The Delphi method is an effective way of creating consensus (Hall, 2009). The purpose of the Delphi technique is to obtain insight about an issue or problem, using expert panelists in a setting where they are free to express their views without the outside influences which often occur in committee work (Linstone & Turoff, 2002). The Delphi method gives an equal voice to each member of the panel and offers them a chance to share their knowledge.

Twenty-two experts participated in the study and used an online instrument to rate statements. The use of the online site for gathering and sharing information was efficient, and it promoted open communication because panelist anonymity added a democratic nature to the study, each response had equal value. The identity of each member remained unknown to the others throughout the study. Before sharing a panelist's comment with the other members, any distinguishing information was removed to protect their identity.

The Delphi instrument used in Round 1 of the study contained statements from current research literature about educational technology implementations. For the second and third rounds, the mean score for each statement and any additional panelist feedback was shared as part of the Delphi instrument. The panelists were asked to rate all statements and comments in each round; however, they could change their ratings in any round. The study continued for three rounds. Analysis of collected data showed consensus about strategies and guidelines which could improve the potential for successful implementation of educational technologies in State X.

The Delphi technique was most appropriate for this study. It provided a structured way to gather and share opinions, experiences, and insights of persons who were familiar with both the past educational technologies implementations in State X and the state's current education environment. The volunteers in this study were highly qualified professionals, including teachers, administrators, directors, and policymakers; however, the study did not include every educational technology expert in State X. Chapter 3 contains the criteria for identifying potential panelists.

Definitions

Educational technologies: John Dewey identified the importance of using technology tools to enhance learning as a part of learning by doing. In 1977, researchers defined educational technology as "a complex, integrated process involving people, procedures, ideas, devices, and organization, for analyzing problems and devising, implementing, evaluating, and managing solutions to those problems, involved in all aspects of human learning" (AECT, 1977, p. 19). In this study, the term refers to technical resources and includes computers, tablets, interactive whiteboards, Internet communication technologies (ICTs), and the use of digital resources, like the Internet, multimedia, and databases. There are usually hardware and software components to the innovations.

Innovations: Rogers (2003) defined an innovation as "an idea, practice, or object that is perceived as new by an individual or other units of adoption" (p. 12). In this study, educational technologies include the use of digital, electronic, or multimedia to enhance student learning. They are innovations which can enhance education and prepare students for college and career.

Many educational technologies, like computers and tablets, are not new to the U.S. K-12 education setting, however, they are included as innovations in this study because their implementation and adoption might not have been fully realized previously by teachers or students.

Student Achievement: Standardized test scores represent a measureable way to identify an increase in student learning. These assessments include the tests aligned to the

Common Core Standards like Smarter Balanced Assessment Consortium (SBAC) and Partnership for Assessment of Readiness for College and Careers (PARCC). Although educational technologies have benefits to teachers and students beyond these measurements, the assessments provide a quantitative way to calculate change. The schools in State X participate in several national and international assessments. These measurements include the National Assessment of Educational Progress.

Assumptions

Two proposed aspects of the study cannot be demonstrated to be true. The first is that schools have not used educational technologies in ways which transform education. Teachers and students have had access to educational technologies in U.S. K-12 public schools for decades. However, a change in school culture is difficult to establish because schools are reluctant to admit failures, yet continue to seek improvement. Educational technologies are available in schools; however, their use to increase student achievement or transform the setting remains an unmet goal of education reformers and a component of education policies.

The second assumption which cannot be confirmed is that the educational environment defined as educators, teachers, and students represents a social system rather than an organization. Rogers (2003) defined a social system as a "set of interrelated units engaged in joint problem-solving to accomplish a common goal" (p. 11). Schools operate as organizations and emphasize formal approaches and models for implementation and adoption of educational technologies. The use of Rogers' theory in this study centered on

viewing educators as a social system, rather than employees of an organization. More information about Rogers' diffusion of innovation theory is included in Chapter 2.

Scope and Delimitations

The purpose of this study was to discover strategies or guidelines to improve the potential of successful implementation and adoption of educational technologies in State X. These recommendations could be used to create a plan for State X's next educational technology implementation. The study was not designed to identify specific educational technologies to be integrated in classrooms.

The panelists used an online survey tool to share information and rate statements gathered from recent research about the implementation and adoption of educational technologies. The experts could add comments to the Delphi instrument which were shared with all panelists. The online environment provided anonymity for the panelists to openly share their comments without possible adverse consequences. The use of an online tool increased the efficiency of the project because the panelists did not have to travel to confer or spend time in a face-to-face meeting.

There were several delimitations to the study. The anonymity of each expert was essential to the study. A feature of the Delphi technique is the ability of expert panelists to share knowledge and insight in an environment where there is freedom from repercussions or outside influences from educators who may want to affect the results of the study. Contributors might have had connections to people who could manipulate the outcomes to where the strategies and guidelines did not represent the recommendations of the panelists. The invitation to the study included an explanation of the importance of

keeping participation in the study confidential until the conclusion of the study when the experts could identify themselves as a panelist.

The early withdrawal from the study by expert panelists could also have affected the results of the study. The procedures used during the recruitment of experts for the study were specific and designed to increase both the potential for procuring a sufficient number of experts and ensuring that those experts who agreed to participate remained in the study until all panelists reached consensus. Because the Delphi instrument was based on Rogers' diffusion of innovation theory and the experts were familiar with State X, it would follow that another group of educational technology experts from State X would reach similar results.

Limitations

The strategies and guidelines identified during the study may not be appropriate to other states or districts. The expert panelists who participated in this study possessed knowledge specific to State X and its past educational technology implementations. Their expertise and familiarity with the education environment in State X may prevent a generalization to other states or districts because the results of this study were specific to State X. However, the researcher-created Delphi instrument is a tool which could be used with other expert panelists to create strategies and guidelines which are applicable to another district or state.

Experts with unique knowledge and understanding of past adoptions of educational technology implementations in State X represented what could be considered a biased sample. The design of the Delphi technique required the assembly of panelists

who possessed expertise which qualified them to participate as experts. Gathering a diverse group as described in Chapters 3 and 4 enhanced the potential to reduce researcher bias. A diverse expert panel provided several viewpoints and represented an understanding of what had occurred and what is happening within the state. That background information was used to make recommendations for the next educational technology plan.

Significance of the Study

The insights and experiences of educational technology experts represents valuable information which could facilitate change in education. Possible contributions of the research include the identification of the most useful strategies and guidelines for creating educational technology plans. These plans have the potential to increase the rate of diffusion and adoption of educational technologies. These changes increase the possibility to improve student achievement and prepare students for college and career.

With limited state and district funds, it is becoming increasingly important to make wise financial decisions about educational technology purchases. Obtaining tools which students and teachers effectively use increases the possibility for transformation in the educational environment. The potential of successful integration of educational technologies increases when teachers have the tools they need (Bill & Melinda Gates Foundation, 2014; Borrego, Froyd, & Hall, 2010; Drape, Westfall-Rudd, Doak, Guthrie, & Mykerezi, 2013). Strategies for successful adoption of educational technologies will increase the process of providing useful educational technologies tools to teachers.

Educational technologies represent an investment in innovations which must produce expected results for students and teachers.

This study also has the potential to improve understanding of the type of diffusion and adoption process to use in the education setting. The strategies and guidelines could be used to create a new model to test for effectiveness. Often the mandatory application of educational technologies in the classroom has been a *top-down* approach which makes adoption difficult because the tool is not matched to the person (Karmeshu, Raman, & Nedugadi, 2012). More research which "further guides to best approaches for bringing new ideas for teaching and learning" is needed (Kardasz, 2014, p. 63). If using a system approach rather than an organizational approach improves the diffusion and adoption of innovations in schools, the different model could increase the rate of diffusion and adoption of other types of educational innovations. Change can be difficult, but recognizing strategies and guidelines which facilitate transformation can benefit all stakeholders. Social change happens with the successful implementation of innovation (Rogers, 2003).

Summary

Educational technologies represent important tools which increase student learning and prepare students for college and career. Educators and stakeholders continue to develop and invest in it; however, past implementations have not produced expected results. This study was designed to identify ways to increase the potential for successful diffusion and adoption of educational technologies tools in State X.

State X is not unique in its disappointing experiences with educational technology implementations. As part of the Delphi technique, the experts rated statements and added comments to develop consensus about strategies and guidelines for implementing educational technologies in K-12 public schools. Chapter 2 contains a detailed explanation of Rogers' diffusion of innovation theory and explains how that approach increases the potential for implementation and adoption of educational technologies in K-12 public schools. There is also an analysis of current research grounded in the innovation diffusion theory which reviewed the implementation and adoption of educational technologies in the education environment. The development of the instrument for the first round of the modified Delphi study included statements from these studies. Also included in Chapter 2 is information about the Delphi technique and how it has been used in educational research. The chapter concludes with a review of the past educational technology implementations of State X.

Chapter 2: Literature Review

Teachers and students use educational technologies to increase student achievement and prepare them for college and career. Access to educational technologies and technology support has increased over the last twenty years and integration is evident in classrooms (Ruggiero & Mong, 2015). Teachers monitor student progress with digital gradebooks and teach using PowerPoint presentations, videos, and interactive whiteboards. Students play online educational games and produce reports using word processors and information obtained from the Internet. Students and teachers recognize that educational technologies belong in the classroom; however, they are not using them in ways that change learning or increase student achievement.

There have been modest increases in student achievement in reading and math as measured by standardized tests in State X since 2001. Magaña and Marzano (2014) reported that educational technologies have an impact on teachers and students; however, it is difficult to determine if the change in student learning is a result of technology use or the pedagogical approach of the teacher who uses the technology. Meanwhile, the integration of educational technology continues as an important part of educational reform.

The purpose of this study was to identify strategies and guidelines to facilitate the implementation and adoption of educational technologies in K-12 public schools in State X. Chapter 2 includes an explanation of the search for relevant literature about the implementation and adoption of educational technology in schools and districts. The chapter also includes an examination of the diffusion of innovations theory which

grounds the study, and the use of the Delphi technique as a research tool, including its use in education research. The Technology Acceptance Model (TAM), the Concerns-based Adoption Model (CBAM) and the Teacher Pedagogy and Knowledge framework are models and a framework which are used to implement educational technologies and innovations in education and a review of those methods is included. The chapter concludes with a review of past educational technology implementations in State X.

Literature Search Strategy

The literature review included multiple approaches and sources. A quality literature review includes sources that are high quality, logical, and free of bias (Dawidowicz, 2010). I reviewed databases including the Academic Search Complete, Education Research Complete, Education Research Complete (ERIC), and Teacher Reference Center. Search terms included *diffusion and adoption*, *change strategies*, *program implementation*, *diffusion*, *educational change*, *educational innovation*, and *technology integration*. I used the keywords *educational technology practices* and *educational technologies integration* to identify studies where researchers reviewed computer use in education. Routine searches identified new scholarship relevant to the study.

The literature review included historical documents and state research reports relevant to educational technologies implementations in State X. Johnson and Christensen (2008) pointed out that these types of documents are appropriate to use if there is a review of authority and accuracy. The reviewed research reports were studies requested by state legislators and completed by the Office of Performance Evaluation, a

department designated to analyzing the impact of state funds on specific projects which were initiated by the legislature. The team of researchers who completed the reviews used quantitative and qualitative methods and included recommendations for future state implementation plans.

Theoretical Foundation

Diffusion of Innovations Theory

Diffusion of innovations theory is a framework for understanding why and how individuals within a system decide to adopt or reject an innovation. Diffusion research as a discipline started in the 1940s and is now used in the fields of sociology, education, public health, communication, and marketing as a process for understanding the implementation and adoption of innovations (Rogers, 2003). Rogers identified stages and generalizations which can be used to increase the potential for successful implementation of an innovation in society or an organization. Rogers (2003) defined diffusion as "the process by which (1) *innovation* (2) is *communicated* through certain *channels* (3) over *time* (4) among the members of a *social system*" (p.11). For this study, the theory provided a structure, or framework, for identifying elements and practices which can lead to successful implementation and increase the potential for adoption of educational technologies tools in classrooms and districts in State X. Successful integration can enhance student achievement and create positive social change.

Rogers also studied the adoption process in organizations. An organization represents people working together to achieve a goal (Rogers, 2003). Members have tasks to accomplish, roles within the organization, and there is usually a leader or someone in

charge. The K-12 public school system represents a unique organization and there is usually a considerable time lag in the rate of adoption of innovations in education (Rogers, 2003). The rate of adoption refers to the speed that an innovation is adopted by members of a system.

The innovation-decision process is divided into five stages: (a) knowledge; (b) persuasion; (c) decision; (d) implementation; and (e) confirmation. These phases involve a series of choices and actions by an individual where communication networks facilitate the process (Rogers, 2003). Understanding the process, including the effective use of communication channels, can improve the rate of adoption and increase the potential for successful implementation of educational technologies in K-12 public schools.

Rogers (2003) explained the processes for both the adoption and non-adoption of an innovation. He pointed out that non-adoption can occur through either passive or active rejection. Passive rejection occurs when the individual declines the tool or idea before a trial use. Active rejection follows an initial decision to accept an innovation, use it, and later dismiss the change. And implementation of an innovation is considered successful when change is confirmed. Rejection can take place both before and after a decision to adopt, and there are generalizations that can be used in each phase of the adoption process to increase the potential for successful adoption.

The use of communication channels is essential to moving the adopter through the process and increasing the rate of adoption. Rogers (2003) identified mass media channels and interpersonal channels as two ways to share information about the innovation among potential adopters. He also pointed out that the interactivity of

communication on the Internet, like the use of social media, is becoming more important to the diffusion process. Internet communication technologies (ICTs) represent both types of communication channels. As a mass media channel, ICTs can reach many individuals where they become aware of innovations, and social media sites provide interpersonal channels for individuals to exchange information which meet their personal needs.

The innovation adoption process for an organization is different from the process for a social system. The organization uses a hierarchical course of action for implementation of innovation that includes five different stages. The phases for the organization are: (a) agenda setting; (b) matching the innovation to gap or need; (c) redefining or restructuring; (d) clarifying; and (e) routinizing. Education represents an organization which uses hierarchical approaches when implementing innovations.

Leadership and modeling influence the rate of diffusion in both the organization and social system. *Change agents* and *opinion leaders* affect the adoption rate in social systems, and *champions* encourage adoption in organizations. Change agents affect innovation decisions and are responsible for communicating the need for change and maintaining a positive relationship with the potential adopter. Opinion leaders are the informal, influential leaders within a system and are viewed as unofficial leaders.

Champions work within organizations to promote innovations. They usually (a) have a significant role in the organization; (b) possess unique skills for relating to other members of the organization; and, (c) demonstrate necessary collaborative skills (Rogers, 2003). The success of an innovation within an organization is dependent upon the skills

of the champion during the implementation. Principals and other district leaders represent champions in education.

The education system may respond to diffusion and adoption more as a social system rather than an organization. Rogers (2003) defined two types of systems, centralized and decentralized. He identified the centralized diffusion system as a system which emphasized needs created by the availability of the innovation, or the technology push. The technology push is defined as the need to use the innovation because it is available. The decentralized system represents a more problem-centered approach, created by a perception of requirements or technology pull, where the technology meets a demand or need. The centralized system produces a lower degree of adoption and increased re-invention; the decentralized system realizes a higher degree of local adaptation where the innovation evolves to meet a need. Technical expertise becomes a problem with a decentralized diffusion due to concerns with quality control and reinvention. The user's skill level enhances the potential for the innovation to be used to meet the need as planned.

Researchers use diffusion of innovations theory to study the rejection and adoption of innovations. Rogers (2003) identified generalizations, or trends, from diffusion studies which can potentially increase the rate of adoption. The educational technology expert panelists rated statements from research based on those generalizations from the innovation-decision process in a social system. Current research matched the phases of the innovation-decision process and generalizations supported those statements.

Education Studies Based on Diffusion of Innovation Theory

Researchers use the diffusion of innovation theory as the foundation for their studies. Recognizing the function of each stage of the diffusion process makes it easier to understand how to successfully implement an innovation. There are five sequential stages in the Innovation-Decision process within a social system: (a) knowledge; (b) persuasion (c) decision; (d) implementation; and (e) the confirmation. The experts rated statements gathered from results of studies which matched Rogers' (2003) innovation-decision process.

Knowledge Stage

It is during the knowledge stage that the individual becomes aware of the innovation and gains information about how it works and what its benefits are. There are three types of knowledge: (a) *awareness knowledge*, the individual becomes informed that the innovation exists, (b) *how-to knowledge*, the individual learns how to use the innovation, and (c) *principles knowledge*, where the individual understands the background and reasoning which supports or explains why the innovation exists. Access to each type of knowledge increases the potential for successful adoption of an innovation by an individual.

Teacher participation in the beginning processes of an implementation where decisions about what type of educational technology will be used is important to successful adoption. Current research consistently identified the need for teacher involvement when identifying an innovation to use in the classroom (Bill & Melinda Gates Foundation, 2014; Elmore, 2004; Hazen, Wu, and Sankar, 2012; Hosman &

Cvetanoska, 2013; Stevens, 2014). The teacher involvement in selecting the educational technology tool to meet the need of the school or district represents a change to the organizational model. In an organization, the leaders, or a team of stakeholders, identifies the appropriate innovation to meet the need of the organization. Teacher inclusion as a representative in the decision process may improve the chances that the innovation is implemented by the organization.

However, a different diffusion model is used if each teacher selects the innovation to use in their classroom rather than sending a teacher representative to participate in a committee decision. Hazen, Wu, and Sankar (2012) noted that teachers represent different disciplines and grade levels, and they have different needs which require different tools. It would be necessary to include a diverse group of teachers in the decision-making process in an education organization. The social system approach represents a personalized approach to providing educational technology tools to teachers and students.

The innovation must match more than a need in the educational environment. There are other attributes of the innovation which increase the potential for successful adoption. The device must be easy to use and understand (Hazen et al., 2012; Jwaifel & Gasaymeh, 2013). The characteristics of the innovation affect the dissemination of the innovation (Hazen et al., 2012). With limited support from outside resources, teachers and students need technologies which do not interrupt learning. Teachers do not adopt innovations which are difficult to use and unreliable.

The individual needs *how-to knowledge*; the teacher needs to see how an educational technology works before being asked to adopt it. Rogers (2003) noted that rejection and discontinuance of the innovation is likely if the potential adopter does not have some level of knowledge about the innovation works before being asked to adopt it. This presents a challenge to a school or district which has made a decision to adopt an educational technology and then is faced with a high annual staff turnover. Teachers who are new to the district are being asked to adopt a new educational technology without an introduction to the technology or training in how to use it. Teachers need to be familiar with the educational technology innovation and how it works before being asked to adopt.

Opinion leaders, champions, or change agents represent leadership and they can improve the diffusion and adoption rate. Drape, Westfall, Doak, Guthrie, and Mykerezi (2013) identified the need for leadership to be involved with the educational technology to increase the *how-to knowledge* of an innovation. Modeling is a visible way for leaders to involve themselves in the adoption process. Principals who used technology in their administrative and instructional tasks acted as influential role models (Afshari, Bakur, Su Luan, & Siraj, 2012). Administrators affected the success of the adoption in a social system when they showed that they could use and support the educational technology innovation.

Teachers need to understand how an innovation can help them meet a need. The third type of knowledge in the innovation-decision process is understanding how a technology can meet an objective; it is knowing why an innovation is effective. Teachers

want products rooted in classroom realities (Stevens, 2014). They will integrate technology into instruction when it matches their goals (Bill & Melinda Gates Foundation, 2014; Means, 2010). Teachers also need instructional technology which supports their efforts to increase student achievement. Increasing educator awareness of the *principles knowledge*, or the understanding of the function and purpose of the innovation, enhances the potential for educator adoption.

Successful adoption begins with an individual becoming aware of an innovation, knowing how to use the innovation, and understanding why it is effective. In a review of past state educational technology implementations, researchers in the Office of Performance Evaluations (2005) for State X pointed to the need for a shift within the state from acquiring technologies to matching them to the needs of educators and students. In the past, State X and districts within the state have attempted to provide a specific type of educational technology like tablets and laptops to all districts, schools, or classrooms. Matching the innovation to the need is a stage of the organizational process of diffusion; however, it can also represent the decentralized structure of the social system.

Persuasion Stage

During the persuasion stage of the innovation-decision process, the educator forms an opinion about the innovation. A positive attitude increases the potential for successful adoption (Rogers, 2003). To develop positive attitudes, teachers must see that the educational technology innovation is an effective teaching tool (Drape et al., 2013) and that it is useful for instruction and matched to classroom realities (Bill & Melinda

Gates Foundation, 2014, Stevens, 2014). Educators want technologies which solve real classroom needs (Jwaifell & Gasaymeh, 2013; Stevens, 2014). Knowing that the innovation is appropriate for use in the classroom increases the teachers' positive feelings about the innovation.

Being able to use an educational technology innovation in a trial run in the individual's classroom or setting also increases the adoption rate. Rogers' (2003) claimed that most individuals do not adopt without first trying a new idea. Trial studies, which provide opportunities for teachers to use an innovation to determine if it matches their needs and environment, increase the potential for successful adoption (Jwaifell & Gasaymeh, 2013). However, individuals can have a favorable outlook on the educational technology and its use in the classroom, and still reject the innovation. The individual can like the tool, but decide not to use it because the educational technology did not meet their classroom needs when they used it in their classroom.

Decision Stage

Individuals within a social system do not all decide to adopt an innovation at the same time. Rogers (2003) identified the five adopter categories and set the criterion for each group using the degree of innovativeness a person might show as a way to determine how open someone might be to an innovation. The five categories are: (a) innovator, (b) early adopter, (c) early majority, (d) late majority, and (e) laggard. Each category is representative of an ideal type with distinct characteristics; however, there are exceptions to each (Rogers, 2003). Innovators tend to be venturesome and unafraid of change. Early adopters decide to use an innovation after careful consideration of its

benefits, but before the mass decides to adopt. Leaders view these earlier adopters as helpful in creating change, hoping the innovators and early adopters model use of an innovation.

Change agents recognize the benefit of using early adopters as opinion leaders because the early adopters are usually respected by other individuals in the system. The early majority represents the next group to adopt. They are not viewed as leaders, but have an interconnectedness with others and represent the largest group within a social system. Members of the late majority approach change with skepticism and their decision to use an innovation is prompted by peer pressure. The laggard focuses on tradition and how things have been done in the past. These labels are terms used to define adopters within a system and are not meant to create a scale where the innovator represents the best member and the laggard is considered the worst member of the social system.

Rogers (2003) identified three groups of characteristics for the identification of the earlier adopters within the social system: (a) socioeconomic characteristics, (b) personality variables, and (c) communication behavior. These characteristics represent variables which affect how a change agent might approach each group. The socioeconomic characteristics do not necessarily apply to educators because teachers are generally equal in level of education and social status. Earlier adopters usually have better attitudes about change and uncertainty. They also share greater levels of connectedness with others within the system and have greater exposure to both mass communication channels and inter-personal communication channels.

Change agents can use the adopter categories to determine how to work with an individual to increase the rate of diffusion and adoption within a system; however, more research is needed to match the characteristics to teachers in an education setting (Hall & Hord, 2011). Elmore (2004) suggested that teachers who are identified as an innovative unit in a school or district are often viewed as outsiders by other educators. The earlier adopters are seen as a privileged group which have special access to the technologies and they may not function as opinion leaders in an education environment. Education grants are often awarded to earlier adopters within a district or school in an effort to create a model for use of the educational technology.

Another approach to determining the potential of educational technologies acceptance and use by educators is to determine the teacher's self-efficacy. Self-efficacy is the individual's perception of their ability to organize and complete certain tasks (Bandura, 1986). Teachers with high levels of self-efficacy identify themselves as using educational technologies in the classroom (Turel, 2014). But to measure the difference between their perceptions and their actual use of educational technologies in the classroom requires a more suitable tool (Fanni, Rega, & Cantoni, 2013). Teachers often express the intention of integrating educational technologies in their classrooms. Positive attitudes about using educational technologies in the classroom increase the potential for decisions to use the innovations, but those perceptions do not always lead to successful adoptions.

Implementation Stage

In an organization, the decision to adopt an innovation is followed with an implementation plan. The implementation plan begins with training in how to use the innovation. Technical support is also provided to members of the organization until use of the innovation becomes routine.

There are challenges to implementing educational technologies in a classroom setting. Adopting an educational technology innovation is difficult when teachers are faced with technical difficulties such as wireless connectivity and useful software which meets the needs of teacher (Çuhadar, 2014). The lack of resources, or the poor coordination of available resources in education, impedes the successful implementation of educational technologies. Teachers and students may experience technical difficulties because the devices or programs do not operate as planned or instructions are not shared or explained. Inadequate technical support can lead to rejection of the innovation because the educational technology is too difficult for the teacher to use in the classroom and interferes with a teacher trying to meet a goal.

Individuals within a social system also begin implementing the innovation after a decision to adopt. Teachers are introduced to how the innovation works as part of the knowledge phase. However, the complexity of change makes adoption less likely if the teacher does not fully understand how to use the innovation beyond the initial *how-to knowledge*. Lee, Hsieh, and Hsu (2011) identified the need for quality training as part of the adoption process. Effective professional development increases the potential for successful implementation that produced an increase in student learning.

Teachers need unique types of instruction and training in how to use an educational technology innovation in an educational setting. Mkhize and Huisemann (2013) identified a need for teacher education which bridges the use of technology with their instructional design skills. Teachers use educational technologies as part of their daily personal and professional activities when they use email and digital grade books; however, they need professional development which includes information about how to match the educational technologies tool to the educational goal.

Professional development which matches a teacher's needs creates a more individualized method for learning. As teachers experienced personalized professional development, they were more likely to take a similar approach with their students (Brooks & Gibson, 2012). A more personalized training for teachers may translate to a more individualized approach to teaching and learning. And, a more individualized approach to teaching and learning represents a shift from a teacher-centric classroom to a student-centered learning environment.

Elements of professional development which include collaborative activities, dialogue, and group participation increased the use of the educational technologies in the classroom. Gu, Xiaodong, Wang, Qin, and Lindberg (2012) reviewed teacher professional development in China and Sweden and pointed out that educators improve when professional development bridges theory and practice through the use of participation and collaboration and includes Internet communication technologies. Multiple types of professional development are necessary for successful implementation.

Educators also require additional technical support during the implementation phase. This support includes adequate wireless access and software which can be used in the classroom to meet the needs of teachers and students (Hazen, Wu, Sankar, & Jones-Farmer, 2012; Mkhize & Huiseman, 2013). If there is a decision to implement, the state can provide this support through stable funding and comprehensive policies. Richardson, Nash, & Flora (2014) identified a need for effective educational technologies policies and funding which will increase adoption. The policies and funding should cover training in the use of technology, support in the educational setting, and time for teacher use and practice. The need for time includes time for teachers outside of the classroom watching other educators use the innovation. With adequate policies and support, educators can utilize the innovations in their classrooms.

If reinvention of an innovation occurs, it usually happens during the implementation stage of the innovation-decision process. The reinvention of an innovation makes it more compatible with the needs of the individual and increases the rate of adoption (Rogers, 2003). However, it means that the innovation is not adopted as it was intended to be used. Poor implementation can also make it difficult for the potential adopter to use the innovation as planned. Potential adopters may reinvent to make the innovation useful to them. Rogers (2003) noted that reinvention in the educational setting usually means that the innovation has changed, not the setting.

Confirmation Stage

The choice to adopt or reject an innovation does not end at the decision stage. Individuals who decided to adopt an innovation could choose to discontinue using it

because they found a replacement for the innovation or because they became disenchanted with it (Rogers, 2003). During the confirmation stage, adopters need support which confirms their decisions to adopt innovations. Post adoption follow-up is also critical to understanding if the innovation was adopted and how successful it was in matching the educator's needs.

Follow up activities that reinforce the acceptance of the innovation provide a picture of use. Collecting quantitative and qualitative data can present an accurate picture of the adoption rate of an innovation. A post-adoption empirical study using educational technologies usage reports can confirm the continued use of innovation and assist in identifying communication channels. Data that show quantitative results and student work samples provide evidence of use. However, teachers' self-reported answers do not always provide information about what was happening in the classroom (Pan and Franklin, 2011). In addition to confirming use, the results strengthen the adopter's decision by validating their decision.

Communication Channels

Mass media and interpersonal communications are the two types of communication channels defined in the diffusion of innovation theory. They represent both new information to the potential adopter and shared knowledge among adopters. Individuals gain knowledge about an innovation through mass media and they share information with others through interpersonal communications. The movement of information through the communication channels is important to the diffusion process

because communication networks help provide structure and stability to the flow of information.

Earlier adopters are more efficient in their use of communication channels. In the concerns-based adoption model, Hall and Hord (2011) use the categories of innovators as a method to increase sharing of information among educators. Individuals who are quicker to adopt tend to use more social networks and make contact with more individuals within the system (Rogers, 2003). Online communities provide ongoing professional development and support for teachers (Booth, 2012). The online community represents both a mass communication channel and an interpersonal network for educators.

Educators can be part of online learning communities as a way to collaborate with other teachers and meet their individual needs for interpersonal networking. The use of social media like Twitter provides interpersonal communication channels where educators can share their experiences with other educators (Carpenter & Krutka, 2015). The educator's professional learning network (PLN) can match several essential needs for professional development by increasing the number of contacts they make with others. Teachers with online spaces can be part of a worldwide network to learn new information and connect with other individuals who can offer support, advice, and feedback (Trust, 2012). This type of reinforcement of educational technology innovations may be helpful to earlier adopters because at the confirmation stage, the individual can still reject the innovation if they do not have adequate support.

Social media create examples of both communication channels for professional development and learning with technology; however, the network may impede adoption if the technology is too difficult or unreliable. Hargreaves & Fullan (2012) pointed out that the role of technology in professional development should be about the innovation and not about the technology used to deliver it. Al-Rahmi, Othman, and Yusuf (2015) reviewed the use of social media to improve collaborative learning and pointed out that use may eventually show benefit, but there is little research in this area. Carpenter and Krutka (2015) discovered that educators who use Twitter to connect with other educators were generally satisfied with the connection; however, their study reviewed only the access and attitudes of the participants. They did not review the quality of the Twitter content for the purpose of professional development. The use of social media as a method of communicating new ideas through mass media or sharing information as an interpersonal channel may effectively support the use of an educational technology, but the depth of necessary professional development may not be available.

Conclusion

The diffusion of innovation theory provides a framework for diffusion and adoption within both a social system and an organization. The five stages of the innovation-decision process include: (a) knowledge, (b) persuasion, (c) decision, (d) implementation, and (e) confirmation. Researchers use this framework to ground studies which review how an innovation is diffused and adopted in both systems and organizations. Current literature that addressed the implementation of educational

technologies became statements to use in Round 1 of the modified Delphi technique. Results from current studies matched each phase.

The diffusion of innovation theory represents a framework for reviewing how an innovation is communicated through a system or an organization (Rogers, 2003). Education is an organization; however, Rogers (2003) pointed out that it requires a unique type of diffusion because educators tend to be involved in collective or authority innovation-decisions and not in the optional innovation decisions which most consumers make. While educators are part of an organization, there have been problems integrating educational technologies in schools and classrooms. Statements which matched the social system framework became items for the review of expert panelists. This framework may provide a more effective approach to diffusion and adoption in schools. The expert panelists had a structured tool to use when identifying strategies and guidelines which increase the potential for successful implementation and adoption of educational technologies in State X.

Other Theories for Educational Technologies Adoptions

Educators use models to plan for the integration of an educational technology innovation in the workplace. The Technology Acceptance Model (TAM) and the Concerns-based Adoption Model (CBAM) are two examples of designs used in education organizations to increase the adoption of educational technologies. Educators and policymakers are also hoping that a new framework for teacher preparation and training will increase effective instruction which uses educational technology. The Technological Pedagogical Content Knowledge (TPACK) is a framework designed to improve the

teacher's use of educational technologies in the classroom as a part of effective instruction. This chapter includes reviews of these models and framework because researchers and policymakers use these designs when they make recommendations to improve the adoption of educational technologies.

Technology Acceptance Model

The Technology Acceptance Model (TAM) is designed to increase the potential for successful adoption of a technology innovation in an organization. The two main components of the framework are the ease of use of the technology and its perceived usefulness to the adopter. Davis (1989) proposes that the scores, or metrics, of these two features of a proposed technology can be correlated to the use and acceptance of a technology innovation. Technologies that are easy to use and meet a need have a better chance of being successfully diffused and adopted.

The first component of the model is the ease of use of the technology. The compatibility, complexity, relative advantage, and the trialability of the innovation as understood by the employees of an organization define the ease of use of the technology (Davis, 1989). Rogers (2003) pointed out that the potential of successful adoption was increased if an innovation had these attributes. If the educational technologies are easy to use the teachers will adopt them; however, the perception of an innovation's usefulness does not always translate to adoption of an educational technology.

Researchers using this model in education, propose changes to the model. Edmunds, Thorpe, and Conole (2012) pointed out that the TAM uses only two constructs of an educational technology, its usefulness and perceived benefit, and the successful

adoption of educational technology may be more complex. Fathema, Shannon & Ross (2015) identified the need to expand the model to include the quality of the innovation as a factor for educator adoption. Lee, Hsieh, and Hsu (2011) validated the use of the technology acceptance model in the education setting, but proposed adding the diffusion of innovation theory to provide a more complete model. The TAM matches the knowledge phase of the diffusion of innovation; however, there is a need for a more complete model which goes beyond creating a positive perception for the potential innovator.

Other aspects of the adoption process should be considered. The TAM framework addresses neither the active rejection of the innovation by the individuals in the system, nor the failure of the innovation to transform in the organizational model. The successful adoption of an educational technology requires more than a positive attitude and quality product.

Concerns-based Adoption Model (CBAM)

The Concerns-based Adoption Model (CBAM) is a theoretical framework used to evaluate and facilitate change within an educational organization. Hall and Hord (2011) designed the model to assist leaders and change agents in the education setting. They identified *10 change principles* which increase the potential for successful implementation of an innovation. Leaders or change agents use questionnaires designed to identify educators' needs for support in acquiring new skills when using the proposed innovation. Additionally, the diagnostic tools are designed to help the leader or change agent recognize which teachers are the early adopters. The identification of these earlier

adopters can be used during the implementation process to increase diffusion through participation as part of the communication channels within the organization. The model is designed for implementing innovations which are mandated for educator use.

The role of the change agent in the CBAM is to provide vision and to obtain feedback from teachers and develop additional professional development to match the needs of the teacher. The goal of the change agent is to provide better training in how to use the innovation and give greater support to increase the acceptance and routinization of the proposed innovation. The CBAM represents an organizational approach which values the professional learning community (PLC) as a collaborative group of educators who are working together to facilitate change.

Researchers also use CBAM as a theoretical lens to evaluate change within an organization and monitor the levels of concerns of potential adopters. Carefully designed questionnaires, or diagnostic tools, are used to evaluate how the potential adopter is changing through the implementation process. Kwok (2014) pointed out that the process is constantly evolving and needs to adjust because the process of change is complex. The CBAM provides insight about the attitudes and concerns of the potential adopter and it also addresses the need for support from both the institution and administration. But it does not deal with the selection process of an innovation. CBAM is a tool for reflection on the implementation process and a way to identify a direction for providing needed support to the teacher.

The CBAM's design gives tools to administrators which they can use to encourage educators to adopt and identify where to provide support during the training

and implementation process. Diagnostic tools provide feedback which can be used to facilitate change. The diffusion of innovation theory is different from the CBAM model because the diffusion of innovation theory follows the individual as part of a social system from the knowledge phase through the adoption or rejection of an innovation. The individual's choice of innovation is not part of the CBAM.

Technological Pedagogical and Content Knowledge (TPACK) Framework

The teacher's choice of the educational technology to use in their classroom to support learning is part of the Technological Pedagogical and Content Knowledge (TPACK) framework. Koehler, Mishra, and Cain (2006) defined the framework as a way to incorporate educational technologies into instruction which also includes knowledge of content and skills which demonstrate an understanding of pedagogy. It is a model which recognizes that educational technologies can support instruction (Graham, Borup, and Smith, 2012). Each educator makes decisions about which innovation to use and how to integrate it based on what fits the needs of teacher and students.

There are growing concerns with the application of the model. It is difficult to use in preservice programs because preservice teachers are limited in their understanding of the benefits of educational technologies because they often lack pedagogical knowledge and classroom experience (Graham, et al., 2012; Pamuk, 2012). The framework represents a model for an effective teacher, but does not show how to achieve the ideal. Also, Pamuk (2012) pointed out that knowledge and attitude do not always lead to implementation. Teachers want to use educational technologies and share that desire as professionals; however, they cannot always integrate technology into their practice as

planned. The use of the TPACK model recognizes the autonomy of the skilled educator, but does not provide strategies for increasing the adoption of innovations.

History of State Educational Technology Implementations

The use of educational technologies by teachers and students is important to the leaders in State X. Over the past decades, they have attempted to integrate educational technologies into classrooms and districts across the state (Office of Performance Evaluations, 2005). However, this has been challenging for the state. A review of state implementations showed limited progress in successfully incorporating educational technologies in classrooms and acknowledgement that the educational system is difficult to change (Office of Performance Evaluations, 2005; Office of Performance Evaluations, 2015). The following is a review of major state implementations of educational technologies.

The state received a federal grant for $9.8 million through the School Technology and Readiness (STaR) program during fiscal years 1990-1991. It used the money to share course content with approximately 3,000 students in remote and rural districts (U.S. Department of Education, 1995). As a member of a three-state consortium, the state also used the satellite system to provide in-service workshops for teachers.

About two-thirds of State X's school districts are rural. State X currently defines a rural school district as meeting one of the following criteria: (a) it has less than 20 enrolled students per square mile within the area encompassed by the district's boundaries or (b) the district's market value for property assessment purposes contains less than 25,000 residents (SB 1165, 2009). Rural districts have struggled to provide a

variety of courses, like higher-level math courses and foreign language courses, to students. Distance learning gives students more options when selecting courses and the students also have access to teachers who are better qualified to teach advanced courses.

The grant brought limited success. Program evaluators identified several highlights to using technology to deliver content to remote areas (U.S. Department of Education, 1995). They acknowledged the math and science programs for using excellent curriculum materials. Students could enroll in a greater variety of courses than those offered in their local schools. In addition to increasing student opportunities for a better education, the online course instructors were available to be examples of effective instructional practices for other teachers located throughout the state who were monitoring coursework. However, there were several challenges and disappointing results.

The program did not increase student achievement in the ways which program planners envisioned (U.S. Department of Education, 1995). Student growth and course effectiveness were not evident. Collaboration and interaction among students who were located at different schools and receiving instruction in a synchronous online setting did not occur as planned. Researchers discovered no changes in classroom practices and students were not collaborating to construct knowledge.

In the mid1990s, state leaders wanted to put personal computers in classrooms to enhance student learning and make educational technology available to all educators and students (Office of Performance Evaluations, 2005). The legislature provided $3.4 million to be shared among districts across the state. The policymakers also appropriated

an additional $7 million each year for the years 1994-2001, and marked $1 million per year for each of those years to Colleges of Education for assistance in developing K-12 technology and curriculum. Other funding included gifts from a nonprofit foundation of $240,000 per district for professional development, computer labs, and video networks. The Office of Performance Evaluations (2005) determined that from 1995-2005, the state directed more than $442 million of state, federal, local, and private funds into hardware, software, and professional development as part of the Public Education Technology Initiatives.

In 2005, the members of the state Legislature directed the Office of Performance Evaluations to review technology initiatives in public education with a focus on fiscal accountability. The results of the Public Education Technology Initiatives (Office of Performance Evaluations, 2005) indicated that the use of state mandates and donor gifts of educational technologies to schools and districts did not produce expected student achievement or technology integration. The report included key findings and offered nine recommendations. The researchers advised that the state shift its focus from the money spent on educational technologies to determining whether districts were achieving their performance goals (Office of Performance Evaluations, 2005). Does the educational technology meet a specific need that can be measured?

A recognized challenge to adding educational technologies to classrooms included educators' resistance. A majority of teachers were not prepared to integrate educational technologies into instruction and they avoided using it because the educational technologies did not match their instructional styles. Barr and Thorsen (2003)

noted that the rapid changes in educational technologies produced two problems for districts: (a) teachers struggled to stay current with technologies and (b) schools had a difficult time maintaining policies which provided for the changing technologies. Rapid change in educational technologies makes successful diffusion and adoption difficult.

In 2001, state leaders and policymakers initiated a statewide student information system. A public agency and a private philanthropy partnered to create a student information management system to meet the need for a statewide standardized data collection tool. A mid-project evaluation revealed that many school districts across the state lacked the technical expertise to successfully implement the innovation and the project would need increased state funding to complete the project. In 2004, the state legislators and policymakers terminated the implementation because creating the system exceeded the expected costs. Adequate and stable financial and technical support is needed for successful implementation. The state joint legislative oversight committee shared other recommendations for future state educational technology plans. The recommendations for future state technology projects included: (a) establishing clear definitions of roles and responsibilities of all stakeholders, (b) considering the views, needs, and resources of end users in the districts and classrooms, (c) maintaining technology projects which have a realistic scope and are supported by realistic expectations, and (d) including an updated plan for all future projects (Office of Performance Evaluations, 2006).

A survey distributed and completed by district administrators revealed that the implementation of the student management system resulted in poor staff morale (Office

of Performance Evaluations, 2006). Rogers (2003) identified the formation of a positive attitude as critical during the persuasion phase of the diffusion of an innovation process. The stakeholders reported concerns about the potential for success of future initiatives because they developed a sense of failure after the termination of the project.

In 2010, the superintendent of public instruction for the state submitted three initiatives to the state legislature that addressed K-12 public school reform. One of the proposed laws increased the funding for educational technologies in all K-12 classrooms and provided digital devices to all high school teachers and students (xxx. SB 1184, 2011). The legislation addressed both the need for increased student achievement and the future changes to the state's education funding. Voters repealed the three laws through a referendum.

The superintendent of public instruction also coordinated a partnership with a private company to deliver and support an education network which connected high school classrooms throughout the state. The education network provided opportunities for virtual field trips and connected classrooms for distance learning. The purpose of the connection was to link about 200 high schools with ample bandwidth for Internet access and share additional technologies for video conferencing. The education network was an effort to give equitable and reliable high-speed connectivity to all state K-12 public high schools. The state coordinated funding for the Internet access by consolidating districts' E-rate applications. The education network closed in February 2015 when a judge ruled that the contract between the state and private business was invalid. The state department

of education instructed each district to secure Internet access through the district's operations.

The state attempted to institute another student and instructional management system in 2011 when it again entered a partnership with a nonprofit organization to purchase services from a private vendor. The purpose of the software program was to give statewide access to student performance data, share curriculum among teachers, and provide personalized professional development to educators across the state. In 2013, the nonprofit organization contracted with the Institute for Evidence-Based Change (IEBC) to conduct a review of the system. The IEBC (2013) identified several problems with the implementation of the project. The leaders and coaches who were employed to provide support and training were unfamiliar with the program and could not adequately help districts. The quality of the comprehensive program did not match the intended use; it was designed for district use and was not capable of supporting the statewide system of users. There were communication issues between districts and State X department of education resulting in unreliable student data for educator use and school funding. Weaknesses in the state system included the lack of understanding of educational technologies and the unique needs of each district throughout the state, the cost of technology, the lack of effective professional development, limited technical assistance, and the rapid changes in technology and the needs of teachers and students (IEBC, 2013).

In 2015, the legislature directed the office of performance evaluations to review the student information system. The purpose of the study was to determine how districts were using the software program. The reviewers labeled the student management system

a failure with a cost of about $61 million (Office of Performance Evaluations, 2015). Identified problems included poor product quality from the vendor, insufficient training of users, and project management concerns which pointed to the need for improved oversight.

This study was designed to identify strategies and guidelines which would enhance the potential for successful diffusion and adoption of educational technologies. The recommendations could also be developed into an educational technology plan for State X. That educational technology plan could increase the implementation rate and change. The expert panelists who participated in this study were familiar or had direct experience with the past implementation attempts in the state.

Theoretical Framework

Delphi Technique

Researchers use the Delphi technique to create unique opportunities for experts to share knowledge which can be used to plan and forecast. Helmer (1966) pointed out that the Delphi technique represented a possible method for problem-solving in education. The method was used in this study to collect data from educational technology experts who made recommendations which could be used when creating the next state educational technology plan.

Educational technology integration in U.S. K-12 classrooms remains a difficult task for educators and policymakers. Attempts at implementing educational technologies in State X resulted in neither integration of educational technologies in the classroom, nor increased student achievement (Office of Performance Evaluations, 2015). However,

educators and policymakers recognize the potential of educational technology use in the classroom to prepare students for college and career. And the policymakers in State X continue to fund educational technology integration.

There are educators and leaders in the state who have experience implementing educational technologies at state, district and classroom levels. These professionals were available to share experience, understanding, and insight. Their unique perspective and familiarity with the state's past technology plans enabled them to work as experts in identifying strategies and recommendations which can be used to create a state educational technology plan. The following paragraphs contain information about the Delphi technique and its use in education.

Background

The purpose of the Delphi technique is to coordinate expert opinion for decision analysis (Dalkey, 1969; Linstone & Turoff, 1975). Developed by Rand Corporation for the United States Air Force, it was first used to study inter-continental warfare. Determined to be a reliable tool for analysis of technology and science trends (Dalkey, 1971), its use has expanded to business, government, and education (Hall, 2007). The Delphi technique is a method of obtaining and organizing the values of expert panelists to achieve consensus.

The three distinct features of the Delphi technique include: (a) the anonymity of the expert, (b) the structure of the feedback, and (c) the control of the data. Experts are defined as experienced professionals in a specific area, and their knowledge and expertise in that area is a critical component to the success of the project. Dalkey (1969) pointed

out that experts in the same field can have different opinions. Using the Delphi technique can help sort through those views.

A person's participation as an expert in a Delphi study is unknown to the other panelists. All experts are asked not to share their contribution to the study with anyone during the study so both panelists and non-panelists cannot advocate their opinions and influence participants. Preserving the anonymity of the experts is a procedure which creates an environment for participation which is unaffected by outside influences or dominant group members (Donohoe, Stellefson, & Tennant, 2012; Linstone & Turoff, 1975). Ensuring anonymity in the setting gives each stakeholder an equal voice because each panelist can participate with equal input.

In a modified Delphi technique, the researcher creates the instrument for the panelists to review for Round 1. The first round begins when a researcher-created instrument is shared with the experts. The panelists rate each statement using a Likert scale using 1 to 4 where 4 is the highest value. The experts are invited to add comments which are added to the instrument and shared with the panelists. The mean scores for the statements and comments are shared after each round and the panelists may change their rating after reviewing the scores of each statement or comment. After three rounds of review, a pattern emerges from the collected data. The structured rounds and collection of experts' comments create a controlled environment for developing consensus. The interquartile deviation of these data provide evidence of change and consensus.

The organized method for reviewing the ratings of others ensures that each member's contribution has equal value. A statistical response can be formulated using a

numerical scale which ranks the worthiness of the statement as it pertains to State X. New data deliver statistical information which are used to identify consensus and provide strategies and recommendations for creating an educational technology plan for innovation implementation.

Collaboration is essential for generating ideas. However, interacting groups can be less productive when time limitations reduce the sharing of ideas or provide too many opportunities for a few members to share their thoughts and monopolize the conversation (Strauss, Parker, Bruce, & Demosky, 2009). The Delphi technique is democratic, and each participant has an equal voice and opportunity to share opinions. Using an online instrument to create an anonymous setting also represents a cost-cutting approach to committee work. There are no travel expenses, and the use of a researcher-created online instrument results in a more efficient use of time.

The confidential nature of the Delphi study requires that panelists do not discuss the statements during the study. The freedom to participate without fear of influence by others is central to the success of the research (Linstone & Turoff, 2002). The importance of continued participation and the need for confidentiality is emphasized during recruitment because it can affect the results of the study.

Critics of the Delphi technique are concerned about the illusion of community building. Opposition focuses on the idea that consensus is achieved through the management of opinions until everyone is manipulated to consensus. Quantitative data are shared with the panelists after each round and no statements or comments are

removed from the Delphi instrument. The potential for researcher bias and other challenges to the study are discussed in Chapter 3.

A different concern is that consensus is not reached during the study. The design of the Delphi technique improves the potential for success, but it is possible that the interquartile deviation score does not show a score less than one. Gathering an appropriate mix of experts and aggregating individual responses offers greater potential for success. The method for identifying potential panelists is explained in Chapter 3. The Delphi technique presents an opportunity for all levels of an organization to share experiences and opinions, eliminating the hierarchical nature of the organization.

Use in Education

The Delphi technique was originally used to forecast needs of the U.S. Air Force. In education, it can be applied "to explore critical issues, predict the future, and equip those in leadership with information which could be vital in decision-making, policy formulation, or improvement of practices in the field" (Nworie, 2011, p. 24). The continued promotion of educational technology innovations makes the technique relevant to the educational setting where changes in education using technology is envisioned. Educators who represent multiple levels of classroom experience, management, and policymakers can collaborate to discover solutions which improve educational technology integration. The results of current research studies and the feedback from experts can be used to create successful strategies for the implementation of education technology innovations.

Delphi studies are evident in education. They are often beneficial when identifying educational technology trends. Vlachopoulos and Cabrera (2012) pointed out that the technique is being used in important studies regarding emerging technologies including *NMC Horizon Report* series by the New Media Consortium, the Educause Learning Initiative (Johnson, Smith, Willis, Levine, & Haywood, 2011), the *Future of the Internet Report* series by the Pew Internet & American Life Project and Elon University (Anderson, Boyles, & Rainie, 2012) and the *Top Teaching and Learning Challenges 2009* project by Educause (Little & Page, 2009). Panels of experts shared their knowledge to create policy, define terms, make decisions, and create predictions about the future of education technologies (Nworie, 2012). The use of the Delphi technique in education is increasing.

The panel of experts in this study provided multiple levels of insights regarding how to improve the integration of educational technologies in State X. As experts, they represented experience from different areas of the education organization. Teachers, administrators, directors, and policymakers were invited to participate and they reviewed statements which matched each stage of Roger's (2003) diffusion of innovation theory. They identified a comprehensive list of strategies and guidelines.

The panelists rated statements from research which were based on the diffusion of innovation theory. Rogers (2003) identified generalizations and patterns which can result in greater success of an innovation by members of a social system. The results from recent peer-reviewed research were used to create the Delphi instrument used in the Round 1. All feedback or comments which were submitted by the experts were added to

the Delphi instrument for the next round and evaluated by the panelists. No statement was removed during the study.

The creation of the instrument is reviewed in Chapter 3 and the results are shown in Chapter 4. A modified Delphi study can be used to reach consensus and identify factors which will increase the potential for successful diffusion (Strauss et al., 2009). I used a modified Delphi technique with a panel of experts to identify strategies or guidelines which could increase the potential for successful implementation of educational technologies in State X.

Summary

Diffusion of innovation theory provides a framework for improving the potential for successful diffusion and adoption of innovations. Rogers (2003) identified generalizations which can be used to increase or improve the rate of adoption of an innovation. The theory provides structures for implementing change in two environments, the social system and the organization. In this study, expert panelists rated statements which could be matched to both approaches to increase the rate of diffusion and adoption of an innovation.

The educational technology experts used an online Delphi instrument and rated statements from current research and comments added by panelists. They collaborated and identified strategies and guidelines which could be helpful when creating an educational technology plan. The Delphi technique is a method for collecting and quantifying experience and knowledge.

In the 2016 National Education Technology Plan, *Future Reading Learning: Reimagining the Role of Technology in Education* (U.S. Department of Education, 2016), policymakers outlined the national vision and plan for learning with technology. They noted the need for educators to use technology effectively and that educational transformation can only come about through leadership which creates a shared vision and a strong technology support system. Recommendations in the report included the call for states, districts, and post-secondary institutions to develop and implement learning resources which create an equitable learning environment for all students (U. S. Department of Education, 2016). The educational technology experts who participated in this study represent a collaborative effort to increase the potential for successful diffusion and adoption of educational technologies in State X. The research methodology and procedures for the Delphi technique are outlined in Chapter 3.

Chapter 3: Research Method

The purpose of this study was to identify strategies and guidelines which could be used to create a plan which would increase the potential for successful implementation of educational technologies in the K-12 public schools in State X. This was accomplished using a modified Delphi technique with a panel who included educational technology experts in the state. They shared knowledge and insight as they moved to consensus. Policymakers and stakeholders may be able to use the recommendations the experts identified when creating a plan for the next state educational technologies implementation designed to provide students and teachers with educational technology innovations.

This chapter includes a review of the research design, including the selection of experts, creation of instruments, and my role in the research process. Also included are explanations regarding the procedures for data collection, data analysis, and the protection of participant rights. The chapter concludes with a review of the threats to validity and challenges of the study.

Research Design and Rationale

The research question guiding my investigation was, What will a panel of experts identify as the best implementation strategy or process to increase the potential for successful adoption of educational technologies in K-12 public schools in State X? Teachers, administrators, directors, and policymakers represent a group with experience

and understanding of the education environment. Their expertise could be helpful in creating recommendations for future educational technology implementations.

Researchers use the Delphi technique as a systematic way to obtain recommendations of experts in a given field (Dalkey, 1969; Hall, 2009; Linstone &Turoff, 1975). In this study, expert panelists rated statements using an online Delphi instrument. They had the opportunity to share comments with other members of the panel and those comments were also reviewed and rated by each member. The mean score of the ratings represented the importance of the statement to the project. The interquartile deviation showed the consensus of the panelists.

The three key features of the Delphi method are (a) the anonymity of the panel of experts; (b) the structured process of obtaining and sharing the opinions; and (c) the statistical value assigned to those opinions (Dalkey, 1969). The researcher systematically gathers the views of the expert panelists and shares the results and additional comments. The panel never meets in a face-to-face setting, and the anonymity of the panelists allows each panelist an equal and independent opportunity to participate. This arrangement eliminates the potential of one prominent member or a few forceful members dominating the committee work, or the possibility of outside influences swaying the panelists' decisions during the study. The distinct characteristics of the technique create an environment where experts in a given field can share ideas in a confidential and democratic manner.

The research method must match the research question; education researchers use multiple research methods to identify solutions to problems which impede student

achievement. The purpose of this study was to determine strategies and guidelines to improve the potential for successful diffusion of a state's implementation of educational technologies as an innovation. In looking for an answer to a real-world problem, applied research assists the identification of strategies which policymakers and educational leadership can utilize to improve society (Johnson & Christensen, 2008). Research approaches considered for this study included phenomenology, ethnography, case study research, and historical research.

Qualitative research is exploratory and helps provide insight into how educators experience educational technologies. Phenomenology is a type of qualitative research which assists in understanding the practice of the teacher in the classroom when implementing educational technologies. However, this approach would only provide insight about one level of educator, either a single grade level or content area, or a novice or experienced teacher, and their experience with educational technologies. The Delphi technique can be used to draw upon the expert opinions of multiple levels of personnel who have had opportunities to observe and experience educational technology integration at different stages in educational technology adoptions.

Case study research involves collecting and reviewing in-depth data of a bound system or case. Creswell (2007) identified case study as an appropriate approach to use when "the inquirer has clearly identifiable cases with boundaries and seeks to provide an in-depth understanding of the cases or a comparison of several cases" (p. 74). It is a design which increases knowledge about a specific system (Johnson & Christensen, 2008). The past educational technologies implementations of State X represented a bound

system. The identifiable statewide educational technologies implementations of State X could be explored and compared to successful implementations in other states. The study of the past state implementations would help develop better understanding of the system, but it would not support or provide decision-making strategies and long-range policy formulation.

Both the Delphi technique and case study research require participant anonymity. A case study uses a composite subject to ensure the anonymity of the participant. A subject which was assembled to hide its identity would decrease the benefits of the study to the education community by making it more difficult for the method or the results of the study to be transferable to other states or districts. Comparing State X to other states or combining the study of other cases would not provide the information needed to identify a strategy for successful implementation which is unique to that community.

Historical research is an interpretive and systematic way of examining past events to provide insight into the future. Historical research is used to uncover the unknown, to identify the relationship of the past to the present, and to provide understanding of the accomplishments of individuals, agencies, or institutions which can be used to develop policy and recognize what has and has not worked (Johnson & Christensen, 2008). A historical research study would be helpful in explaining what happened during the past educational technologies implementations in State X. A review of history provides perspective and understanding of events and experiences, but depends solely on the perception of the researcher.

The use of the modified Delphi technique in this study increased the potential for identifying strategies for the successful implementation of educational technologies. The inclusion of expert opinions and the anonymity of panelists as part of the communication process provides a clearer understanding of what will benefit education (Strauss, Parker, Bruce, & Dembosky, 2009). The data gathered and reported provided quantitative evidence to verify and quantify panelists' ratings, increasing the potential for consensus.

The Delphi technique met the requirements of an appropriate and efficient research type for this study. Researchers use it in education for creating policy, defining terms, and decision-making (Nworie, 2012). In this study, it provided a unique opportunity for technology experts in State X to share expertise and determine strategies or guidelines which could increase the potential for successful implementation of educational technologies in State X.

Turoff and Linstone (2002) pointed out that there are criticisms of the Delphi technique. Execution of the study is central to those criticisms. Researcher bias, oversimplification of the issues, and careless implementation of the procedures can affect the results. Responsible execution of the Delphi technique is important to the success of the study (Nworie, 2012). These concerns are addressed in the Role of Researcher section in this chapter.

The research question in this study required insight from the expert panelists who shared their experience and informed judgment and collaborated to meet consensus. They rated statements from quantitative and qualitative studies and identified recommendations for successful adoption of educational technology innovations. The group's goal was not

to create new ideas or determine the best educational technologies, but to use knowledge and theory to facilitate the implementation and adoption of educational technology tools to increase student achievement.

Each participant had the opportunity to share comments in a systematic way. This process maximizes opportunities to share novel ideas and minimizes the influence of the loudest or most powerful members (Anastasio & Morgan, 1972). The use of the Delphi technique can bring together conflicting values and facilitate group consensus (Dalkey, 1969). In the Delphi technique, demonstrated expertise and decision-making are formalized in a quantitative way.

The online survey method represented an efficient way to gain consensus. Internet technologies are transforming research through increased flexibility and reflexivity (Donohoe et al., 2012). The panelists did not have to schedule face-to-face meetings or travel. The experts were located throughout the state and they used an online instrument to review and rate statements on the researcher-created instrument. They were not required to travel to a location and had increased time to read and consider responses.

Setting and Sample

Population

Educational technologies experts from throughout State X were invited to participate in the study. Each panelist's unique experiences enabled them to understand the problem (Hall, 2009); however, the qualifications that were required for participation in the study as an expert panelist created a limited population. Other experts outside of State X were also asked to participate in the study because they brought expertise in the

change process. The qualifications for participation in the study are listed in the Participant Criteria section which follows.

All experts possessed knowledge which qualified them in one of two categories. They had experience with, or participated in, past educational technologies implementations in State X, or they held a unique understanding of the potential and practice of educational technologies to enhance student achievement. The two categories of experts represented four groups of contributors who used educational technologies in the classroom, or created or implemented educational technology policies: (a) teachers; (b) administrators; (c) policymakers; (d) and national or international educational theorists. Figure 1 shows criteria for each group.

Theorist	Teachers
Has conducted research related to educational technologies Has authored publications in the area of educational technologies Is currently working as a college professor, leader in a professional organization, or a consultant for public education	Consistently uses educational technologies in the classroom and participates in statewide forums and conferences Participated in the professional development or implementation of past state educational technology plans, including recipients of educational technology grants
K-12 Public School Administrators	**Policymakers**
District-level administrators, directors of curriculum, directors of technology, or building principals who participated in the professional development or implementation of past state educational technology plans	Experience developing statewide laws directed at the use of educational technologies in districts and classrooms Participation on panels or state-level boards that focused on past statewide educational technology implementations

Figure 1. The educational technology experts invited to participate in the study will represent four groups of experts.

The identification of potential panelists included the consideration of their experience with past educational technologies implementations. There were several approaches used to identify the experts. Individuals who participated in the administration or the professional development of past implementations received invitations because they had experience with the process. Selection criteria for the theorists who did not have experience with State X implementations included an advanced degree or recent publication of educational technologies research. The Participant Criteria section provides a list of resources for identifying panelists.

Here is an outline for identifying and recruiting expert panelists. This procedure was established to reduce the potential for researcher bias in selecting an expert panel and to identify a sufficient number of experts to ensure a valid report.

1. Completed a review of literature to identify 60 potential experts. These experts represented two categories of experts (a) policymakers, and (b) educators. The list included the names of at least 20 teachers, 20 administrators, 10 policymakers, and 10 theorists.
2. The number of national experts invited to the study did not exceed the number of representatives from State X. No more than 10 national experts were invited and there was no minimum required number to complete the study.
3. A personal invitation (see Appendix A) was extended to an expert if their work phone number was available. Email invitations were sent to all identified experts (see Appendix B).

4. If the panel had not included at least 5 representatives from each group (administrators, teachers, and policymakers), another round of recruitment.
5. The study began after receipt of all consent forms (see Appendix C).

Efforts were made to include experts from each of the four geographic sections of State X as outlined by the regions defined by the State X Educational Technology Association. These divisions include a reasonably equal number of students who attend schools in these divisions. An equal number of panelists were recruited from the northern part of the state, the central part and the southwestern and southeastern sections. Two-thirds of the districts in State X are rural districts with student populations of less than 3,000 students. However, each area also includes larger districts.

A purposive or criterion sampling was used to identify experts. It is important in execution of the Delphi technique that each panelist possesses greater than average knowledge about policy (Helmer, 1966). An appropriate panelist possesses knowledge of the issues being studied and provides quality feedback to reduce biases (Nworie, 2011). Their experience with past educational technologies implementations provided insight and perspective regarding what has worked and what has not worked in State X.

Participant Criteria. A careful selection of the expert panelists was essential to the success of the study. To precisely define the steps for selecting and recruiting experts demonstrated an effort to eliminate researcher bias and assemble a panel which was equipped to answer the question. Nationally recognized educational technologies experts helped the process of developing consensus by bringing a better understanding of the

diffusion and adoption process to the study.

The selection of experts included individuals who piloted educational technology projects, delivered professional development as part of the plans, or created educational technology policy. Persons received invitations if their identity was found during a review of Department of Education reports, State X Legislature reports, and newspaper articles or they demonstrated involvement with the projects. The documents for consideration included, but were not exclusive to:

- The State X Legislature site to identify policymakers on the education committees who funded implementations
- The state department of education site to identify educational technology administrators involved with past plans
- The department of education site to review documents related to educational technology grants that identified administrators and teachers who received awards
- The State X Educational Technologies Association site to identify board members
- The State X ed chat forum to find teachers who distinguish themselves through use of educational technologies in the classroom
- The State X ed chat forum to find educators who use social media as a professional learning network or professional learning community

- Professors at State X colleges and universities to discover educators and administrators who are involved in educational technology implementations and promote the use of educational technologies
- *State X Leads* an organization which promotes educational technologies in schools
- Researchers and authors of past studies and reviews of implementations
- Newspapers to search for persons who were interviewed because they were identified as policymakers or participated in past educational technology implementations

Watchful selection of the panel and reflexivity protected the study from researcher bias. This critical self-reflection was necessary during the creation of the expert panel. Engaging a variety of experts who met the participation criteria promoted trustworthiness. In addition, self-awareness of the potential biases and predispositions of members was used when identifying potential panelists to provide for a variety of experiences and positions.

Potential panelists received an email invitation to participate (see Appendix B). If a business phone number was available, they were contacted prior to receiving the email to increase the potential for participation. The research and the importance of the study was explained in both contacts. The communications also described the protection of the participant's rights, including anonymity and the confidential nature of the research.

Each expert panelist was asked to sign a consent form (see Appendix C) which explained the study in language which was understandable to the participant as outlined

by the university's Institutional Review Board (Approval# 06-30-15-0059763). The consent form described the importance of the study, the research process, and procedures. It also explained that participation in the study was voluntary and that the panelist could discontinue involvement in the study at any time.

Sample Size

There is no optimal number of experts to include in a panel for the Delphi study; however, Kramer, Walker, & Brill (2007) pointed out that purposive sampling must match the reason for the study. Ludwig (1997) identified a panel of 13 experts as necessary for reliability. Brockhoff (1975) pointed out that a group of four panelists can successfully participate in a Delphi study and reach consensus. The goal for this study was a positive response to the invitation to participate in the study from at least 22 experts. Forecasting the potential for participation is difficult. Hsu and Sandford (20) noted

> "…if the sample size is too small, these subjects may not be considered as having provided a representative pooling of judgments regarding the target issue. If the sample size is too large, the drawbacks inherent within the Delphi technique such as potentially low response rates and the obligation of large blocks of time by the respondents and the researcher(s) can be the result," (p. 4).

State X is a sparsely populated state with less than 2 million people. The goal was to begin the study with 22 educational technology experts. If, after two weeks of recruitment, no response was received from a potential panelist to participate in the study, a follow-up invitation was extended through a telephone call or email. If the minimum 22

experts had not responded, including at least 5 representatives from each group, additional experts would have been contacted and asked to participate. If less than 20 experts responded to the request or a group did not have a representative number of five contributing members, invitations would have been extended to other educational technology experts who matched the qualifications and the category within State X.

The greatest threat to the Delphi technique was attrition. The results of the study might have been affected if experts dropped out and failed to complete the study. Careful recruitment of experts assisted in ensuring that each panelist completed the study. The process included a personal invitation which expressed the importance of full participation. The panelists were offered no potential of financial gain by participating in this study. The experts did not receive any gifts, payments, compensation, reimbursement, free services, or extra credit for participation.

Instruments

Instrument Development

Research that matched the stages of Rogers' (2003) diffusion of innovation theory was used to design the Delphi instrument for first round of this study. If sufficient and established information is available, it is appropriate to modify the Delphi technique by using known data to create the first round of the instrument and streamline the process for the panelists (Hsu & Sanford, 2007). Education researchers use Rogers' diffusion of innovations theory as a lens to analyze and evaluate the adoption process of educational technologies. They reflect on the innovation-decision process, including the communication channels to determine what halted diffusion, or caused rejection or

reinvention of the innovations (Crompton & Keane, 2012, Jwaifel & Gasaymeh, 2013; Herbert, 2012). The expert panelists used a first round instrument designed to reflect the innovation-decision process. The Delphi instrument contained five sections, and each section represented a phase of Rogers (2003) theory of diffusion and adoption. The five parts are: (a) information; (b) persuasion; (c) decision; (d) implementation; and (e) confirmation. The panelists were unaware of the sections, or divisions, of the instrument; they responded to one list of 56 statements in Round 1.

The panelists identified the importance of each statement to successful adoption of educational technologies innovation. Each instrument included statements and comments for the panelists to rate using a Likert-type scale of 1-4 where a rating of 4 indicated the highest importance. The panelists had access to additional spaces for sharing declarations and comments with the other experts in subsequent rounds.

To increase the reliability of the instrument, a separate group of educational technologies experts reviewed the instrument used in the first round. They provided editing and feedback about the clarity of the tool. Each expert was interviewed to obtain feedback about instrument statements. The discussion included the following questions:

- Which statements lacked clarity?
- Do any statements cause concern about confidentiality?
- Do any statements cause concern about the nature of the study?
- Do you have any questions or concerns about this instrument?

The panelists had access to both the ratings and participant feedback. Comments were reviewed to protect the anonymity of the expert. The comments from the expert

panelists were added to the Delphi instrument in the following rounds. Between each round, the scores of the items were calculated to find the mean. Panelists received the mean score for each item in the following round. No statements or comments were removed from any round. The data collected in the last round were analyzed to identify the mean and the interquartile range (IQR = (Q3 – Q1) / 2). The average was used to measure the central tendency or the level of importance of each statement and the interquartile range established the level of consensus.

The panelists used a Qualtrics© online survey link to access the survey. The use of an Internet survey tool increases the efficiency of use for the participant and thereby increases the potential for participation (Chou, 2002; Skulmosky & Hartman, 2007). An email link was sent to the panelists, the ratings were gathered from members and used to create instrument for the next round. The panelists used the online link to review the mean scores for the previous round, rate statements and comments, and submit feedback and comments to include in the following rounds.

Walden University's Institutional Review Board reviewed the instrument to ensure that it protected the rights of the expert. The approval # is 06-30-15-0059763.

Role of Researcher

I had several roles in this study. I assembled a group of experts who had experience with educational technology implementations. The panel included an adequate number of experts who were interested in identifying a successful strategy for State X. State instructional technology implementations have been difficult, and planning for continued educational technologies integration has created an atmosphere and desire for

leaders and educators to share insight and experience. The recruitment process included procedures to ensure that the panelists continued in the study and followed a plan which promoted continued participation by the experts in the study.

The continued anonymity of the expert panelists was essential to the study. The Delphi technique represents group consensus and the concealment of each panelist's identity contributes a safe environment for each expert. They received instructions which emphasized the importance of protecting the privacy of all experts during the recruitment phase and throughout the study. Possible identifying information was removed from the panelists' comments.

The Delphi technique is distinctive because the instrument used in the study changes with each round. Panelists can adjust their rating for any statement or comment and the differences in ratings after each round are shared with all panelists. Quantitative scores show differences and consensus. The mean score for each item on the Delphi instrument is shared with all panelists.

Researcher bias was a threat to research validity. Self-reflection and reflexivity help to combat bias. I used a journal to keep reflections during the study and recruited experts who represented administrators, policymakers, teachers, and directors. The experts were able to add comments which were added for review. Participant review of mean scores after each round also increased interpretive validity because the expert panelists' could compare their ratings to statements and comments with the responses of others. The panelists were able to review how their answers were interpreted and reported

to the other panelists. There was no conflict of interest in this study. No incentives or rewards were offered or provided to those experts who participated.

Procedures

Data Collection

Data were collected through a series of structured sequences or rounds, designed to assist the respondents in reaching consensus. Each round followed a schedule which started when the panelists received a link to the researcher-created Delphi instrument. The results were collected and reviewed, including the feedback from the panelists. The mean scores were added to the statements or comments for the next round. The identity of the experts was known only to me. Established deadlines for each round were communicated during the recruitment process. Setting deadlines is necessary for all research; however, it is especially important in the Delphi technique because the iterative rounds require feedback from all experts (Hsu & Sanford, 2007). The schedule is outlined in Table 1.

Table 1

Schedule for Delphi study

Day	*Round 1:*	*Round 2:*	*Round 3:*
D1	Instrument submitted to panelists	Instrument submitted to panelists	Instrument submitted to panelists
D5	Instrument returned	Instrument returned	Instrument returned
D6	Results reviewed	Results reviewed	Results reviewed
	Mean score calculated	Mean score calculated	Mean score and IQD calculated
	Comments included in instrument for Round 2	Comments included in instrument for Round 3	

The expert panelists received a link to a password protected site and submitted their responses using an online survey. Three rounds were sufficient for them to achieve consensus which was identified when the interquartile range was equal to or less than one (≤ 1). Occasionally during a Delphi study, a fourth round is needed if consensus is not attained by the end of the third round. This study was completed after three rounds.

The expert panelists added new comments in rounds 1 and 2. These comments were reviewed and listed immediately after the statements where the expert added them. They were included for ranking by panelists in rounds 2 and 3. No statements were deleted from any round and the panelists reviewed all statements and comments in each round.

Digital and hard copies of all communications and research data were stored in a safe deposit box and will be destroyed after 5 years. The results from the Delphi

instrument were shared with the panelists after each round as part of the modified Delphi study. Each expert panelist will receive the final results and a copy of the report after the report has been approved by the university.

Data Analysis

After each round, the ratings were retrieved and reviewed for variance by analyzing the distribution. The expert panelists received the mean score as part of the statement in the next round so they could evaluate how the group was ranking each statement and how it compared to their score. Each panelist had the opportunity to defend or change their score for any statement or comment. All statements remained in the survey.

Quantitative analysis of each round strengthened the study by providing concrete data for review. The panelists received the mean scores for each statement in each new round as a way to see the central tendency. The panelists were able to see how their answers compared to the group's responses. The interquartile range was used to determine consensus in the final round because it provided a measurement which showed consensus. For an improvement toward consensus, there must be changes in estimates (Dalkey, 1969). Careful consideration of the expert panelists' responses ensured the interpretive validity of the instruments.

Data feedback was necessary between rounds because responses from the panelists can influence their ratings for the subsequent round. The largest change usually occurs between the first-round and second-round replies after sharing the first-round

mean scores (Dalkey, 1969). As the panelists identified the most important statements or comments, this method of analyzing the data provided a clear picture of consensus.

Time Frame

The expected time frame for preparing for the study, including inviting experts and securing their consent forms was four weeks. The study continued for three weeks after the panelists received the Delphi instrument for Round 1. Each member was asked to spend about 20-30 minutes each week reading and responding to the survey and results. The study continued for 3 rounds with each round taking at least one week as indicated.

The link to the instrument for each round was sent via electronic mail through the Qualtrics© online survey site. The rounds began on Sunday when the members received the instrument. The panelists were expected to respond within four days. The responses were calculated, and new statements were added to each new round. The results from each round created the Delphi instrument for the next round. The links to new instruments for each round were sent to panelists. The process was repeated for three rounds.

Participant Rights

Participation in the study was voluntary and the experts were instructed not to share information about their participation during the study. This aspect of the Delphi technique was critical to its success because confidentiality provided freedom for each participant to share responses without concern about outside influence or repercussions from opinions shown during the study (Linstone & Turnoff, 1975). Each panelist's

contribution was considered appropriate for the study and their identity was protected. This anonymity will continue when results of the study are presented or published.

Each participant returned a consent form using a digital signature. The consent form explained the purpose of the study and reviewed participant's rights. The experts could refuse to participate or withdraw early from the study. There were no incentives for participation. Their participant rights were explained in the consent form (see Appendix C).

Appendix C outlines the rights and expectations of members. In addition, Walden University's Institutional Review Board (IRB) reviewed this proposal to ensure that the treatment of expert panelists follows their guidelines. The Walden University Institution Review Board (IRB) approval number is #06-30-15-0059763.

Summary

Teachers, administrators, educational technology directors, and policymakers used their knowledge and understanding of educational technology implementations to identify strategies and guidelines to use when developing successful implementation plans for educational technology implementations in State X. The Delphi technique is an efficient and effective team approach to solving a problem and creating forecasts for new technologies (Hall, 2009). This team of expert panelists had the expertise and experience to make decisions about educational technology implementations.

The use of a Delphi technique offered them a systematic way to collaborate and share their knowledge. The online instrument ensured anonymity and provided an efficient method for the panelists to communicate what they knew about past

implementations of education technologies in State X. The collected information may be useful when creating a successful plan for educational technology implementations which can increase the rate of adoptions.

Chapter 3 included a review of the modified Delphi technique and information about participant selection. The explanation of the research design and study procedures established routines and supported how experts can collaborate to deliver valuable information to increase the rate of diffusion which results in a successful adoption of educational technology innovations. The results of the Delphi study are discussed in Chapter 4, including comments which were added by the experts. The tables include the mean score for each round and interquartile deviation.

Chapter 4: Results

The purpose of this study was to develop consensus from a panel of experts regarding strategies or guidelines which could be useful in creating a model or plan for the implementation of educational technologies in K-12 public schools in State X. The research question guiding my investigation was, What will a panel of experts identify as the best implementation strategy or process to increase the potential for successful adoption of educational technologies in K-12 public schools in State X?

This chapter includes a review of my data collection process, key results, and an explanation of the challenges faced in conducting the study and how these were addressed. Tables are included which display the results obtained through the use of the Delphi instrument.

Pilot Study

The panelists reviewed a researcher-created instrument for the first round of the Delphi technique. After the Institutional Review Board reviewed the Delphi instrument used in the first round of this study, two experts who were not a part of the study examined the document for clarity and errors. They also studied it to identify statements which would make it difficult to maintain the anonymity and confidentiality of those who participated in the study. The reviewers signed consent forms (see Appendix D) and evaluated the Delphi instrument using an online site. They were able to make comments and ask questions. And they orally responded to the statements to increase the clarity and confidentiality of the Delphi instrument.

There were minor changes made to the modified Delphi instrument to enhance the clarity of the statements. The phrase “one must” was added to the first statement to improve it. Another enhancement, single words or phrases were highlighted in a few statements where a single word or phrase changed each sentence. At first glance, they appeared to be duplicates. Bolding the single word or phrase which differentiated it from another statement made it easier to understand and more user friendly for the experts. Two statements were removed because they were redundant, none were added. The Institutional Review Board did not require an additional review of the instrument.

Setting

Recruitment of the experts was scheduled to begin in June; however, it was difficult to contact potential panelists during what is routinely a time when educators are not in classrooms or offices. Some educators do not routinely check their email during summer vacation. Waiting until the mid-August and the beginning of a new schoolyear made it easier to contact teachers, administrators, directors, and policymakers. Although the beginning of the year is a busy time, a sufficient number of panelists were recruited to begin the study.

Demographics

The success of the Delphi technique depended on the selection of experts. The participants met criteria as outlined. They were selected based on their experience in the field and service in education as explained in Chapter 3. This included experience with educational technology implementations in State X. These panelists demonstrated an

understanding of education policy or their use of educational technologies through their experience with past implementations or recent communications and publications.

Data Collection

I invited 60 people to participate and I received positive responses and signed consent forms from 24 experts. Four people verbally agreed to participate, but did not sign consent forms. Two experts signed consent forms but did not follow through with the study. One person did not complete round 2 but did complete rounds 1 and 3. One panelist withdrew after completing the initial round and did not respond to rounds 2 and 3. The numbers of experts who did and did not respond to the invitation are displayed in Table 2.

Table 2

Number of Experts who Responded to the Invitation and Completed in the Study

Type	Number
Experts who were invited to participate in the study	60
Experts who responded to invitation but declined to participate in the study	34
Experts who never responded to the invitation	26
Experts who agreed to participate in the study	22
Experts who completed the study	21

The potential panelists who were invited to contribute to the study received email invitations with an explanation of the protocol used for the Delphi technique and a copy of the consent form. If possible, the potential panelist received a phone call from me which outlined the study and invited them to participate. The script used to explain the procedure appears in the appendices (see Appendix A).

I conducted the Delphi technique in a systematic manner over a designated time period. The instrument for round 1 included 56 statements and the expert panelists rated each statement using a Likert scale from 1 to 4 with 4 being the highest score. Panelists could include comments that were added to the next round. The experts added 89 comments to the original 56 statements. All statements remained in the instrument for each round, no statements or comments were removed. The expert panelists reviewed all statements and comments.

The Delphi technique represents committee work where each member is free to contribute (Strauss, Parker, Bruce, & Demosky, 2009). Because of this tenet, there was a need for equal distribution of each of the respondent groups -- teachers, policymakers, administrators, and directors of technology and curriculum. Each member had an opportunity to share and participate without concerns about possible repercussions or outside influences. Each response was reviewed and included in the score. At least two representatives from each group (teachers, administrators, policymakers) were included to provide balance to the panel. In this way teachers, administrators, and policymakers could share their perspective and expertise. The breakdown of the panelists' professions is shown in Table 2.

Table 2

Panelists' Professions

Field	Number
K-12 Teachers	7
Administrators and Directors of Curriculum or Technology	8
Policymakers	7

There were three challenges to the study. These were overcome without impacting the results. The first involved the scheduling of the Delphi study. The original date for the start of the study was rescheduled from June to August to ensure the inclusion of members from all groups. It was easier to contact potential panelists after summer vacation time and time out of the office was less likely to interfere with participation. Changing the start date improved the potential for a positive response to the invitation and the ongoing contributions of the experts to the study.

The participant's understanding of the Delphi technique created another challenge. A review of the basic elements of the Delphi study was included in both the invitation and the consent form and directions were provided for completing the Delphi instrument in each round; however, some panelists were unfamiliar with the technique and needed clarification regarding the instrument used in Round 2. A few panelists asked if they needed to respond to a statement they had rated in a previous round. It was explained that each rating was necessary and that they could change their response to any statement or comment. The number of items on the instrument grew from the original 56 statements to 145 statements and comments in the last round.

Also, the experts spent more time completing the survey then was expected. Many experts spent between 25-60 minutes completing the survey, longer than the projected 20 minutes. No one expressed concern over the time commitment. Each challenge to the study was resolved to complete the study.

Results

The modified Delphi instrument used in Round 1 had 56 statements. Each statement was based on a recommendation from a current research study which aligned to Rogers' diffusion of innovation theory. The panelists rated each statement using a Likert scale where ratings ranged from 1 (*least*) to 4 (*most*). The mean score for each item appeared at the beginning of each statement and comment in Rounds 2 and 3.

The interquartile deviation (IQD = (Q3 – Q1) / 2) was calculated to identify the data spread, and a score less than or equal to 1 defined consensus. Consensus was reached on all items. A few items which did not receive a higher score, defined as a 3 or 4, were included in the proposed strategies or guidelines identified by the expert panelists because they need to be defended as part of the set of guidelines which can be tested and used to design a model. The panel's rankings of statements in Rounds 1-3 are shown in Appendix G. These calculations include the minimum and maximum values, mean, variance, standard deviation, and interquartile deviation. All items are listed in the order reviewed by panelists.

Rogers' diffusion of innovation theory provided the outline, or guide, for construction of the initial instrument used in Round 1. The modified Delphi instrument was designed to reflect the five stages of the innovation-decision process (Rogers, 2003). The expert panelists reviewed a modified Delphi instrument which listed the statements in order for each stage; however, there were no indications on the instrument which showed the phases or separated the items in categories. The panelists reviewed all items without any separation for stage. The instrument was divided in this way:

- Stage 1 Knowledge – Items 1-17;
- Stage 2 Persuasion – Items 18-29;
- Stage 3 Decision – Items 30-44;
- Stage 4 Implementation – Items 45-50;
- Stage 5 Confirmation – Item 51-56.

The panelists reached consensus on each item. The Delphi method does not require agreement by the panelists, but does provide an opportunity for experts to participate and share comments. The panelists added statements as they reviewed the instrument. Those comments were shared with all panelists and the experts had opportunities to rate those as they were added in Rounds 2 and 3. All statements remained as part of the online Delphi instrument for review by the expert panelists. Those comments added by the experts remained in the section where they were added for Rounds 2 and 3. But the comments were later moved, if necessary, to the phase which better matched Rogers' theory. The statements and comments that received the higher rating were used to create the list of strategies and guidelines. However, even the statements or comments with lower ratings may need to be tested as part of a model.

The strategies and guidelines identified in this study have not be tested as part of a model to show successful adoption. The results of this study show that the Delphi instrument created using Rogers' (2003) theory, including those statements from current research and comments added by the experts, were consistent with the innovation-decision process. The results are divided into five phases of the innovation-decision

process (Rogers, 2003). These strategies and guidelines need to be reviewed for effectiveness as a potential model.

Stage 1. Knowledge

The first stage in the innovation-decision process is the knowledge phase. The first 17 items of the instrument for Round 1 were statements related to this stage. Rogers (2003) defined the knowledge phase as the period when the individual becomes aware of an innovation. He identified three types of knowledge. These are: (a) *awareness-knowledge*, when an individual learns that the innovation exists; (b) *how-to knowledge*, when the individual understands how to use the innovation; and (c) *principles-knowledge*, when the individual begins to understand the functioning principles behind the innovation. The panelists added 46 items to the original 17 in this section. Table 3 includes a complete list of Statements 1-17, including the items added by the experts.

The panelists identified the need for an educator to be aware of an innovation before being asked to adopt as an important statement to include in the strategies and recommendations (Item 1 *mean* score = 3.86, *IQD* = 0.25). The panelists added 2 comments. The first, comment 1a (*mean* = 3.67, *IQD* = 0.5) stated that educators should be trained on the use of educational technologies innovations. This comment matched the need for *how-to knowledge*, so an individual knows how to operate the innovation before being asked to make a decision. The panelists addressed the need for the innovation to fit the teaching style of the education in Item 1b (*mean* = 2.67, *IQD* = 0.5).

The experts considered ways to create awareness for educators. Networking within a building received higher mean scores for making teachers aware of an

innovation than the use of mass media. This included the use of social media. The panelists recommended that product developers pay attention to how teachers first find out about products. (Statement 2 *mean* = 3.14, *IQD* = 0.25). The use of social media (Item 3a *mean* = 2.62, *IQD* = 0.5) as the most efficient way to make teachers aware of the existence of effective educational technologies received a lower score. That teachers became aware of educational technologies through peers in their building (item 3b *mean* = 3.10, *IQD* = 0.25) and the use of workshops to keep faculty informed (Item 3c *mean* = 3.29, *IQD* = 0.5) received similar or higher scores than the use of mass media. The use of social media received the lowest score for making teachers aware of the existence of effective educational technologies.

Statements 4 and 5, including comments added, reflected an organizational approach to implementation. These statements matched a *top-down* or structured approach to diffusing an educational technology innovation. The panelists addressed the need to include teachers in every step of the process in Statement 4 and showed a lower score (*mean* = 2.71, *IQD* = 0.75). These results will be addressed in Chapter 5. The panelists showed concern that teachers do not have the time to be involved in the planning (Item 4d *mean* = 3.71, *IQD* = 0.5), and that not everyone possesses the technical knowledge to make decisions about educational technologies (Item 4e mean = 3.71, IQD = 0.5). These comments added by the panelists received high scores.

Statements which addressed the *principles-knowledge* received higher mean scores than the statements that reflected the needs for *awareness-knowledge* and the *how-to knowledge.* A statement related to how the innovation needed to help educators meet

their needs received a *mean* score of 3.90 (Item 7 *IQD* = 0.0). Comments were added which explained the need for educators to know the *why* behind the educational technology innovation (Item 7a *mean* = 3.71, *IQD* = 0.0) and that educators need to see the results rather than hear about them (Item 7b *mean* = 3.95, *IQD* = 0.0). These comments received the highest scores and reflected a high level of consensus.

The panelists dismissed the statement regarding the need for educators to see the research which showed that the innovation was effective (Item 8 *mean* – 2.67, *IQD* = 0.5). Comments were added about how educational technologies deeply rooted in research were not relevant to all classrooms (Item 8 *mean* = 2.67, *IQD* = 0.5) and that application and success rates (Item 8a *mean* = 3.2, *IQD* = 0.5) were just as important to teachers. Educators want to see that ideas for educational technologies are deeply rooted in classroom realities (Item 9 *mean* = 3.7, *IQD* = 0.5).

Items 10 and 11 also addressed the *how-to knowledge* of the innovation. Rogers (2003) explained that an adequate level of understanding about how an innovation works is important before adoption, or the discontinuance or rejection of the innovation will occur. The panelists indicated that an educational technology innovation must be easy to use (Item 10 *mean* = 3.67, *IQD* = 0.5) and understand (Item 11 *mean* 3.71, *IQD* = 0.5). More importantly, it must be reliable (10a *mean* = 3.86, *IQD* = 0.0). The educational technology must not interfere with the original goal of why it was being implemented (Item 10b *mean* = 3.86, *IQD* = 0.0). An educational technology innovation should be evaluated as a teaching tool (Item 12 *mean* = 3.71, *IQD* = 0.5). A higher score was given

to a statement that educational technologies should be considered one tool in an array of tools (Item 12b. *mean* = 3.90, *IQD* = 0.0).

When asked to rate statements about whether teachers follow leadership who model technologies or they follow other teachers who model the educational technology innovations, the panelists rated teachers a little higher (Item 14b *mean 3.52, IQD = 0.5*) compared to leadership (Item 14a *mean* = 3.24, *IQD* = 0.5). Teachers follow leadership who understand the educational technology innovation (Item 14 *mean = 3.33, IQD = 0.5* and leadership who communicate why the educational technology is important (14c *mean = 3.38, IQD = 0.5*).

It is important for leadership to have a clear picture of how the educational technology can be implemented (Item 15c *mean = 3.57, IQD = 0.5*) and how it will work (Item 15 *mean = 3.24, IQD = 0.5*). The panelists indicated that leadership should be required to learn the innovation being used by teachers (Item 15a *mean = 3.43, IQD = 0.5*) and that teachers follow leadership who "truly know how the innovation works (Item 15b *mean = 3.43, IQD = 0.5*).

A statement reflecting that the *how-to knowledge* of an innovation benefits the entire organization (Item 16a *mean = 3.62, IQD = 0.5*) received slightly higher ratings than the statement about the need for leadership to concentrate on increasing the *how-to knowledge* of an innovation (Item 16 *mean = 3.43, IQD = 0.5*). These statements are related to the *how-to knowledge* defined in the social system approach to change; however, the statement and comment define the role of leadership in an organization.

The identification of a need is the first phase of the diffusion and adoption process in an organization. The panelists added a comment which reflected that this was an important first step in the implementation process of education (Item 17b *mean = 3.62, IQD = 0.5*). That educational technology solutions identify a real need (Item 17 *mean = 3.43, IQD = 0.5*) and that leadership identify educational technology solutions that meet a real need (Item 17a *mean = 3.43, IQD = 0.5*) received the same ratings. The importance of this step is discussed in Chapter 5.

An analysis connecting these statements to Rogers' theory is included in Chapter 5. The panelists added statements and comments which matched the innovation-decision process and were included in the list of strategies and guidelines. These statements and comments could be used to create a model. Even those statements which did not receive higher ratings, defined as Likert scores of 3 or 4, were included because they were identified in current research as potentially improving the rate of diffusion and adoption. This is explained in Chapter 5. The mean scores for each round which the panelists reviewed for Round 2 and 3 are shown in Table 3.

Table 3.

Stage 1. Knowledge	**R1 Mean**	**R2 Mean**	**R3 Mean**	**IQD**	**Consensus**
1. Before educators are asked to adopt an educational technologies innovation, one must make them aware that it exists (Hazen, Wu, Sankar, Jones-Farmer, 2012).	3.86	3.60	3.76	0.25	yes
1a. Educators should be trained on the use of educational technologies innovation.		3.55	3.67	0.5	yes
1b. Educators should use educational technologies if it fits their teaching style		2.95	2.67	0.5	yes
2. Recommend that product developers pay attention to how teachers find out about products (Bill & Melinda Gates Foundation, 2014).	3.23	2.95	3.14	0.25	yes
2a. Product developers do not care about teachers, they are looking for business opportunities for financial gain.		2.60	2.43	0.5	yes
2b. Teachers are not often interested in new products.		2.15	2.48	0.5	yes
3. The use of mass media is the most efficient way to make teachers aware of the existence of effective educational technologies (Rogers, 2003).	2.71	2.26	2.38	0.5	yes
3a. The use of social media is the most efficient way to make teachers aware of the existence of effective ed technologies		2.45	2.62	0.5	yes
3b. Teachers become aware of new technology and educational technology integration practices through peers in their building or district.		3.60	3.10	0.25	yes
3c. The use of workshops is an effective way to keep faculty informed.		3.11	3.29	0.5	yes
3d. If teachers are **not interested**, it remains only an awareness of educational technologies.		3.00	3.10	0.25	yes
3e. If teachers are **not required**, it remains only an awareness of the technology.		2.80	3.00	0.0	yes
3f. Too many ed technology products make it difficult for teachers to manage.			3.33	0.5	yes

(table continues)

Stage 1. Knowledge	R1 Mean	R2 Mean	R3 Mean	IQD	Consensus
4. Districts and school networks should involve teachers in any system level procurement process (Drape et al., 2013, Elmore, 2004).	3.32	2.63	2.71	0.75	yes
4a. Districts and school networks should involve teachers who have background knowledge of instructional practices with technology.		3.30	3.48	0.5	yes
4b. Network design and infrastructure is not a role for teachers.		2.60	2.86	1.0	yes
4c. Advisory groups that include experts from both education and technology are critical when evaluating the direction for educational technologies.		3.45	3.62	0.5	yes
4d. Teachers do not have the time to be involved in the procurement process.		3.55	3.71	0.5	yes
4e. Some people are better informed about educational technologies than others.		3.55	3.71	0.5	yes
4f. Some people have a personal benefit bias.		3.25	3.14	0.5	yes
5. Educators should be included in every stage of development from idea formation to final refinement (Stevens, 2014).	3.36	3.16	3.10	0.75	yes
5a. It is important for educators to commit to follow-through as part of the final refinement.		3.50	3.52	0.5	yes
5b. It is important to recognize system efficiency when defining levels of involvement.		3.25	3.43	0.5	yes
5c. Teachers need to be involved in implementation guidelines only.		2.55	2.24	0.5	yes

(table continues)

Stage 1. Knowledge	R1 Mean	R2 Mean	R3 Mean	IQD	Consensus
6. Teachers need to be able to see the results of the innovation (Jwaifell & Gasaymeh, 2013).	3.86	3.78	3.71	0.5	yes
6a.Teachers need to be able to see numerous examples of success with the innovation.		3.58	3.76	0.25	yes
6b. Teachers will not use something that is not beneficial.		3.16	3.48	0.5	yes
7. Educators need to know that an educational technology innovation can help them meet their goals (Drape et al., 2013, Means, 2010).	3.91	3.78	3.90	0.0	yes
7a. Educators need to know the 'why' behind the educational technology innovation.		3.58	3.71	0.0	yes
7b. Seeing/showing how technology can help a teacher meet their goals is more useful than telling them that technology can help them reach their goals.		3.95	3.95	0.0	yes
8. Educators want to see that ideas for educational technologies are **deeply rooted in research** (Stevens, 2014).	2.91	3.06	2.67	0.5	yes
8a. Application and success rates are just as important.		3.32	3.2	0.5	yes
8b. Educators do not often use the educational technologies as designed and research does not apply.		2.47	2.43	0.5	yes
8c. Each classroom is unique and research does not apply.		2.79	2.71	0.5	yes
9. Educators want to see that ideas for educational technologies are **deeply rooted in classroom realities** (Stevens, 2014).	3.86	3.83	3.67	0.5	yes
9a. Classroom realities are too often based on tradition and not innovative models.		3.21	3.14	0.5	yes

(table continues)

Stage 1. Knowledge	R1 Mean	R2 Mean	R3 Mean	IQD	Consensus
10. The educational technologies innovation **must be easy to use** (Hazen et al., 2012; Jwaifel & Gasaymeh, 2013).	3.76	3.61	3.67	0.5	yes
10a. The educational technology innovation **must be reliable.**		3.84	3.86	0.0	yes
10b. The educational technologies must not interfere with the original goal of why it is being implemented.		3.84	3.86	0.0	yes
10c. Most educators do not have the technical skills to teach themselves how to use the technology.		2.79	2.76	0.5	yes
10d. Educators struggle with educational technologies.		2.89	2.76	0.75	yes
11. The educational technologies innovation must be easy to understand (Hazen et al., 2012).	3.68	3.68	3.71	0.5	yes
12. Educational technologies should be evaluated as a teaching tool (Drape et al., 2013; Bill & Melinda Gates Foundation, 2014).	3.55	3.56	3.71	0.5	yes
12a. The method of evaluation should be defined before implementation.		3.53	3.57	0.5	yes
12b. Educational technologies should be considered one tool in an array of tools.		3.63	3.90	0.0	yes
12c. Educational technologies should be considered as a way that students can demonstrate subject mastery.		3.32	3.62	0.5	yes
13. Teachers should be able to experiment with the innovation before deciding to adopt (Jwaifell & Gasaymeh, 2013).	3.55	3.22	3.29	0.5	yes
13a. Educational technologies changes so quickly that it is difficult to spend much time experimenting.		2.67	2.62	0.5	yes
13b. The innovation should be free of cost to the teacher.		3.53	3.67	0.5	yes

(table continues)

Stage 1. Knowledge	R1 Mean	R2 Mean	R3 Mean	IQD	Consensus
14. Teachers follow leadership who understand the educational technologies innovation (Drape et al., 2013).	3.10	3.39	3.33	0.5	yes
14a. Teachers follow **leadership** who model the educational technologies.		3.32	3.24	0.5	yes
14b. Teachers follow **teachers** who model the educational technology innovation.		3.42	3.52	0.5	yes
14c. Teachers follow leadership who communicate why the educational technologies is important.		3.53	3.38	0.5	yes
15. Teachers follow leadership who know the educational technology innovation (Drape et al., 2013).	3.18	3.39	3.24	0.5	yes
15a. Leadership should be required to learn the innovation being used by teachers.		3.63	3.43	0.5	yes
15b. Teachers follow leadership who know how educational technologies will work.		3.37	3.43	0.5	yes
15c. Teachers follow leadership who have a clear picture of how the educational technologies can be implemented.		3.37	3.57	0.5	yes
16. Leadership should concentrate on increasing the how-to knowledge of an innovation (Drape, Westfall, Doak, Guthrie, & Mykerezi, 2013).	3.55	3.44	3.43	0.5	yes
16a. The how-to knowledge of an innovation benefits the entire organization.		3.58	3.62	0.5	yes
17. Educators want to see that educational technology solutions identify a real need (Jwaifell & Gasaymeh, 2013; Stevens, 2014).	3.55	3.50	3.43	0.5	yes
17a. Educators want to see that leadership identify educational technology solutions that meet a real need.		3.42	3.43	0.5	yes
17b. Identification of the need is an important first step in the process.		3.61	3.62	0.5	yes

Stage 2 Persuasion

It is during the persuasion stage that an individual forms an opinion, favorable or unfavorable, about an innovation. Here, they also look for assurances that the innovation will help their situation. Forward planning is a part of the process. The panelists reviewed the role of State X in the innovation-decision process in this section.

Teachers should have access to the digital instructional tools they need (Item 19 *mean* = 3.71, *IQD* = 0.25) and not to the innovation promoted by a change agent (Item 29 *mean* = 3.57, *IQD* = 0.5). When recognizing who makes that decision, items which identified the district as the change agent received higher scores than those which named the state as bearing responsibility for determining innovation and policies. Districts should conduct trials to evaluate effects of an innovation under real-life classroom conditions. (Item 20a *mean* = 3.22, *IQD* = 0.5); the state should develop a sense of best practice and communicate those results (Item 20b *mean* = 3.05, *IQD* = 0.0).

The panelists rated items which identified the state's role as providing funding for the educational technologies (Item 26 *mean 3.71, IQD = 0.5*) and professional development (Item 27 *mean = 3.62, IQD = 0.5*). To maintain equity, the state must work with districts to develop effective funding mechanisms to provide training (Item 27a *mean* = 3.81, *IQD* = 0.0). Item 28a showed the importance of the state's role in helping maintain equity among districts in the state (*mean = 3.71, IQD = 0.5*).

The panelists added 16 comments to the 11 statements. Those items and the ratings and scores are displayed in Table 4.

Table 4.

Stage 2. Persuasion	**R1 Mean**	**R2 Mean**	**R3 Mean**	**IQD**	**Consensus**
18. The state should make recommendations for educator use of educational technologies rather than mandate use.	3.59	3.56	3.43	0.5	yes
18a. The state should provide guidance as districts identify need.		3.21	3.24	0.5	yes
18b. The unique nature of each district requires unique support from the state.		3.26	3.19	0.5	yes
18c. Competitive-type grants create a system of winners and losers, not a system for student achievement.		3.26	3.24	0.5	yes
18d. Some districts will not use it unless it is mandated.		3.11	3.0	0.75	yes
19. Teacher should have access to the digital instructional tools that they need (Bill & Melinda Gates Foundation, 2014; Borrego, Froyd, & Hall, 2010; Drape et al., 2013).	3.77	3.88	3.71	0.5	yes
20. The state should conduct trials to evaluate effects of an innovation under real-life classroom conditions.	3.18	3.22	3.05	0.0	yes
20a. Districts should conduct trials to evaluate effects of an innovation under real-life classroom conditions.		3.18	3.22	0.5	yes
20b. The state should develop a sense of best practices and communicate those results.		3.05	3.05	0.0	yes
20c. The state lacks credibility in this area.		3.21	2.95	0.5	yes
21. The state should recommend educational technology innovations for use by educators (Hazen et al., 2012).	3.09	2.89	2.90	0.0	yes
21a. Districts should recommend educational technology innovations for use by educators.		3.47	3.52	0.5	yes

(table continues)

Stage 2. Persuasion	R1 Mean	R2 Mean	R3 Mean	IQD	Consensus
22. The state must develop effective policies to provide time for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014).	3.32	3.22	3.10	0.25	yes
22a. The community should be involved in developing effective policies to provide time for the use of technology in an educational setting.		2.79	2.62	0.5	yes
23. The state must develop effective policies to provide training for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014).	3.41	3.17	3.19	0.5	yes
23a. The state must provide districts the professional development resources needed in order for them to provide the needed time for professional development.		3.79	3.57	0.5	yes
23b. Unless the technology is easy to use, do not bother with time for professional development.		3.00	2.95	0.5	yes
24. The state must develop effective policies to provide support for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014)	3.45	3.39	3.14	0.0	yes
24a. Effective policies to provide support for the use of technology in an educational setting is best done at the district level.		3.42	3.14	0.5	yes
25. The state must develop effective funding mechanisms to provide access for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014).	3.91	3.72	3.75	0.5	yes

(table continues)

Stage 2. Persuasion	R1 Mean	R2 Mean	R3 Mean	IQD	Consensus
26. The state must develop effective funding mechanisms to provide support for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014).	3.91	3.72	3.71	0.5	yes
26a. The state must work with districts to develop effective funding mechanisms.		3.79	3.62	0.5	yes
27. The state must develop effective funding mechanisms to provide training for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014).	3.77	3.71	3.62	0.5	yes
27a. To maintain equity, the state must work with districts to develop effective funding mechanisms to provide training.		3.79	3.81	0.0	yes
28. The state must develop effective funding mechanisms to provide time for the use of technology in an educational setting (Richards, Nash, & Flora, 2014).	3.68	3.61	3.57	0.5	yes
28a. To maintain equity, the state must work with districts to develop an effective funding mechanism to provide time for the use of technology in n educational setting.		3.78	3.71	0.5	yes
29. Change agents (official and unofficial leaders) need to focus on teachers' needs over promotion of a specific innovation (Stevens, 2014).	3.55	3.53	3.38	0.5	yes
29a. Change agents (official and unofficial leaders in education) need to focus on student achievement over promotion of a specific innovation.		3.50	3.57	0.5	yes
29b. The needs of the teacher should be a part of the criteria in making a decision about an innovation.		3.28	3.38	0.5	yes

Stage 3. Decision

It is during the decision phase when an individual adopts or rejects an innovation (Rogers, 2003); however, it should be noted that rejection of an innovation can take place in any stage. During this stage, peer usage of an innovation affects individual use. The panelists rated statements and comments related to online communities and professional development as part of the interpersonal communication that affects the decision. The option to use an innovation on a limited basis can support adoption (Rogers, 2003). The panelists added 13 items to the 14 statements in the researcher-created instrument used in Round 1.

The panelists addressed the need for districts and school networks to give flexibility to teachers to select resources for their classrooms in Item 30 (*mean* = 3.33, *IQD* = 0.25). They added comments clarifying the prerequisite that teachers have the technical ability to use the resources prior to adoption if they are going to use them (Item 30d. *mean* = 3.52, *IQD* = 0.5). Teachers should also work with technology experts when identifying resources for their classrooms (Item 30b *mean* = 3.33, *IQD* = 0.5), When asked to rate the statement about the need for teachers to use available technology with students (Item 31 *mean* = 3.48, *IQD* = 0.5), the experts expressed the notion teachers had a responsibility to show students how to use educational technologies (Item 31a *mean* = 3.71, *IQD* = 0.5).

Rogers (2003) identified two types of rejection, (a) active and (b) passive. Active rejection is a decision to adopt, followed by discontinuance. Passive rejection is deciding to never adopt. Support from peers and change agents can assist in a decision to adopt.

This section of the instrument included statements regarding several types of support for teachers to encourage adoption and continued use.

Booth (2012) sees online spaces as learning communities where people learn together. The panelists identified them as a way to provide ongoing support for teachers (Item 32 *mean* = 3.52, *IQD* 0.5) and as a type of professional development (Item 33 *mean* = 3.38, *IQD* = 0.5). However, the panelists added comments which recognized that teachers should decide if an online learning community meets their needs (Item 32a *mean* = 3.43, *IQD* = 0.25). The experts did not see a need for a national or state educational help desk for educators and these statements received lower scores (Item 33a *mean* = 2.62, *IQD* = 0.5 and Item 33b *mean* = 2.76, *IQD* = 0.5). Online learning communities were seen as a potential source of ongoing support for teachers (Item 32 *mean* = 3.52, *IQD* = 0.5). Districts need to identify the true experts within the schools and enable them to help others (Item 35 *mean* = 3.52, *IQD* = 0.5), but only if they provide time (Item 35a *mean* = 3.67, *IQD* = 0.5). Leadership should provide time for teacher collaboration if teacher leaders are to be effective (Item 36a *mean* = 3.57, *IQD* = 0.5).

Items 37 to 45 addressed teacher professional development. Higher scores were given to statements about the need for professional development to be anchored in both individual and collaborative activities (Item 40a *mean* = 3.60, *IQD* = 0.5). If teachers experience a more personalized approach to learning which uses technologies and makes authentic connections to their practice, they may take a similar approach with their students (Item 43 *mean* = 3.57, *IQD* = 0.5 and Item 44 *mean* = 3.52, *IQD* = 0.5). The complete results of the Decision stage are displayed in the following Table 5.

Table 5.

Stage 3. Decision	R1 Mean	R2 Mean	R3 Mean	IQD	Consensus
30. Districts and school networks should give teachers the flexibility to select resources for their classrooms (Bill & Melinda Gates Foundation, 2014).	3.14	3.29	3.33	0.25	yes
30a. Districts and school networks should work with teachers to identify resources for their classrooms.		3.67	3.45	0.5	yes
30b. Teachers should work with technology experts when identifying resources for their classrooms.		3.17	3.33	0.5	yes
30c. Many teachers are too fearful of technology to make that decision.		3.22	3.24	0.5	yes
30d. If teachers have the ability, they should have the flexibility to select resources.		3.44	3.52	0.5	yes
31. Teachers should direct their students to use the available digital products (Bill & Melinda Gates Foundation, 2014).	3.77	3.35	3.48	0.5	yes
31a. Educators have a responsibility to show today's students how to use available technology.		3.83	3.71	0.5	yes
32. Online learning communities should provide ongoing support for teachers (Booth, 2012).	3.55	3.24	3.52	0.5	yes
32a. Teachers should decide if an online learning community meets their needs.		3.33	3.43	0.25	yes
33. Online learning communities should provide a form of ongoing professional development for teachers (Booth, 2012).	3.45	3.43	3.38	0.5	yes
33a. There should be a National Educational Help Desk for educators.		2.83	2.62	0.5	yes
33b. There should be a State Educational Help Desk for educators.		2.83	2.76	0.5	yes

(table continues)

Stage 3. Decision	R1 Mean	R2 Mean	R3 Mean	IQD	Consensus
34. Teachers need coordinated training time so they can share with other teachers (Bill & Melinda Gates Foundation, 2014).	3.64	3.53	3.43	0.5	yes
34a. This type of professional development should occur during regular working hours.		3.22	3.24	0.5	yes
35. Districts need to identify the true experts and enable them to help others (Penuel & Riel, 2007).	3.59	3.65	3.52	0.5	yes
35a. Experts from within a district need guidance from leaders.		3.50	3.48	0.5	yes
35b. Experts from within a district need time to help others.		3.83	3.67	0.5	yes
36. Identifying a few teachers who can use innovation creates an isolated group of teachers rather than innovation leaders (Elmore, 2004).	2.86	2.76	2.24	0.75	yes
36a. Identifying a few teachers within a district works if leadership provides time for teacher collaboration		3.61	3.57	0.5	yes
36b. Teachers need to lead by example.		3.63	3.67	0.5	yes
36c. Leaders should be selected anonymously by stakeholders, not principals.		2.68	2.50	1.0	no
37. Professional development programs aimed at integrating technology in the classroom should be based on each teacher's needs (Uslu & Bumen, 2012).	3.14	3.17	3.19	0.5	yes
37a. Professional development programs aimed at integrating technology in the classroom should be based on **district needs**.		2.84	2.76	0.5	yes

(table continues)

Stage 3. Decision	R1 Mean	R2 Mean	R3 Mean	IQD	Consensus
38. Professional development programs aimed at integrating technology in the classroom should be based on each teacher's abilities (Uslu & Bumen, 2012).	2.82	2.72	2.85	0.5	yes
38a. Teacher's needs are more important than teacher's abilities when providing professional development. Abilities are enhanced during the process.		3.05	3.05	0.0	yes
38b. All teachers should be expected to have a certain level of technology skills.		3.42	3.33	0.5	yes
38c. Abilities are enhanced through professional development.		3.53	3.48	0.5	yes
39. Professional development needs to be anchored in teacher participation (Gu, Xiaodong, Wang, Qin, & Lindberg, 2012).	3.43	3.47	3.52	0.5	yes
40. Professional development needs to be anchored in collaborative activities (Gu, Xiaodong, Wang, Qin, & Lindberg, 2012).	3.32	3.33	3.05	0.0	yes
40a. Professional development needs to be anchored in both individual and collaborative activities.		3.63	3.60	0.5	yes
41. Professional development needs to be anchored in dialogue (Gu, et al., 2012).	3.19	3.12	3.00	0.0	yes
42. Train teachers to gain instructional design skills (Mkhize & Huisman, 2013).	3.00	3.24	3.24	0.5	yes
42a. Teachers gain instructional design skills through collaborative work.		3.33	3.38	0.5	yes
42b. When teachers know how to use the educational technologies they can work collaboratively.		3.44	3.29	0.5	yes

(table continues)

Stage 3. Decision	R1 Mean	R2 Mean	R3 Mean	IQD	Consensus
43. When teachers are able to experience a more personalized approach to learning that incorporates technologies, they are more likely to take a similar approach with their students (Brooks & Gibson, 2012).	3.59	3.57	3.57	0.5	yes
44. When teachers are able to experience a more personalized approach to learning that makes authentic connections to their practice, they are more likely to take a similar approach with their students (Brooks & Gibson, 2012).	3.71	3.35	3.52	0.5	yes

Stage 4. Implementation

"Implementation occurs when an individual (or other decision-making unit) puts an innovation to use" (Rogers, 2003, p. 179). In an organization, there is a degree of adaptation. Labeled by Rogers (2003) as redefining/restructuring, changes happen to both the organization and innovation. Also, reinvention often occurs during this stage. This is addressed in Chapter 5. Organizational and technical support as often needed to limit the uncertainty which the adopter experiences during this phase.

Support from the online learning community was not rated as highly as the need to provide greater technical support. The educators' Professional Learning Network is a "system of interpersonal connections and resources that support informal learning" (Trust, 2012, p. 133). The educators' PLN should be an option for teachers to access to acquire new information (Item 45a *mean* = 3.24, *IQD* = 0.5). The panelists expressed the need for more technical support type (Item 50 *mean* = 3.29, *IQD* = 0.5) instead of real-

time support in the form of a help desk. The panelists added four comments to the five original statements from Round 1. These results are shared in Table 6.

Table 6.

Stage 4. Implementation	**R1 Mean**	**R2 Mean**	**R3 Mean**	**IQD**	**Consensus**
45. Educators' Professional Learning Network (PLN) should provide online spaces where teachers can learn new information (Trust, 2012).	3.14	2.94	2.67	0.5	yes
45a. Educators' PLN should be an option for teachers to access to learn new information.		3.16	3.24	0.5	yes
45b. Teachers should be provided time to access PLNs.		3.16	3.33	0.5	yes
46. Educator's Professional Learning Network (PLN) should provide online spaces where teachers can connect with other individuals worldwide who **can offer support** (Trust, 2012).	3.19	3.11	3.24	0.5	yes
47. Educators' Professional Learning Network (PLN) should provide online spaces where teachers can connect with other individuals worldwide who **can offer advice** (Trust, 2012).	3.19	3.12	3.00	0.5	yes
48. Educators' Professional Learning Network (PLN) should provide online spaces where teachers **can offer feedback** (Trust, 2012).	3.05	2.94	2.86	0.75	yes
49. Educators' Professional Learning Network (PLN) should provide online spaces where teachers can connect with other individuals worldwide who **can offer collaboration opportunities** (Trust, 2012).	3.19	3.12	2.95	0.75	yes

(table continues)

Stage 4. Implementation	R1 Mean	R2 Mean	R3 Mean	IQD	Consensus
50. Provide more technical support (Mkhize & Huiseman, 2013).	3.55	3.24	3.29	0.5	yes
50a. The state should provide more technical support to districts.		3.22	3.30	0.5	yes
50b. The state should provide more technical support to teachers.		3.06	3.10	0.25	yes

Stage 5. Confirmation

The confirmation stage involves the routinization of the use of the innovation by the adopter (Rogers, 2003). At this stage the adopter seeks affirmation which diminishes any uncertainty about the benefits of the innovation. Discontinuance also occurs during this phase. There are two types of discontinuance: (a) replacement discontinuance where an innovation is replaced by a better idea, and (b) disenchantment discontinuance where discontinuance results because the innovation did not deliver expected results.

The confirmation phase involves an evaluation of the use of the innovation. Post adoption evaluation, discussion, and assessment tools will aid in increased utilization and implementation (Item 54a *mean* = 3.05, *IQD* = 0.0). The panelists addressed the reporting of the effectiveness of the innovation in Item 51. The panelists claimed that information about real action in the classroom requires more than teachers' self-reported answers; the information collected to review the effectiveness of the innovation should include students' samples, including data. (Item 51a *mean* = 3.52, IQD = 0.5). The potential for biased reporting of the effectiveness of the innovation is discussed in Chapter 5.

The panelists identified post adoption implementation activities (Item 52 *mean* = 3.29, *IQD* = 0.5) and post adoption evaluation (Item 53 *mean* = 3.19, *IQD* = 0.5) as

needed to ensure that the innovation becomes routine. Greater consensus among the experts was evident as they reviewed the need for post adoption review using teacher feedback for the innovation to become routine (Item 55 *mean* = 3.05, *IQD* = 0.0). The panelists were less enthusiastic about a post adoption review using quantitative data (Item 54 *mean* = 2.90, *IQD* = 0.5). Items that addressed the need for research-based results received lower scores.

The panelists added seven comments to the six items listed on the Delphi instrument used in Round 1. All items and results are listed in Table 7.

Table 7.

Stage 5 – Confirmation	**R1 Mean**	**R2 Mean**	**R3 Mean**	**IQD**	**Consensus**
51. Information about real action in the classroom requires more than teachers' self-reported answers (Pan & Franklin, 2011).	3.64	3.13	3.33	0.5	yes
51a. Information about real action in the classroom requires students' samples, data, etc.		3.44	3.52	0.5	yes
52. Post adoption implementation activities help to ensure that the innovation becomes routine (Hazen et al., 2012).	3.23	3.31	3.29	0.5	yes
53. Post adoption evaluation ensures that the innovation becomes routine (Hazen et al., 2012).	3.23	3.06	3.19	0.5	yes
54. Post adoption review using quantitative data ensures that the innovation becomes routine (Hazen et al., 2012).	3.18	2.88	2.90	0.5	yes
54a. Post evaluation, discussion, and assessment tools will aid in increased utilization and implementation.		3.22	3.05	0.0	yes

(table continues)

Stage 5 – Confirmation	R1 Mean	R2 Mean	R3 Mean	IQD	Consensus
55. Post adoption review using teacher feedback ensures that the innovation becomes routine (Hazen et al., 2012).	3.27	3.11	3.05	0.0	yes
55a. Post adoption review should not be based only on teacher feedback.		3.17	2.95	0.25	yes
56. The adoption rate would increase if the relative advantage of educational technologies innovation was communicated to students (Mkhize & Huiseman, 2013).	2.86	2.88	2.81	0.5	yes
56a. Students should be viewed as partners.		3.22	3.29	0.5	yes
56b. When students know why they are doing something, the outcomes are generally better.		3.44	3.48	0.5	yes
56c. Educator buy-in is generally more difficult than student buy-in.		3.50	3.55	0.5	yes
56d. Students do not always know the most effective way to use technology for learning.		3.33	3.24	0.5	yes

Summary

The experts used an online Delphi instrument to rate statements from current research and comments which they added. The mean score for each reviewed statement was shared with the experts in Rounds 2 and 3. They were able to adjust their ratings and add comments for each round. Their comments were added to the Round 2 and Round 3 instrument for all panelists to review and rate.

The experts used a researcher-created instrument in Round 1 which was developed using Rogers' (2003) diffusion of innovation theory as a guideline. The initial 56 statements published for review by the experts did not display the innovation-decision process. The tables included in Chapter 4 are divided using the stages. Consensus was

defined as an interquartile deviation score of less than or equal to one and calculated after Round 3. The expert panelists reached consensus on all items and additional rounds of the study were not necessary.

An explanation of the data is included in Chapter 4. The results are divided and matched to the five phases of the innovation-decision process (Rogers, 2003). The tables list the statement mean score for each round, the interquartile deviation, and a yes or no regarding consensus. Chapter 5 includes an analysis of the data and recommendations for use.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this study was to identify strategies or guidelines which could be used to increase the rate of diffusion and adoption of educational technologies in K-12 public schools in State X. The research question guiding this investigation was, What is the best implementation strategy or process to increase the successful adoption of educational technologies in K-12 public schools in State X? A group of educational technology experts used a Delphi instrument to rate statements from current research studies which were grounded in Rogers' (2003) diffusion of innovation theory. The expert panelists added comments to the original instrument and they reviewed and rated all statements and comments. The use of the Delphi technique, enabled experts who had experience with past educational technology implementations in State X to share opinions. They shared their understanding of what might be a better diffusion and adoption process for implementing educational technologies in State X.

The expert panelists brought first-hand experience of efforts to provide educational technologies for teachers and students. The experts compared their experiences and knowledge with statements from current research which were listed in the Delphi instrument used in Round 1. A diverse group—participants included teachers, administrators, and policymakers--represented multiple viewpoints regarding the education environment. The experts moved to consensus as they rated statements about how to implement educational technologies.

The results from this study provide strategies and guidelines which may be useful to educators and policymakers when they create educational technology plans and decide

how to improve the implementation of educational technologies in classrooms and schools. The panelists made recommendations which could be used to develop a complete plan or model for successful diffusion and adoption of educational technology innovations in education environments. The experts also defined the state's responsibility and explained how the state might provide support to districts and educators.

Interpretation of the Findings

The expert panelists identified strategies and guidelines during this study which could be used to create a statewide educational technology plan for State X. In addition, they made recommendations about the role of the state to provide support and identified three reasons for continuing to implement educational technologies in K-12 public schools in State X. The results can be divided into sections which match the phases of the innovation-decision process of Rogers' (2003) diffusion of innovation theory.

Knowledge Stage

The innovation-decision process begins with the knowledge stage. It is during this phase that an individual becomes aware of an innovation and begins to develop an opinion (Rogers, 2003). There are three types of knowledge associated with this stage: (a) *awareness-knowledge*, (b) *how-to knowledge*, and (c) *principles-knowledge*. The potential for successful adoption of an innovation is improved if an adopter possesses each type of knowledge about an innovation. Statements from the Delphi instrument matched each type of knowledge and the panelists rated statements and comments to be included in the list of strategies and guidelines which support this knowledge stage.

Educators should be aware that an innovation exists before they are asked to adopt (Statement 1. *mean* = 3.76, *IQD* = 0.25). Hazen, Wu, Sankar, and Jones-Farmer (2012) pointed to the need for awareness of an innovation before implementation. This statement matched the *awareness-knowledge* which Rogers (2003) identified as an important first step in the innovation-decision process for a social system. Organizations make decisions about which innovation to adopt, frequently to meet a specific need. In a social system, the rate of diffusion and adoption increases if the individual knows about the innovation before being asked to adopt.

The individual learns about the innovation through communication channels. A clear understanding of which communication channel was most effective for making educators aware of an educational technologies was not evident. Rogers (2003) identified two communication channels for making the innovation known: (a) mass media, and (b) interpersonal communication channels. He generalized that mass media were more important during the knowledge stage and interpersonal channels were more effective during the persuasion stage. The panelists' ratings did not show these types of communication as highly effective ways to share information about an innovation. Workshops received higher scores (Statement 3c. *mean* = 3.29, *IQD* = 0.5) than the use of mass media (Statement 3. *mean* = 2.38, *IQD* = 0.5) or social media (Statement 3a. *mean* 2.62, *IQD* = 0.5).

Within a school, teachers may represent the most effective communication channel for sharing awareness about an innovation. The panelists added a comment to the original Delphi instrument about the importance of peers who use educational technology

practices as an effective way to keep faculty informed (Statement 3b. *mean* = 3.10, *IQD* = 0.25). These results may be caused by the selection process of the study. The teachers who were invited to participate were educators who would be considered earlier adopters when using educational technologies in the classroom. This concept would need further investigation and may be unique to each school or district environment.

Educators should be trained in the use of educational technologies innovation (Statement 1a. *mean* = 3.67, *IQD* = 0.5). This comment represents the *how-to knowledge*. It is helpful for teachers to learn how an educational technology works before making a decision about adoption. Professional development which includes more comprehensive information about the technology is part of the implementation phase. During the knowledge stage, the potential adopter learns the basic operation of the innovation and learns about attributes of the innovation.

The educational technology must be (a) easy to use, (b) easy to understand, and (c) reliable. The perceived attributes of an innovation are important to the rate of adoption (Rogers, 2003). The experts rated several statements which matched this '*how-to' knowledge* which increases the potential for successful implementation and adoption. The educational technologies innovation must be easy to use (Hazen et al., 2012; Jwaifel & Gasaymeh, 2013) (Statement 10 *mean* = 3.67, *IQD* = 0.5) and understand (Hazen et al., 2012) (Statement 11. *mean* = 3.71, *IDQ* = 0.5). The panelists added a comment that the innovation must be reliable (Item 10a. *mean* = 3.86, *IQD* = 0.0). These directly relate to the Technology Acceptance Model (TAM); it relates to the measurements regarding the usability of the innovation.

Educational technologies should be evaluated as a teaching tool (Drape et al., 2013; Bill & Melinda Gates Foundation, 2014) (Item 12 *mean* = 3.71, *IQD* = 0.5). Rogers (2003) emphasized the importance of *procedural knowledge*; the individual should understand why an innovation is effective and how it meets a need. When evaluating statements about a potential adopter needing procedural knowledge, the expert panelists gave the statements high ratings confirming the importance of the recommendation.

Teachers need to be able to see numerous examples of success with the innovation (Ertmer, & Ottenbreit-leftwich (2010). *Demonstrating how a technology can help a teacher meet their goals is more useful than telling them that technology can help them reach their goals.* The need of educators to know that an educational technology innovation can help them meet their goals (Drape et al., 2013, Means, 2010) was a statement which received one of the highest scores. (Statement 7. *mean* = 3.90, *IQD* = 0.0). The panelists added two comments to that statement. Educators needed to know the 'why' behind the educational technologies innovation (Statement 7a. *mean* = 3.71, *IQD* = 0.0) and educators needed to 'see' rather than 'hear' about how technology can help them meet their goals (Statement 7b *mean* = 3.95, *IQD* = 0.0). Classroom use must not interfere with the original goal of why an educational technology is being implemented.

When considering an innovation to use, the expert panelists indicated that research which supported the use of the innovation was not important. Stevens (2014) noted that educators need to see that ideas for educational technologies are deeply rooted in research; however, the panelists dismissed this statement (Statement 8. *mean* = 2.67,

IQD = 0.5) and indicated in Statement 9 (*mean* = 3.67, *IQD* = 0.5) that educators want to see ideas for educational technologies which are deeply rooted in classroom realities (Stevens, 2014). Application and success rates are just as important and each classroom is unique, therefore, research does not always apply (Statement 8a *mean* = 3.2, *IQD* = 0.5). An added concern was that teachers do not always use the innovation as designed and research does not apply (Item 8b *mean* = 2.71, *IQD* = 0.5). Statement 9 (*mean* = 3.67, *IQD* = 0.5) indicated that more importantly, as Stevens (2014) also indicated, the innovation must be deeply rooted in classroom realities.

Persuasion Stage

It is during the persuasion stage that forward planning becomes part of the process. Meanwhile, opinions continue to be developed and favorable ones increase the potential of successful adoption (Rogers, 2003). Teachers should be able to use the innovation in their classrooms to determine if the innovation is appropriate for their students and meets their goals. Trialability of an innovation increases the potential for successful adoption (Rogers, 2003); however, rapidly changing technologies make implementation difficult because another innovation may replace it or it may be improved. It is on this point that the panelists made recommendations about the role of the state; the state could support districts by monitoring changes and offering support and guidance in new and effective educational technologies. This is discussed in the section regarding the Role of the State.

Teachers should be able to experiment with the innovation before deciding to adopt (Jwaifell & Gasaymeh, 2013). (Statement 13. *mean* = 3.29, *IQD* = 0.5.) The

panelists noted in an added comment that the innovation should be free of cost to the teacher (State 13b. *mean* = 3.67, *IQD* = 0.5). This comment was not added to the recommendations because it is proposed that districts and state budgets provide necessary equipment and supplies.

Leadership need to focus on teachers' needs and student achievement over promotions of a specific innovation. Educators want to see leadership identify educational technologies solutions that meet a real need. (Item 17a *mean* = 3.43, *IQD* = 0.5). A champion is a leader within an organization who has a high position and strongly supports the innovation (Rogers, 2003). An opinion leader assumes that role within a system where they prove their abilities to be effective (Rogers, 2003). The role of educational leadership as either a champion or opinion leader could be important in the adoption process depending on how the institution is identified.

Decision Stage

The experts indicated that teachers would make decisions to adopt if supported by leadership. The results of the ratings to questions that matched the decision phase more closely matched the organizational model than the social system. This makes it difficult to clearly identify strategies or guidelines for individuals; however, Rogers (2003) indicated that education is a unique organization. The experts added comments which added expectations and clarity to leadership's decision to adopt. The culture or environment of the district or school may affect how the leadership role is displayed. It may mean that leadership is more than a managerial position.

Teachers follow leadership who understand and model use of the educational technology innovation (Drape et al., 2013). (Statement 14. *mean* 3.33, *IQD* = 0.5).

Teachers follow leadership who communicate why the educational technology is important and how it will work (Item 14c. mean = 3.58, IQD = 0.5).

Teachers follow leadership who have a clear picture of how the educational technologies can be implemented (Statement 15c. mean = 3.57, IQD = 0.5).

Teachers should work with district and technology experts when identifying resources for their classrooms (Statement 30b. mean = 3.33, IQD = 0.5). This added comment showed the need for collaboration among educators to include members who have knowledge of the technology infrastructure. Several comments were added which addressed the need for inclusion of the technical aspect in both planning and support during implementation. Additional discussion about funding and supporting technology is included in the Role of the State.

The panelists disagreed with Elmore (2004) who noted that identifying a few teachers who can use an innovation creates an isolated group of teachers rather than innovation leaders (Statement 36. *mean* = 2.24, *IQD* = 0.75). The selection process for the study may have affected this result. The group of teachers selected for the study were those who use educational technologies in innovative ways and they may not view themselves as a separate group with privileges. This perception needs further investigation.

Implementation Stage

An individual puts the innovation into practice during the implementation stage. The expert panelists reached consensus about the importance of professional development for teachers, however, training should meet the teacher's needs. They also indicated that all teachers should achieve a certain level of technology skills (Item 38b. *mean* =3.33, *IQD* =0.5). The experts did not identify specific skills, but they did point out that technology abilities are enhanced through professional development (Item 38d. *mean* = 3.33, *IQD* = 0.5). These recommendations were not included in the list of strategies and guidelines because the definition or scale for these abilities has not been identified (Fanni, Rega, & Cantoni, 2013).

Professional development needs to be anchored in teacher participation (Gu, Xiaodong, Wang, Qin, & Lindberg, 2012). (Statement 39. *mean* = 3.52, *IQD* = 0.5). Teacher professional development (TPD) that includes teacher participation and collaborative activities allows educators to explore and compare strategies. This approach to learning helps teachers recognize the connection between theories and practice (Gu, Xiaodong, Qin, & Lindberg, 2012).

*Professional development needs to be anchored in both individual and collaborative activities (*Statement 40a *mean = 3.60,* IQD = *0.5).* The panelists added this comment to Statement 40 (*mean* 3.05, *IQD* = 0.0) about professional development indicating a need for a mixture of types of professional development.

Teachers should decide if an online learning community meets their needs (Statement 32a. mean = 3.43, IQD = 0.25). The experts indicated that online learning

communities could be effective (Item 32. mean = 3.52, IQD – 0.5), but recognize that this does not apply to all teachers.

Provide more technical support (Mkhize & Huiseman, 2013). A clarifying comment was added to this statement (Statement 50. *mean* = 3.29, *IQD* = 0.5). The state should provide more technical support to districts (Comment 50a. *mean* = 3.22, *IQD* = 0.5). It is the state's responsibility to provide more technical support; however, the way to do this was not defined. The panelists rated the idea of creating a National Educational Help Desk for educators (Item 33a. *mean* = 2.62, *IQD* = 0.5) or a State Educational help Desk (Item 33b. *mean* = 2.83, *IQD* = 2.76) as lower than other types of support. They agreed with Richards, Nash, and Flora (2014), effective policies to provide training in the use of technology in an educational setting should be provided by the state (Item 23 *mean* = 3.19, *IQD* = 0.5). This idea is included in the following section about the role of the state (Item 23. *mean* = 3.19, *IQD* = 0.5).

Post adoption implementation activities help to ensure that the innovation becomes routine (Hazen et al., 2012) (Statement 53. *mean* = 3.19, *IQD* = 0.5.). These activities are related to professional development and address the need for ongoing support and practice.

Conformation Stage

The method of evaluation should be defined before implementation (Comment 12a. *mean* = 3.57, *IQD* = 0.5). Topper & Lancaster (2013) noted that districts which plan for formal assessment were better able to measure success and follow implementation.

Measured successes can be shared to provide confirmation to the potential adopter that the tool is working as planned.

Post evaluation, discussion, and assessment tools will aid in increased utilization and implementation (Comment 54a *mean 3.05, IQD* = 0.0). The experts rated this comment higher than the statement that *post adoption review using quantitative data ensures that the innovation becomes routine* (Hazen et al., 2012) (Statement 54. *mean* = 2.90, *IQD* = 0.5). This may reflect some of the issues with measuring implementation and adoption. The panelists shared comments which reflected concerns about quantitative data that are not applicable to every classroom. This continued the questioning of the quantitative data and research results when evaluating an implementation. Evaluation is important and should include quantitative data, but it should also include other types of review.

*Information about real action in the classroom requires students' work samples, data, and teacher feedback (Comment 51a. mean = 3.52, IQD = 0.5). Information about real action in the classroom requires more than teachers' self-reported answers (*Statement 51a. *mean* = 3.52, *IQD* = 0.5*).*

*Post adoption review using teacher feedback ensures that the innovation becomes routine (Hazen et al., 2012). (*Statement 55 *mean* = 3.05, *IQD* = 0.0*).* This was an important piece to the total process for successful diffusion of innovation because it represented the recognition that the adoption process continues beyond decision and implementation stages to routinization or confirmation. Anecdotal evidence does not confirm success. Gathering evidence of successful diffusion provides something to

celebrate and can be used to evaluate what needs to be repaired (Topper & Lancaster, 2013).

Diffusion of Innovation Theory

Strategies and guidelines emerged which matched each stage of the innovation-decision process. The Technology Adoption Model (TAM) and the Concerns-Based Adoption Model (CBAM) have been used to promote change in the education environment. These models are focused on the knowledge and persuasion stages of the innovation-decision process which precede the decision to adopt. The attributes of the technology are central to the TAM. The attitude of the potential adopter is important to the success of the adoption in both models. If the teacher develops a positive attitude about the innovation, they will use the innovation which has been selected by the organization. Rogers (2003) pointed out that a decision to reject an innovation could happen following a decision to adopt. The inclusion of strategies and guidelines that can be used in each phase when creating a plan provides a more complete plan.

The strategies and guidelines are listed here. This list does not include the stages of the innovation-decision process. The recommendations divided into the phases of the process is included in Appendix F.

Implementation Strategies and Guidelines to Increase Innovation Adoption

- Educators should be aware that an educational technology exists before being asked to adopt.

- The educational technologies must be (a) easy to use, (b) easy to understand, and (c) reliable. Classroom use must not interfere with the original goal of why it is being implemented.
- Educators should be trained in the use of an educational technology innovation.
- Educational technologies should be evaluated as teaching tools.
- Teachers should be able to experiment with the innovation before deciding to adopt.
- Teachers need to be able to see numerous examples of success with the innovation. Demonstrating how a technology can help a teacher meet their goals is more useful than telling them that the educational technology can help them reach their goals.
- Leadership need to focus on teachers' needs and student achievement over promotions of a specific innovation. Educators want to see leadership identify educational technology solutions that meet real needs.
- Teachers follow leadership who understand and model use of the educational technology innovation.
- Teachers follow leadership who communicate why the educational technology is important and how it will work.
- Teachers follow leadership who have a clear picture of how the educational technology can be implemented.

- Teachers should work with district and technology experts when identifying resources for their classrooms.
- Professional development needs to be anchored in both individual and collaborative activities.
- The use of workshops is an effective way to keep faculty informed.
- Teachers should decide if an online learning community meets their needs.
- Post adoption implementation activities help to ensure that the innovation becomes routine. The method of evaluation should be defined before implementation.
- Post evaluation, discussion, and assessment tools will aid in increased use and implementation. Information about real action in the classroom requires students' samples, data, and teacher feedback. Information about real action in the classroom requires more than teachers' self-reported answers.
- Post adoption review using teacher feedback ensures that the innovation becomes routine.

Role of the State

The panelists rated statements and comments which provided a list of strategies and guidelines for the next state educational technologies plan. The following strategies and guidelines are not included in the innovation-decision process because they represent support which the state can offer districts, schools, and educators. A qualification for participating as an expert panelist included possessing knowledge or experience about

past educational technologies plans in State X. These experts had a unique understanding about the needs and goals of State X and experience with past attempts by the state to implement educational technologies into K-12 public schools and classrooms. Most recommendations included in this list appeared on the Delphi instrument in the sections that matched the persuasion stage or implementation stage. During the persuasion phase, the potential adopter looks for assurance that the innovation will help their situation. The following strategies and guidelines could be included in a state technology plan which identifies how the state would provide support and increase the rate of diffusion and adoption of educational technologies in the classroom.

*The state should develop effective funding mechanisms to provide access and support for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014). (*Statement 25. *mean* = 3.75, *IQD* = 0.5.) *(*Statement 26. *mean* = 3.71, *IQD* = 0.5). The Institute for Evidence Based Change report (IEBC,2013) pointed out that State X is struggling with the cost of the accessibility of technology in school districts, in the classroom and outside the classroom and identified a need to develop a 3-5 year statewide strategic technology and data use plan.

*Develop effective funding mechanisms to provide time for the use of technology in an educational setting (Richards, Nash, & Flora, 2014) (*Statement *28. mean* = 3.57*, IQD* = 0.5*.)* Districts need to plan and fund time for teachers to use the technology. The experts identified this as an equity issue. Seventy-five percent of the state's school districts are rural and small districts. *To maintain equity, the state must work with districts to develop an effective funding mechanism to provide time for the use of*

technology in an educational setting (Item 28a *mean* = 3.71, *IQD* = 0.5). This concurs with the IEBC report (2013), researchers recommended that the state explore solutions to provide technical support to districts because there were large differences among them. The educational technology gap in services and support is most notable in the smaller districts.

*Make recommendations for educators' use of educational technologies rather than mandate use (*Statement 18. *mean* = 3.43, *IQD* = 0.5*).* In the past, the state has tried a grant process to distribute funds to districts for educational technologies. The expert panelists who participated in this study added a higher rating to a comment about the state's use of grants, indicating that competitive-type grants created a system of winners and losers, not a system for student achievement (Comment 18c. *mean* = 3.24, *IQD* = 0.5). This statement aligns with the concept that in education, the earlier adopters are not opinion leaders and do not represent an intrapersonal communication channel. But as Elmore (2004) pointed out, in education this method of identifying teachers who are expected to serve as positive models creates an elite group that becomes isolated from the others.

*Develop a sense of best practices and communicate those results. Effective policies to provide support for the use of technology in an educational setting are best formed at the district level (*Comment 20b. *mean* = 3.05, *IQD* = 0.0.). The panelists considered whether districts or the state should conduct trials to evaluate effects of an innovation under real-life classroom conditions. The districts should conduct trials to evaluate effects of an innovation under real-life classroom conditions (Comment 20a.

mean = 3.22, *IQD* = 0.5) received a higher rating than the state (Statement 20. *mean* = 3.05, *IQD* = 0.0). The role of the state was then identified as providing a way to communicate those best practices. This concurs with what Cavanaugh, Dawson, and Ritzhaupt (2011) considered the success of Florida's Leveraging Laptops initiative because the implementation was conducted at district level.

*Maintain equity by working with districts to develop effective funding mechanisms to provide training (*Comment 28a *mean* = 3.81, *IQD* = 0.0). *The unique nature of each district requires unique support from the state* (Item 18b *mean* = 3.19, *IQD* = 0.5). Equity for students was a concern and a comment was added which pointed to the need to mandate the use of educational technologies or a district will choose not use them (Comment 18d. *mean* = 3.0, *IQD* = 0.75). This comment received a lower rating with a greater range and did meet consensus; however, this strategy has not been successful in State X.

Provide more technical support to districts and teachers. Mkhize and Huiseman (2013) pointed to the need for more technical support to meet successful implementation (Statement 50. *mean* = 3.29, *IQ* = 0.5). The panelists identified the need for the state to provide more technical support to districts (Comment 50a. *mean* = 3.30, *IQD* = 0.5) and teachers (Comment 50b. *mean* = 3.10, *IQD* = 0.25.).

Include educators and technology experts when evaluating the direction for educational technologies. Advisory groups that include experts from both education and technology are critical when evaluating the direction for educational technologies

(Comment 4c. *mean* = 3.62, *IQD* = 0.5. This may reflect the need for a sense of direction and the coordination of tools and infrastructure.

The complete list which identifies the role of the state and identified through the Delphi instrument is provided in the following:

Strategies and Guidelines to Increase Potential for Successful Implementation of Educational Technologies

The state should

- Develop effective funding mechanisms to provide access and support for the use of technology in an educational setting.
- Develop effective funding mechanisms to provide time for the use of technology in an educational setting.
- Make recommendations for educators' use of educational technologies rather than mandate use.
- Develop a sense of best practices and communicate those results. Effective policies to provide support for the use of educational technologies in an education setting are best formed at the district level.
- Maintain equity for all students by working with districts to develop effective funding mechanisms to provide training for students and educators. The unique nature of each district requires unique support from the state.
- Provide more technical support to districts and teachers.

- Include educators and technology experts when evaluating the direction for educational technologies.

The expert panelists moved to consensus regarding three statements about the purpose for diffusing educational technologies in the education environment. They rated these statements with high scores to confirm that (a) educators have a responsibility to show today's students how to use available technology (Comment 31a. *mean* = 3.71, *IQD* = 0.5), (b) teachers should have access to the digital instructional tools that they need (Bill & Melinda Gates Foundation, 2014; Borrego, Froyd, & Hall, 2012; Drape et al., 2013) (Statement 19. *mean* = 3.71, *IQD* = 0.,25), and (c) educational technologies should be considered one tool in an array of devices (Comment 12b. *mean* = 3.90, *IQR* = 0.0).

Limitations of the Study

For this study, a panel of experts identified strategies and guidelines which could be used to create a plan for State X. The first limitation was identifying the qualifications of an educational technology expert because a clear understanding of the skill-level needed to be declared and there is no definition for an expert in educational technology. Koehler, Mishra, and Cain (2013) pointed to the need to identify a measurement of expertise in the area of educational technologies to access a teacher's technology abilities as part of the Technological Pedagogical Content Knowledge (TPACK) framework. A scale that indicates a level of educational technology expertise does not exist. However, the results of the Delphi technique are dependent upon the expertise of the panelists.

The success of the Delphi technique is dependent upon the expert panelists who gather to consider the problem. Experts need to have (a) knowledge about the problem,

(b) a willingness to participate, (c) time to participate, and (d) communication skills (Adler & Ziglio, 1996). For this study, the expert panelists possessed knowledge and experience with the educational technology implementations of State X. Their understanding of failed implementations and knowledge of the current education environment in the state qualified them to come together to make recommendations. The complete list of the qualifications for participating as an expert panelist is outlined in Chapter 3. Only panelists who met the qualifications were invited to participate and this ensured that the panel was capable of answering the research question.

A limited number of experts were available for the study because they had to meet the qualifications; however, a sufficient number of experts from each category joined the panel and identified recommendations which could be used by policymakers when creating an educational technology implementation plan for State X. The panelists were not identifying the next educational technology innovation to diffuse within State X, but rather determining ways to improve the potential for successful adoption of any educational technology innovation. Experts from outside the state were included as expert panelists because they represented policymakers with expertise in educational technology integration.

Participation in this Delphi study was a time-consuming activity for the panelists. They spent between 20-60 minutes completing each round. They rated the original 56 statements and also reviewed the 89 comments that were added during Rounds 2 and 3. No statements were removed from the study. There was some confusion among the panelists regarding the Delphi technique because they did not understand that the

inclusion of all statements and comments for each round was part of the instrument for each round and provided them an opportunity to change their ratings and move to consensus. The panelists completed ratings for all statements and comments in each round.

Another limitation of the study was the potential for researcher bias. This was addressed in several ways, including the careful selection of the expert panelists. The panelists were not paid for their participation and they volunteered their time to participate in the study. The mean scores of the panelists' ratings and their added comments were reported and added to Rounds 2 and 3. The experts could compare their score to the other panelists' scores and contact me with any concerns.

The results of this Delphi study are unique to State X. The research question guiding this investigation was, What is the best implementation strategy or process to increase the successful adoption of educational technologies in K-12 public schools in State X? The expert panelists who participated in this study possessed knowledge fit for the study because they were familiar with the past experiences and the present environment. However, the methodology and the Delphi instrument based on Rogers' (2003) diffusion of innovation theory could be used in another setting with results which are applicable to that district or state.

Recommendations

The expert panelists rated statements from research studies and added comments which reflected what they considered important to the successful and efficient implementation of educational technology innovations in Stave X. They moved to

consensus to identify strategies and guidelines which could be used in several ways to improve the diffusion and adoption rate of education technologies and increase the potential for successful educational technology integration in K-12 public schools.

These strategies and guidelines could be used as a type of checklist to follow when implementing an educational technologies innovation. A list that outlines all aspects would provide guidance for each stage of the innovation-decision process. This agenda could also be included in a manual designed for implementing new innovations at the district level. The results of the study showed that the expert panelists identified the district as the best level for managing change. Meanwhile, the expert panelists also identified a specific list of recommendations regarding the state. The strategies and guidelines could be used to create an educational technologies plan for State X.

While these recommendations may not be appropriate for other states, the Delphi instrument and study design could be used with other states and districts as a tool to gather information unique to that environment. Statements from current research were used to create the Delphi instrument and those statements were submitted to a panel for review. The panelists had the opportunity to review current research regarding educational technology implementations and rate the statements according to their experiences and opinions. Using the Delphi instrument, the experts were exposed to research which may not have exactly matched the content area or setting of K-12, a common complaint about research, but the panelists were able to make decisions related to the students, educators, and policymakers of State X.

This study was designed to identify recommendations for successful implementation of educational technologies in State X; however, patterns emerged in the ratings which indicated that the diffusion of innovations in education organizations may be more efficient if they were approached as a blend between a social system and an organization, if not just considered a social system. Rogers (2003) claimed that education was unique because teachers worked in organizations and organizational-type decisions were involved when implementing innovations. Most of the research that uses the diffusion of innovation theory in education focused on the knowledge and persuasion stages. The recommendations and strategies presented in this study matched other stages and those statements were confirmed by the panelists. If the strategies and recommendations were used to create a model for evaluation, a clearer picture of how to increase the potential of implementing an innovation in education may appear.

The panelists recommended quality professional development for teachers when implementing new technologies and additional technical support. However, they did not indicate the specifications for each. Also, the experts suggested that all teachers should have educational technology skills, but they did not identify them. Further investigation regarding effective professional development and required technology skill level is needed.

Implications

The 2016 National Education Technology Plan, *Future Reading Learning: Reimagining the Role of Technology in Education* (U.S. Department of Education, 2016), outlined the national vision and plan for learning with technology. Noted is the need for

educators to use technology effectively and community members to collaborate. Recommendations in the report included the call for states, districts, and post-secondary institutions to develop and implement learning resources which create an equitable learning environment for all students (U. S. Department of Education, 2016).

The adoption of an innovation can produce positive social change; however, even innovations which can transform in positive ways do not always diffuse to successful adoption. More research that "further guides to best approaches for bringing new ideas for teaching and learning" is needed (Kardasz, 2014, p. 63). The expert panelists used a Delphi instrument to identify strategies and guidelines which could be used to increase the potential of successful adoption of educational technologies in K-12 public schools, the adoption of innovations that could change education and increase student achievement. The strategies and guidelines which were identified during the study followed an innovation-decision process (Rogers, 2003) which creates a complete plan that starts with the knowledge stage and moves through the five stages to the confirmation stage where an innovation is adopted as planned. A plan created to follow the adoption process would provide insight into what enhanced the implementation and what impeded, or slowed, the diffusion of the innovation.

State X leadership recognizes the importance of including stakeholders when planning and making decisions. After the failure of the state's plan to provide each student with a digital device, there was an effort to include representatives from business, community, and all parts of education when planning for education change. This study included experts from education and included teachers, administrators, and policymakers.

In an organization, the implementation of an innovation follows a decision to adopt a tool or idea which fills a particular need in the organization. Frank, Zhao, Penuel, Ellefson, and Porter (2011) contend that in schools, knowledge flows throughout the group from person to person rather than through a hierarchy. Oguz (2016) suggests that a more flexible approach to organizational leadership may be beneficial to the implementation process. This flow of communication would indicate that the social system approach rather than an organizational approach might be a more appropriate approach for diffusing innovation in the educational setting. The differences between the social system model and the organizational model may present small, but significant differences in an education setting. The panelists were unaware of how the statements from recent literature matched the diffusion of innovation theory. Their ratings of statements, and the comments they added, showed a strong pattern for a change in how educational technologies are implemented.

Conclusion

This study created an opportunity for educational technology experts to share insight and identify ways to increase the process for successful implementation and adoption of educational technologies. The expert panelists were able to identify strategies and guidelines which could be used in the next educational technologies plan of State X. This was important because the state has experienced several expensive, unsuccessful attempts to implement innovations in the state's schools, and leadership continue to purchase more educational technologies for K-12 public schools. K-12 public schools are subject to constant reform. However, change in education is slow, and the innovations are

often reinvented (Owens & Valesky, 2011; Rogers, 2003). Linda Darling-Hammond (2010) identified a need for a paradigm shift within school districts "from managing compliance to managing improvement" (p. 270). This study represents a change in the way that the education setting is viewed, and could provide opportunities for better understanding of how the system adopts innovations which produce positive change. Working with teachers and students to help them adopt the innovations which improve student achievement could represent a positive change.

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Appendix A: Script for Recruiting Expert Panelists

Your participation in my research study is requested because you have unique knowledge and experience in the area of educational technologies. The purpose of this study is to develop a strategy for successful diffusion of educational technologies in (redacted)'s K-12 public schools. This study is part of my doctoral research at Walden University.

I hope you will be interested in serving on this panel of experts to further advance the literature and research for integrating educational technologies in K-12 public schools. The methodology for this study is a Delphi technique. The benefits of the Delphi technique include (a) participant confidentiality, (b) a controlled feedback procedure, and (c) statistical response. There will be three or four rounds of data collection via an online instrument that will require about 20 minutes per week to respond to the statements on the instrument. Each round will begin on Sunday evening and end on Thursday.

If you choose to participate, please digitally sign the consent form. The link is below.

I appreciate your participation; however, I request that you not discuss this study with anyone now or during the study. If at a later date when the study is complete, and you chose to make your participation in this study known to colleagues, you may do so. All results will be posted and published without indicators that would identify experts. I will protect participant confidentiality.

Thank you.

Appendix B: Email Invitation Requesting Participation in Study

Date
Re: Letter of invitation for study participation
Subject Title: Expert Recommendations for Implementing Educational technologies
From: Jennie Gibson

Dear,

You possess unique knowledge and experience with educational technologies, and I hope you will be interested in participating in my study. It is designed to advance the literature and research for integrating educational technologies in K12 public schools. This study is part of my doctoral research as a student at Walden University, and the purpose is to identify a strategy for successful diffusion and implementation of educational technologies.

The methodology for the study is a Delphi technique. The benefits of the Delphi technique include (a) participant confidentiality, (b) a controlled feedback procedure, and (c) statistical response. You will rate statements from current research. There will be three or four rounds of data collection via an online instrument. Participation will require about 20 minutes per week. Each round will begin on Sunday evening when the link to the survey is emailed to you. The survey will close on Thursday.

If you choose to participate, you will collaborate anonymously with other experts as you respond to the statements on the Delphi instrument. You will have the opportunity to share your opinions in a confidential manner and your involvement in this study will be with total anonymity.

The tentative timeline for data collection is:

Round 1:
Round 2:
Round 3:
Round 4: (if necessary)

Additional information is provided in the Letter of Consent (attached). A link is available for your digital signature. Your commitment to complete all three rounds is essential to the success of the research project. Your opinion is highly respected.

Please reply to this email as soon as possible.

If you have any questions or concerns, please contact me at [redacted] or my dissertation chairperson, Dr. Carla Lane at [redacted] or [redacted]

Sincerely,

Jennie VanDyk Gibson, Doctoral Student
[redacted]

Appendix C: Consent Document

Consent Document

Title: A Delphi Study to Identify an Implementation Strategy for Educational technologies

I am requesting your participation in a research study because you are an educator or an educational policymaker with experience with educational technologies.

Your participation in this research study is essential to its success; however, you do not have to join in this study, and if you decide to participate, you may quit the study at any time.

What is the purpose of the study?

The purpose of this study is to identify strategies that will increase the potential for successful diffusion and implementation of educational technologies in K-12 public schools. A panel of educational technologies experts that includes teachers, administrators, tech directors, and policy designers will participate in a modified Delphi technique.

What are the study procedures?

A modified Delphi technique is a systematic way to obtain ideas and recommendations from experts in a given field and use their ideas to create consensus. It is committee work without manipulation or outside influences from other members because each expert participates in total anonymity. Only you may disclose that you participated in the study after the study is complete. The Delphi technique uses (a) the anonymity of experts, (b) a group controlled feedback procedure, and (c) statistical response as an efficient decision-making process.

Each panelist will be asked to rate statements according to importance. Space will be available for comments and feedback that you can share with the other panelists in an anonymous manner. Each round begins on Sunday when expert receive the link to an online instrument. The deadline for completing the review of items will be Thursday. I will gather the data from the online tool and compile the results. This information will be used to create the instrument for the next round.

The Delphi instrument includes statements from current research studies. These statements focus on the implementation and diffusion of education technology innovations. The items represent the five stages of Diffusion of Innovations theory (Rogers, 2003). Examples of the statements include:

The educational technologies innovation must be easy to use (Hazen et al., 2012; Jwaifel& Gasaymeh, 2013).

The state must develop effective policies to provide training for the use of technology in an educational setting. (Richardson, Nash, & Flora, 2014).

Online learning communities should provide ongoing support for teachers (Booth, 2012).

The online instruments and responses will be saved for five years and then destroyed. Participant anonymity will be protected. I will code your name and answers for your protection.

How long will the study take? Your review of the instrument should take about twenty minutes per week for three weeks. Consensus is usually obtained after three rounds. Occasionally, an additional round is needed.

Where will the study take place?

Email will be used to send the invitation, consent, and Delphi instrument for your responses.

What happens if I say no, I do not want to be in the study?

If you decide not to participate in the study, there will be no adverse consequences.

What happens if I say yes, but change my mind later?

You may choose to join the study and later decide that you no longer want to participate. There will be no negative consequences for leaving the study before the end.

Will it cost me anything to be in the study?

No incentives will be offered; however, there will be an investment of your time.

Will I be paid for my time?

No. There will be no gifts, payments, compensation, or reimbursement.

Is there any way being in this study could be bad for me?

There are no risks associated with this study. The nature of the Delphi technique is strict confidentiality during the study. I request that you not discuss this study with anyone during the study. When the study is complete and you choose to make your participation in this study known to colleagues, you may do so. All results will be posted and published without indicators that will identify expert. I will protect participant confidentiality.

What are the benefits of participating in this study?

The state has spent millions of dollars on educational technologies for K-12 schools and plans to continue investing in educational technologies. This study focuses on identifying strategies that will increase the potential for successfully implementing educational technologies as a tool to improve student achievement. You will receive a copy of the results of this study.

What if I have questions?

Please contact me, a doctoral student at Walden University
Jennie VanDyk Gibson: redacted or email at [redacted]

or the chairperson and adviser
Dr. Carla Lane:
or Research Participant Advocate at Walden University

Walden University's approval number for this study is 06-30-15-0059763 and it expires June 29, 2016.

Do I have to electronically sign this document?

Yes, please sign and indicate your intended participation in this study. A space is provided for your digital signature. If you decide not to participate, your name is not required, and you do not need to sign this form.

.

What should I do if I want to participate in the study?

Please use the space to initial and digitally sign this form. A copy of the consent form is attached to the email for your records.

Thanks.

Sincerely,
Jennie VanDyk Gibson
Electronic signature:

Appendix D: Consent Document for Interview

Title: A Delphi Study to Identify an Implementation Strategy for Educational technologies

I am asking you to participate in a research study because you have been identified as either an educator or an educational policymaker with experience in educational technologies implementations.

Your participation in this research study is essential to its success.
You do not have to join in this study. And if you decide to participate, you may quit the study at any time.

What is the purpose of the study? The purpose of this study is to identify strategies that will increase the potential for successful diffusion of educational technologies in K-12 public schools. A panel of educational technologies experts that includes teachers, administrators, technology directors, and policy designers will participate in a modified Delphi technique.

What are the study procedures? Your participation in this study involves reviewing a Delphi instrument. The methodology used in the study is a modified Delphi technique. It is a systematic way to obtain ideas and recommendations from experts in a given field and use their ideas to create consensus. It is committee work without outside influences or manipulation from other members because each expert participates in total anonymity. Only you may disclose that you took part when the study is completed. The Delphi technique utilizes the anonymity of experts, a group controlled feedback procedure, and statistical response as an efficient decision-making process.

Each panelist will be asked to rate statements according to importance. Space will be available for feedback that you can share with the other panelists in an anonymous manner. The ratings and feedback will be shown anonymously with the other expert for their consideration.

Your part in the research project. The statements used in the Delphi instrument are from current research studies that focus on the implementation and diffusion of education technology innovations. The items represent the 5 stages of Diffusion of Innovations theory (Rogers, 2003). Examples of the statements provided for review include:

The educational technologies innovation must be easy to use (Hazen et al., 2012; Jwaifel& Gasaymeh, 2013).

The state must develop effective policies to provide training for the use of technology in an educational setting. (Richardson, Nash, & Flora, 2014).

Online learning communities should provide ongoing support for teachers (Booth, 2012).

You are being asked to review the instrument for clarity. Following your review, you will be asked the following questions:

- Which statements lacked clarity?
- Do any statements cause concern about confidentiality?
- Do any statements cause concern about the nature of the study?
- Do you have any questions or concerns about this instrument?

How long will the review take? The review should take about 20 minutes.

Where will the study take place? Email will be used to send the invitation, consent, and Delphi instrument for your review.

What happens if I say no, I do not want to be in the study? If you decide not to participate in the study, there will be no adverse consequences.

What happens if I say yes, but change my mind later?
You may choose to join the study and later decide that you no longer want to participate. There will be no negative consequences for leaving the study before the end.

Will it cost me anything to be in the study? No incentives will be offered; however, there will be an investment of your time.

Will I be paid for my time? No. There will be no gifts, payments, compensation, or reimbursement.

Is there any way being in this study could be bad for me? There are no risks associated with this study. The nature of the Delphi technique is strict confidentiality during the study. I request that you not discuss this study with anyone during the study. If at a later date when the study is complete, and you chose to make your participation in this study known to colleagues, you may do so. All results will be posted and published without indicators that would identify expert. I will protect participant confidentiality.

What are the benefits of participating in this study? The state has spent millions of dollars on educational technologies for K-12 schools and plans to continue investing in educational technologies. This study focuses on identifying strategies that will increase the potential for successfully implementing educational technologies as a tool to improve student achievement. You will receive a copy of the results of this study.

What if I have questions? Please contact me, a doctoral student at Walden University
Jennie VanDyk Gibson: redacted or email at [redacted]
or the chairperson and advisor
Dr. Carla Lane:

or Research Participant Advocate at Walden University
[redacted]

Appendix E: Delphi Instrument Results

Q 1. Before educators are asked to adopt an educational technologies innovation, one must make them aware that it exists (Hazen, Wu, Sankar, Jones-Farmer, 2012).

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		3	5
4		19	16
Min Value		3	3
Max Value		4	4
Mean		3.86	3.76
Variance		0.12	0.19
Standard Deviation		0.35	0.44
Total Responses		22	21

Q 1a. Educators should be trained on the use of educational technologies.

Answer	RD 1	RD2	RD3
1		0	0
2		1	0
3		7	7
4		12	14
Min Value		2	3
Max Value		4	4
Mean		3.55	3.67
Variance		0.37	0.23
Standard Deviation		0.60	0.48
Total Responses		20	21

Q 1b. Educators should use educational technology if it fits their teaching style.

Answer	RD 1	RD2	RD3
1		2	2
2		3	6
3		9	10
4		6	3
Min Value		2	1
Max Value		4	4
Mean		3.55	2.67
Variance		0.37	0.73
Standard Deviation		0.60	0.86
Total Responses		20	21

Q 2. Recommend that product developers pay attention to how teachers find out about products (Bill & Melinda Gates Foundation, 2014).

Answer	RD 1	RD2	RD3
1	0	0	0
2	3	4	2
3	11	12	14
4	8	3	5
Min Value	2	2	2
Max Value	4	4	4
Mean	3.23	2.95	3.14
Variance	0.47	0.39	0.33
Standard Deviation	0.69	0.62	0.57
Total Responses	22	19	21

Q 2a. Product developers do not care about teachers, they are looking for business opportunities for financial gain.

Answer	RD1	RD2	RD3
1		2	2
2		9	11
3		4	5
4		5	3
Min Value		1	1
Max Value		4	4
Mean		2.60	2.43
Variance		0.99	0.76
Standard Deviation		0.99	0.87
Total Responses		20	21

Q2b. Teachers are not often interested in new products.

Answer	RD1	RD2	RD3
1		5	3
2		9	8
3		4	7
4		2	3
Min Value		1	1
Max Value		4	4
Mean		2.15	2.48
Variance		0.87	0.86
Standard Deviation		0.93	0.93
Total Responses		20	21

Q 3. The use of mass media is the most efficient way to make teachers aware of the existence of effective educational technologies (Rogers, 2003).

Answer	RD 1	RD2	RD3
1	3	1	3
2	5	12	9
3	8	6	7
4	5	0	2
Min Value	1	1	1
Max Value	4	3	4
Mean	2.71	2.45	2.38
Variance	1.01	0.32	0.75
Standard Deviation	1.01	0.56	0.86
Total Responses	21	20	21

Q 3a. The use of social media is the most efficient way to make teachers aware of the existence of effective educational technologies.

Answer	RD1	RD2	RD3
1		0	1
2		11	9
3		9	8
4		0	3
Min Value		2	1
Max Value		3	4
Mean		2.45	2.62
Variance		0.26	0.65
Standard Deviation		0.51	0.80
Total Responses		20	21

Q 3b. Teachers become aware of new technology and educational technology integration practices through peers in their building or district.

Answer	RD1	RD2	RD3
1		0	0
2		0	3
3		8	13
4		12	5
Min Value		3	2
Max Value		4	4
Mean		3.60	3.10
Variance		0.25	0.39
Standard Deviation		0.50	0.62
Total Responses		20	21

Q 3c. The use of workshops is an effective way to keep faculty informed.

Answer	RD1	RD2	RD3
1		0	0
2		4	3
3		9	9
4		6	9
Min Value		2	2
Max Value		4	4
Mean		3.11	3.29
Variance		0.54	0.51
Standard Deviation		0.74	0.72
Total Responses		19	21

Q 3d. If teachers are not interested, it remains only an awareness of educational technologies.

Answer	RD1	RD2	RD3
1		1	0
2		5	3
3		7	13
4		7	5
Min Value		1	2
Max Value		4	4
Mean		3.00	3.10
Variance		0.84	0.39
Standard Deviation		0.92	0.62
Total Responses		20	21

Q 3e. If teachers are not required, it remains only an awareness of the technology.

Answer	RD1	RD2	RD3
1		2	0
2		5	4
3		8	13
4		5	4
Min Value		1	2
Max Value		4	4
Mean		2.80	3.00
Variance		0.91	0.40
Standard Deviation		0.95	0.63
Total Responses		20	21

Q 3f. Too many new products make it difficult to manage.

Answer	RD 1	RD2	RD3
1			0
2			3
3			8
4			10
Min Value			2
Max Value			4
Mean			3.33
Variance			0.53
Standard Deviation			0.73
Total Responses			21

Q 4. Districts and school networks should involve teachers in any system-level procurement process (Drape et al., 2013, Elmore, 2004).

Answer	RD 1	RD2	RD3
1	2	4	1
2	1	2	9
3	7	10	6
4	12	3	5
Min Value	1	1	1
Max Value	4	4	4
Mean	3.32	2.63	2.71
Variance	0.89	1.02	0.81
Standard Deviation	0.95	1.01	0.90
Total Responses	22	19	21

Q 4a. Districts and school networks should involve teachers who have background knowledge of instructional practices with technology.

Answer	RD 1	RD2	RD3
1		0	0
2		3	2
3		8	7
4		9	12
Min Value		2	2
Max Value		4	4
Mean		3.30	3.48
Variance		0.54	0.46
Standard Deviation		0.73	0.68
Total Responses		20	21

Q 4b. Network design and infrastructure is not a role for teachers.

Answer	RD 1	RD2	RD3
1		4	1
2		7	8
3		2	5
4		7	7
Min Value		1	1
Max Value		4	4
Mean		2.60	2.86
Variance		1.41	0.93
Standard Deviation		1.19	0.96
Total Responses		20	21

Q 4c. Advisory groups that include experts from both education and technology are critical in evaluating directions for educational technologies.

Answer	RD 1	RD2	RD3
1		0	0
2		1	0
3		9	8
4		10	13
Min Value		2	3
Max Value		4	4
Mean		3.45	3.62
Variance		0.37	0.25
Standard Deviation		0.60	0.50
Total Responses		20	21

Q 4d. Teachers do not have the time to be involved in the procurement process.

Answer	RD 1	RD2	RD3
1		1	1
2		12	8
3		5	12
4		2	0
Min Value		1	1
Max Value		4	3
Mean		2.40	2.52
Variance		0.57	0.36
Standard Deviation		0.75	0.60
Total Responses		20	21

Q 4e. Some people are better informed about educational technologies than others

Answer	RD 1	RD2	RD3
1		0	0
2		1	0
3		7	6
4		12	15
Min Value		2	3
Max Value		4	4
Mean		3.55	3.71
Variance		0.37	0.21
Standard Deviation		0.60	0.46
Total Responses		20	21

Q 4f. Some people have personal benefit bias.

Answer	RD 1	RD2	RD3
1		0	2
2		2	0
3		11	12
4		7	7
Min Value		2	1
Max Value		4	4
Mean		3.25	3.14
Variance		0.41	0.73
Standard Deviation		0.64	0.85
Total Responses		20	21

Q 4g. Responsibility resides at a certain level within a system.

Answer	RD 1	RD2	RD3
1		1	0
2		3	3
3		10	13
4		6	5
Min Value		1	2
Max Value		4	4
Mean		3.05	3.10
Variance		0.68	0.39
Standard Deviation		0.83	0.62
Total Responses		20	21

Q 5. Educators should be included in every stage of development from idea formation to final refinement (Stevens, 2014).

Answer	RD 1	RD2	RD3
1	2	0	1
2	0	4	4
3	8	8	8
4	12	7	8
Min Value	1	2	1
Max Value	4	4	4
Mean	3.36	3.16	3.10
Variance	0.81	0.58	0.79
Standard Deviation	0.90	0.76	0.89
Total Responses	22	19	21

Q 5a. It is important for educators to commit to follow through as part of the final refinement.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		10	10
4		10	11
Min Value		3	3
Max Value		4	4
Mean		3.50	3.52
Variance		0.26	0.26
Standard Deviation		0.51	0.51
Total Responses		20	21

Q 5b. It is important to recognize system efficiency when defining levels of involvement.

Answer	RD 1	RD2	RD3
1		0	0
2		2	0
3		11	12
4		7	9
Min Value		2	3
Max Value		4	4
Mean		3.25	3.43
Variance		0.41	0.26
Standard Deviation		0.64	0.51
Total Responses		20	21

Q 5c. Teachers need to be involved in implementation guidelines only.

Answer	RD 1	RD2	RD3
1		1	3
2		10	11
3		6	6
4		3	1
Min Value		1	1
Max Value		4	4
Mean		2.55	2.24
Variance		0.68	0.59
Standard Deviation		0.83	0.77
Total Responses		20	21

Q 6. Teachers need to be able to see the results of the innovation (Jwaifell & Gasaymeh, 2013).

Answer	RD 1	RD2	RD3	Response Percent
1	0	0	0	
2	0	0	0	
3	3	4	6	
4	19	14	15	
Min Value	3	3	3	
Max Value	4	4	4	
Mean	3.86	3.78	3.71	
Variance	0.12	0.18	0.21	
Standard Deviation	0.35	0.43	0.46	
Total Responses	22	18	21	

Q 6a. Teachers need to be able to see numerous examples of success with the innovation.

Answer	RD 1	RD2	RD3
1		0	0
2		1	0
3		6	5
4		12	16
Min Value		2	3
Max Value		4	4
Mean		3.58	3.76
Variance		0.37	0.19
Standard Deviation		0.61	0.44
Total Responses		19	21

Q 6b. Teachers will not use something that is not beneficial.

Answer	RD 1	RD2	RD3
1		1	0
2		4	2
3		5	7
4		9	12
Min Value		1	2
Max Value		4	4
Mean		3.16	3.48
Variance		0.92	0.46
Standard Deviation		0.96	0.68
Total Responses		19	21

Q 7. Educators need to know that an educational technologies innovation can help them meet their goals (Drape et al., 2013, Means, 2010).

Answer	RD 1	RD2	RD3
1	0	0	0
2	0	0	0
3	2	4	2
4	20	14	19
Min Value	3	3	3
Max Value	4	4	4
Mean	3.91	3.78	3.90
Variance	0.09	0.18	0.09
Standard Deviation	0.29	0.43	0.30
Total Responses	22	18	21

Q 7a. Educators need to know the ‘why’ behind the educational technologies innovation.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		8	6
4		11	15
Min Value		3	3
Max Value		4	4
Mean		3.58	3.71
Variance		0.26	0.21
Standard Deviation		0.51	0.46
Total Responses		19	21

Q 7b. Seeing/showing how technology can help a teacher meet their goals is more useful than telling them that technology can help them reach their goals.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		1	1
4		18	20
Min Value		3	3
Max Value		4	4
Mean		3.95	3.95
Variance		0.05	0.05
Standard Deviation		0.23	0.22
Total Responses		19	21

Q 8. Educators want to see that ideas for educational technologies are deeply rooted in research (Stevens, 2014).

Answer	RD 1	RD2	RD3
1	2	0	2
2	6	4	6
3	6	9	10
4	8	5	3
Min Value	1	2	1
Max Value	4	4	4
Mean	2.91	3.06	2.67
Variance	1.04	0.53	0.73
Standard Deviation	1.02	0.73	0.86
Total Responses	22	18	21

Q 8a. Application and success rates are just as important.

Answer	RD 1	RD2	RD3
1		0	0
2		2	1
3		9	13
4		8	7
Min Value		2	2
Max Value		4	4
Mean		3.32	3.29
Variance		0.45	0.31
Standard Deviation		0.67	0.56
Response Rates		19	21

Q 8b. Educators do not often use the educational technologies as designed and research does not apply.

Answer	RD 1	RD2	RD3
1		2	0
2		7	13
3		9	7
4		1	1
Min Value		1	2
Max Value		4	4
Mean		2.47	2.43
Variance		0.60	0.36
Standard Deviation		0.77	0.60
Total Responses		19	21

Q 8c. Each classroom is unique and research may not apply.

Answer	RD 1	RD2	RD3
1		1	0
2		6	9
3		8	9
4		4	3
Min Value		1	2
Max Value		4	4
Mean		2.79	2.71
Variance		0.73	0.51
Standard Deviation		0.85	0.72
Total Responses		19	21

Q 9. Educators want to see that ideas for educational technologies are deeply rooted in classroom realities (Stevens, 2014).

Answer	RD 1	RD2	RD3
1	0	0	0
2	0	0	0
3	3	3	7
4	19	15	14
Min Value	3	3	3
Max Value	4	4	4
Mean	3.86	3.83	3.67
Variance	0.12	0.15	0.23
Standard Deviation	0.35	3.38	0.48
Total Responses	22	18	21

Q 9a. Classroom realities are too often based on tradition and not innovative models.

Answer	RD 1	RD2	RD3
1		1	0
2		3	3
3		6	12
4		9	6
Min Value		1	2
Max Value		4	4
Mean		3.21	3.14
Variance		0.84	0.43
Standard Deviation		0.92	0.65
Total Responses		19	21

Q 10. The educational technologies innovation must be easy to use (Hazen et al., 2012; Jwaifel & Gasaymeh, 2013).

Answer	RD 1	RD2	RD3
1	0	0	0
2	0	1	0
3	5	5	7
4	16	12	14
Min Value	3	2	3
Max Value	4	4	4
Mean	3.76	3.61	3.67
Variance	0.19	0.37	0.23
Standard Deviation	0.44	0.61	0.48
Total Responses	21	18	21

Q 10a. The educational technologies innovation must be reliable.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		3	4
4		16	17
Min Value		3	3
Max Value		4	4
Mean		3.84	3.81
Variance		0.14	0.16
Standard Deviation		0.37	0.40
Total Responses		19	21

Q 10b. The educational technologies must not interfere with the original goal of why it is being implemented.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		3	3
4		16	18
Min Value		3	3
Max Value		4	4
Mean		3.84	3.86
Variance		0.14	0.13
Standard Deviation		0.37	0.36
Total Responses		19	21

Q 10c. Most educators do not have the technical skills to teach themselves how to use the technology,

Answer	RD 1	RD2	RD3
1		2	0
2		5	9
3		7	8
4		5	4
Min Value		1	2
Max Value		4	4
Mean		2.79	2.76
Variance		0.95	0.59
Standard Deviation		0.98	0.77
Total Responses		19	21

Q 10d. Educators struggle with educational technologies.

Answer	RD 1	RD2	RD3
1		0	0
2		7	10
3		7	6
4		5	5
Min Value		2	2
Max Value		4	4
Mean		2.89	2.76
Variance		0.65	0.69
Standard Deviation		0.81	0.83
Total Responses		19	21

Q 11. The educational technologies innovation must be easy to understand (Hazen et al., 2012).

Answer	RD 1	RD2	RD3
1	0	0	0
2	0	0	0
3	7	6	6
4	15	13	15
Min Value	3	3	3
Max Value	4	4	4
Mean	3.68	3.68	3.71
Variance	0.23	0.23	0.21
Standard Deviation	0.48	0.48	0.46
Total Responses	22	19	21

Q 12. Educational technologies should be evaluated as a teaching tool (Drape et al., 2013, Bill & Melinda Gates Foundation, 2014).

Answer	RD 1	RD2	RD3
1	1	0	0
2	1	0	0
3	5	8	6
4	15	10	15
Min Value	1	3	3
Max Value	4	4	4
Mean	3.55	3.56	3.71
Variance	0.64	0.26	0.21
Standard Deviation	0.80	0.51	0.46
Total Responses	22	18	21

Q 12a. The method of evaluation should be defined before implementations.

Answer	RD 1	RD2	RD3
1		0	0
2		1	2
3		7	5
4		11	14
Min Value		2	2
Max Value		4	4
Mean		3.53	3.57
Variance		0.37	0.46
Standard Deviation		0.61	0.68
Total Responses		19	21

Q 12b. Educational technologies should be considered one tool in an array of tools.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		7	2
4		12	19
Min Value		3	3
Max Value		4	4
Mean		3.63	3.90
Variance		0.25	0.09
Standard Deviation		0.50	0.30
Total Responses		19	21

Q12c. Educational technologies should be considered as a way that students can demonstrate student mastery.

Answer	RD 1	RD2	RD3
1		0	0
2		2	1
3		9	6
4		8	14
Min Value		2	2
Max Value		4	4
Mean		3.32	3.62
Variance		0.45	0.35
Standard Deviation		0.67	0.59
Total Responses		19	21

Q 13. Teachers should be able to experiment with the innovation before deciding to adopt (Jwaifell & Gasaymeh, 2013).

Answer	RD 1	RD2	RD3
1	0	0	0
2	1	3	2
3	8	8	11
4	13	7	8
Min Value	2	2	2
Max Value	4	4	4
Mean	3.55	3.22	3.29
Variance	0.35	0.54	0.41
Standard Deviation	0.60	0.73	0.64
Total Responses	22	18	21

Q 13a. Educational technologies changes so quickly that it is difficult to spend much time experimenting.

Answer	RD 1	RD2	RD3
1		2	1
2		4	8
3		10	10
4		2	2
Min Value		1	1
Max Value		4	4
Mean		2.67	2.62
Variance		0.71	0.55
Standard Deviation		0.84	0.74
Total Responses		18	21

Q 13b. The innovation should be free of cost to the teacher.

Answer	RD1	RD2	RD3
1		0	0
2		2	1
3		5	5
4		12	15
Min Value		2	2
Max Value		4	4
Mean		3.53	3.67
Variance		0.49	0.33
Standard Deviation		0.70	0.58
Total Responses		19	21

Q 14. Teachers follow leadership who understand the educational technologies innovation (Drape et al., 2013).

Answer	RD 1	RD2	RD3
1	0	0	0
2	5	1	2
3	9	9	10
4	7	8	9
Min Value	2	2	2
Max Value	4	4	4
Mean	3.10	3.39	3.33
Variance	0.59	0.37	0.43
Standard Deviation	0.77	0.61	0.66
Total Responses	21	18	21

Q 14a. Teachers follow leadership who model the educational technologies.

Answer	RD 1	RD2	RD3
1		0	0
2		2	2
3		9	12
4		8	7
Min Value		2	2
Max Value		4	4
Mean		3.32	3.24
Variance		0.45	0.39
Standard Deviation		0.67	0.62
Total Responses		19	21

Q 14b. Teachers follow teachers who model the educational technologies innovation.

Answer	RD 1	RD2	RD3
1		0	0
2		2	0
3		7	10
4		10	11
Min Value		2	3
Max Value		4	4
Mean		3.42	3.52
Variance		0.48	0.26
Standard Deviation		0.69	0.51
Total Responses		19	21

Q 14c. Teachers follow leadership who communicate why the educational technologies innovation is important.

Answer	RD 1	RD2	RD3
1		0	0
2		1	0
3		7	10
4		11	11
Min Value		2	2
Max Value		4	4
Mean		3.53	3.38
Variance		0.37	0.45
Standard Deviation		0.61	0.67
Total Responses		19	21

Q 15. Teachers follow leadership who know the educational technologies innovation (Drape et al., 2013).

Answer	RD 1	RD2	RD3
1	0	0	0
2	5	1	2
3	8	9	12
4	9	8	7
Min Value	2	2	2
Max Value	4	4	4
Mean	3.18	3.39	3.24
Variance	0.63	0.37	0.39
Standard Deviation	0.80	0.61	0.62
Total Responses	22	18	21

Q 15a. Leadership should be required to learn the innovation being used by teachers.

Answer	RD 1	RD2	RD3
1	0	0	0
2	0	0	0
3	10	7	12
4	12	12	9
Min Value	3	3	3
Max Value	4	4	4
Mean	3.55	3.63	3.43
Variance	0.26	0.25	0.26
Standard Deviation	0.51	0.50	0.51
Total Responses	22	19	21

Q 15b. Teachers follow leadership who truly know how the educational technologies will work.

Answer	RD 1	RD2	RD3
1		0	0
2		1	0
3		10	12
4		8	9
Min Value		2	3
Max Value		4	4
Mean		3.37	3.43
Variance		0.36	0.26
Standard Deviation		0.60	0.51
Total Responses		19	21

Q 15c. Teachers follow leadership who have a clear picture of how the educational technologies can be implemented.

Answer	RD 1	RD2	RD3
1		0	0
2		2	0
3		8	9
4		9	12
Min Value		2	3
Max Value		4	4
Mean		3.37	3.57
Variance		0.47	0.26
Standard Deviation		0.68	0.51
Total Responses		19	21

Q 16. Leadership should concentrate on increasing the how-to knowledge of an innovation (Drape, Westfall, Doak, Guthrie, & Mykerezi, 2013).

Answer	RD 1	RD2	RD3
1	0	0	0
2	0	1	0
3	10	8	12
4	12	9	9
Min Value	3	2	3
Max Value	4	4	4
Mean	3.55	3.44	3.43
Variance	0.26	0.38	0.26
Standard Deviation	0.51	0.62	0.51
Total Responses	22	18	21

Q 16a. The ‘how-to’ knowledge of an innovation benefits the entire organization.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		8	8
4		11	13
Min Value		3	3
Max Value		4	4
Mean		3.58	3.62
Variance		0.26	0.25
Standard Deviation		0.51	0.50
Total Responses		19	21

Q 17. Educators want to see that educational technologies solutions identify a real need (Jwaifell & Gasaymeh, 2013; Stevens, 2014).

Answer	RD 1	RD2	RD3
1	0	0	0
2	2	0	1
3	6	9	10
4	14	9	10
Min Value	2	3	2
Max Value	4	4	4
Mean	3.55	3.50	3.43
Variance	0.45	0.26	0.36
Standard Deviation	0.67	0.51	0.60
Total Responses	22	18	21

Q 17a. Educators want to see that leadership identify educational technologies solutions that meet a real need.

Answer	RD 1	RD2	RD3
1		0	0
2		0	1
3		11	10
4		8	10
Min Value		3	2
Max Value		4	4
Mean		3.42	3.43
Variance		0.26	0.36
Standard Deviation		0.51	0.60
Total Responses		19	21

Q 17b. Identification of the need is an important first step in the process.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		7	8
4		11	13
Min Value		3	3
Max Value		4	4
Mean		3.61	3.62
Variance		0.25	0.25
Standard Deviation		0.50	0.50
Total Responses		18	21

Q18. The state should make recommendations for educator use of educational technologies rather than mandate use

Answer	RD 1	RD2	RD3
1	0	0	0
2	3	2	1
3	3	4	10
4	16	12	10
Min Value	2	2	2
Max Value	4	4	4
Mean	3.59	3.56	3.43
Variance	0.54	0.50	0.36
Standard Deviation	0.73	0.70	0.60
Total Responses	22	18	21

Q 18a. The state should provide guidance as districts identify need.

Answer	RD 1	RD2	RD3
1		1	0
2		1	1
3		10	14
4		7	6
Min Value		1	2
Max Value		4	4
Mean		3.21	3.24
Variance		0.62	0.29
Standard Deviation		0.79	0.54
Total Responses		19	21

Q 18b. The unique nature of each district requires unique support from the state.

Answer	RD 1	RD2	RD3
1		1	0
2		1	3
3		9	11
4		8	7
Min Value		1	2
Max Value		4	4
Mean		3.26	3.19
Variance		0.65	0.46
Standard Deviation		0.81	0.68
Total Responses		19	21

Q 18c. Competitive-type grants create a system of winners and losers, not a system for student achievement.

Answer	RD 1	RD2	RD3
1		1	0
2		2	3
3		7	10
4		9	8
Min Value		1	2
Max Value		4	4
Mean		3.26	3.24
Variance		0.76	0.49
Standard Deviation		0.87	0.70
Total Responses		19	21

Q 18d. Some districts will not use it unless it is mandated.

Answer	RD 1	RD2	RD3
1		2	1
2		4	4
3		3	10
4		10	6
Min Value		1	1
Max Value		4	4
Mean		3.11	3.00
Variance		1.21	0.70
Standard Deviation		1.10	0.84
Total Responses		19	21

Q 19. Teachers should have access to the digital instructional tools that they need (Bill & Melinda Gates Foundation, 2014; Borrego, Froyd, & Hall, 2010; Drape et al., 2013).

Answer	RD 1	RD2	RD3
1	0	0	0
2	1	0	1
3	3	2	4
4	18	15	16
Min Value	2	3	2
Max Value	4	4	4
Mean	3.77	3.88	3.71
Variance	0.28	0.11	0.31
Standard Deviation	0.53	0.33	0.56
Total Responses	22	17	21

Q 20. The state should conduct trials to evaluate effects of an innovation under real-life classroom conditions.

Answer	RD 1	RD2	RD3
1	0	0	1
2	6	3	1
3	6	8	15
4	10	7	4
Min Value	2	2	1
Max Value	4	4	4
Mean	3.18	3.22	3.05
Variance	0.73	0.54	0.45
Standard Deviation	0.85	0.73	0.67
Total Responses	22	18	21

Q 20a. Districts should conduct trials to evaluate effects of an innovation under real-life classroom conditions.

Answer	RD 1	RD2	RD3
1		0	0
2		0	1
3		12	13
4		7	7
Min Value		3	2
Max Value		4	4
Mean		3.37	3.29
Variance		0.25	0.31
Standard Deviation		0.50	0.56
Total Responses		19	21

Q 20b. The state should develop a sense of best practices and communicate those results.

Answer	RD 1	RD2	RD3
1		0	1
2		3	1
3		12	15
4		4	4
Min Value		2	1
Max Value		4	4
Mean		3.05	3.05
Variance		0.39	0.45
Standard Deviation		0.62	0.67
Total Responses		19	21

Q 20c. The state lacks credibility in this area.

Answer	RD 1	RD2	RD3
1		0	1
2		5	4
3		5	11
4		9	5
Min Value		2	1
Max Value		4	4
Mean		3.21	2.95
Variance		0.73	0.65
Standard Deviation		0.85	0.80
Total Responses		19	21

Q 21. The state should recommend educational technologies innovations for use by educators (Hazen et al., 2012).

Answer	RD 1	RD2	RD3
1	1	1	0
2	3	3	4
3	11	11	15
4	7	3	2
Min Value	1	1	2
Max Value	4	4	4
Mean	3.09	2.89	2.90
Variance	0.66	0.58	0.29
Standard Deviation	0.81	0.76	0.54
Total Responses	22	18	21

Q 21a. Districts should recommend educational technologies innovations for use by educators.

Answer	RD 1	RD2	RD3
1		0	0
2		1	1
3		8	8
4		10	12
Min Value		2	2
Max Value		4	4
Mean		3.47	3.52
Variance		0.37	0.36
Standard Deviation		0.61	0.60
Total Responses		19	21

Q 22. The state must develop effective policies to provide time for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014).

Answer	RD 1	RD2	RD3
1	1	0	0
2	2	1	3
3	8	12	13
4	11	5	5
Min Value	1	2	2
Max Value	4	4	4
Mean	3.32	3.22	3.10
Variance	0.70	0.30	0.39
Standard Deviation	0.84	0.55	0.62
Total Responses	22	18	21

Q 22a. The community should be involved in developing effective policies to provide time for the use of technology in an educational setting.

Answer	RD 1	RD2	RD3
1		1	0
2		7	12
3		6	5
4		5	4
Min Value		1	2
Max Value		4	4
Mean		2.79	2.62
Variance		0.84	0.65
Standard Deviation		0.92	0.80
Total responses		19	21

Q 23. The state must develop effective policies to provide training for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014).

Answer	RD 1	RD2	RD3
1	1	1	0
2	1	1	1
3	8	10	15
4	12	6	5
Min Value	1	1	2
Max Value	4	4	4
Mean	3.41	3.17	3.19
Variance	0.63	0.62	0.26
Standard Deviation	0.80	0.79	0.51
Total Responses	22	18	21

Q 23a. The state must provide districts the professional development resources needed in order for them to provide the needed time for professional development.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		4	9
4		15	12
Min Value		3	3
Max Value		4	4
Mean		3.79	3.57
Variance		0.18	0.26
Standard Deviation		0.42	0.51
Total Responses		19	21

Q 23b. Unless the technology is easy to use, do not bother with time for professional development.

Answer	RD 1	RD2	RD3
1		2	2
2		4	3
3		5	10
4		8	6
Min Value		1	1
Max Value		4	4
Mean		3.00	2.95
Variance		1.11	0.85
Standard Deviation		1.05	0.92
Total Responses		19	21

Q 24. The state must develop effective policies to provide support for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014).

Answer	RD 1	RD2	RD3
1	0	0	0
2	2	1	1
3	8	9	16
4	12	8	4
Min Value	3	3	3
Max Value	5	4	5
Mean	3.45	3.39	3.14
Variance	0.45	0.37	0.23
Standard Deviation	0.67	0.61	0.48
Total Responses	22	18	21

Q 24a. Effective policies to provide support for the use of technology in an educational setting is best done at the district level.

Answer	RD 1	RD2	RD3
1		1	0
2		1	2
3		6	11
4		11	8
Min Value		1	2
Max Value		4	4
Mean		3.42	3.29
Variance		0.70	0.41
Standard Deviation		0.84	0.64
Total Responses		18	21

Q 25. The state must develop effective funding mechanisms to provide access for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014).

Answer	RD 1	RD2	RD3
1	0	0	0
2	0	0	0
3	2	3	5
4	20	15	16
Min Value	3	3	3
Max Value	4	4	4
Mean	3.91	3.83	3.76
Variance	0.09	0.15	0.19
Standard Deviation	0.29	0.38	0.44
Total Responses	22	18	21

Q 26. The state must develop effective funding mechanisms to provide support for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014).

Answer	RD 1	RD2	RD3
1	0	0	0
2	0	0	0
3	2	5	6
4	20	13	15
Min Value	3	3	3
Max Value	4	4	4
Mean	3.91	3.72	3.71
Variance	0.09	0.21	0.21
Standard Deviation	0.29	0.46	0.46
Total Responses	22	18	21

Q 26a. The state must work with districts to develop effective funding mechanisms.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		4	8
4		15	13
Min Value		3	3
Max Value		4	4
Mean		3.79	3.62
Variance		0.18	0.25
Standard Deviation		0.2	0.50
Total Responses		19	21

Q 27. The state must develop effective funding mechanisms to provide training for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014).

Answer	RD 1	RD2	RD3
1	0	0	0
2	0	1	0
3	5	3	8
4	17	14	13
Min Value	3	2	3
Max Value	4	4	4
Mean	3.77	3.72	3.62
Variance	0.18	0.33	0.25
Standard Deviation	0.43	0.57	0.50
Total Responses	22	18	21

Q 27a. To maintain equity, the state must work with districts to develop effective funding mechanisms to provide training.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		4	4
4		15	17
Min Value		3	3
Max Value		4	4
Mean		3.79	3.81
Variance		0.18	0.16
Standard Deviation		0.42	0.40
Total Responses		19	21

Q 28. The state must develop effective funding mechanisms to provide time for the use of technology in an educational setting (Richardson, Nash, & Flora, 2014).

Answer	RD 1	RD2	RD3
1	0	0	1
2	0	1	0
3	7	5	6
4	15	12	14
Min Value	3	2	1
Max Value	4	4	4
Mean	3.68	3.61	3.57
Variance	0.23	0.37	0.56
Standard Deviation	0.48	0.61	0.75
Total Responses	22	18	21

Q 28a. To maintain equity, the state must work with districts to develop an effective funding mechanism to provide time for the use of technology in an educational setting.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		4	6
4		15	15
Min Value		3	3
Max Value		4	4
Mean		3.61	3.71
Variance		0.37	0.21
Standard Deviation		0.61	0.46
Total Responses		18	21

Q 29. Change agents need to focus on teachers' needs over promotion of a specific innovation (Stevens, 2014).

Answer	RD 1	RD2	RD3
1	0	0	0
2	2	1	0
3	6	6	13
4	14	11	8
Min Value	2	2	3
Max Value	4	4	4
Mean	3.55	3.56	3.38
Variance	0.45	0.38	0.25
Standard Deviation	0.67	0.62	0.50
Total Responses	22	18	21

Q 29a. Change agents (official and unofficial leaders in education) need to focus on student achievement over promotion of a specific innovation.

Answer	RD 1	RD2	RD3
1		0	0
2		1	0
3		7	9
4		11	12
Min Value		2	3
Max Value		4	4
Mean		3.53	3.57
Variance		0.37	0.26
Standard Deviation		0.61	0.51
Total Responses		19	21

Q 29b. The needs of the teacher should be part of the criteria in making a decision about an innovation.

Answer	RD 1	RD2	RD3
1		0	0
2		2	0
3		10	13
4		7	8
Min Value		2	3
Max Value		4	4
Mean		3.26	3.38
Variance		0.43	0.25
Standard Deviation		0.65	0.50
Total Responses		19	21

Q 30. Districts and school networks should give teachers the flexibility to select resources for their classrooms (Bill & Melinda Gates Foundation, 2014).

Answer	RD 1	RD2	RD3
1	1	0	0
2	4	2	2
3	8	8	10
4	9	8	9
Min Value	1	2	2
Max Value	4	4	4
Mean	3.14	3.33	3.33
Variance	0.79	0.47	0.43
Standard Deviation	0.89	0.69	0.66
Total Responses	22	18	21

Q 30a. District and school networks should work with teachers in identifying resources for their classrooms.

Answer	RD 1	RD2	RD3
1		0	0
2		0	1
3		7	9
4		12	11
Min Value		3	2
Max Value		4	4
Mean		3.63	3.48
Variance		0.25	0.36
Standard Deviation		0.50	0.60
Total Responses		19	21

Q 30b. Teachers should work with technology experts when identifying resources for their classrooms.

Answer	RD 1	RD2	RD3
1		0	0
2		4	1
3		8	12
4		7	8
Min Value		2	2
Max Value		4	4
Mean		3.16	3.33
Variance		0.58	0.30
Standard Deviation		0.76	0.58
Total Responses		19	21

Q 30c. Many teachers are too fearful of technology to make that decision.

Answer	RD 1	RD2	RD3
1		1	0
2		3	2
3		6	12
4		9	7
Min Value		1	2
Max Value		4	4
Mean		3.21	3.24
Variance		0.84	0.39
Standard Deviation		0.92	0.62
Total responses		19	21

Q 30d. If teachers have the ability, they should have the flexibility to select resources.

Answer	RD 1	RD2	RD3
1		0	0
2		1	0
3		9	10
4		9	11
Min Value		2	3
Max Value		4	4
Mean		3.42	3.52
Variance		0.37	0.26
Standard Deviation		0.61	0.51
Total Responses		19	21

Q 31. Teachers should direct their students to use the available digital products (Bill & Melinda Gates Foundation, 2014).

Answer	RD 1	RD2	RD3
1	0	0	0
2	0	0	0
3	5	11	11
4	17	7	10
Min Value	3	3	3
Max Value	4	4	4
Mean	3.77	3.39	3.48
Variance	0.18	0.25	0.26
Standard Deviation	0.43	0.50	0.51
Total Responses	22	18	21

Q 31a. Educators have a responsibility to show today's students how to use available technology.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		3	6
4		16	15
Min Value		3	3
Max Value		4	4
Mean		3.84	3.71
Variance		0.14	0.21
Standard Deviation		0.37	0.46
Total Responses		19	21

Q 32. Online learning communities should provide ongoing support for teachers (Booth, 2012).

Answer	RD 1	RD2	RD3
1	0	0	0
2	2	1	1
3	6	11	8
4	14	6	12
Min Value	2	2	2
Max Value	4	4	4
Mean	3.55	3.28	3.52
Variance	0.45	0.33	0.36
Standard Deviation	0.67	0.57	0.60
Total Responses	22	18	21

Q 32a. Teachers should decide if an online learning community meets their needs.

Answer	RD 1	RD2	RD3
1		0	0
2		2	1
3		9	10
4		8	10
Min Value		2	2
Max Value		4	4
Mean		3.32	3.43
Variance		0.45	0.36
Standard Deviation		0.67	0.60
Total Responses		19	21

Q 33. Online learning communities should provide a form of ongoing professional development for teachers (Booth, 2012).

Answer	RD 1	RD2	RD3
1	0	0	0
2	2	2	1
3	8	5	11
4	12	10	9
Min Value	2	2	2
Max Value	4	4	4
Mean	3.45	3.47	3.38
Variance	0.45	0.51	0.35
Standard Deviation	0.67	0.72	0.59
Total Responses	22	17	21

Q 33a. There should be a nation educational help desk for educators.

Answer	RD 1	RD2	RD3
1		3	2
2		3	8
3		7	7
4		6	4
Min Value		1	1
Max Value		4	4
Mean		2.84	2.62
Variance		1.14	0.85
Standard Deviation		1.07	0.92
Total Responses		19	21

Q 33b. There should be a state educational help desk for educators.

Answer	RD 1	RD2	RD3
1		1	1
2		5	7
3		6	9
4		7	4
Min Value		1	1
Max Value		4	4
Mean		3.00	2.76
Variance		0.89	0.69
Standard Deviation		0.94	0.83
Total Responses		19	21

Q 34. Teachers need coordinated training time so they can share with other teachers (Bill & Melinda Gates Foundation, 2014).

Answer	RD 1	RD2	RD3
1	0	0	0
2	0	1	1
3	8	7	10
4	14	10	10
Min Value	3	2	2
Max Value	4	4	4
Mean	3.64	3.50	3.43
Variance	0.24	0.38	0.36
Standard Deviation	0.49	0.62	0.60
Total Responses	22	18	21

Q 34a. This type of professional development should occur during regular working hours.

Answer	RD 1	RD2	RD3
1		1	0
2		4	4
3		5	8
4		9	9
Min Value		1	2
Max Value		4	4
Mean		3.16	3.24
Variance		0.92	0.59
Standard Deviation		0.96	0.77
Total Responses		19	21

Q 35. Districts need to identify the true experts and enable them to help others (Penuel & Riel, 2007).

Answer	RD 1	RD2	RD3
1	1	0	0
2	1	0	0
3	4	7	10
4	16	11	11
Min Value	1	3	3
Max Value	4	4	4
Mean	3.59	3.61	3.52
Variance	0.63	0.25	0.26
Standard Deviation	0.80	0.50	0.51
Total Responses	22	18	21

Q 35a. Experts from within a district need guidance from leaders.

Answer	RD 1	RD2	RD3
1		0	0
2		2	0
3		5	11
4		12	10
Min Value		2	3
Max Value		4	4
Mean		3.53	3.48
Variance		0.49	0.26
Standard Deviation		0.70	0.51
Total Responses		19	21

Q 35b. Experts from within a district need time to help others.

Answer	RD 1	RD2	RD3
1		0	0
2		1	0
3		1	7
4		17	14
Min Value		2	3
Max Value		4	4
Mean		3.84	3.67
Variance		0.25	0.23
Standard Deviation		0.50	0.48
Total Responses		19	21

Q 36. Identifying a few teachers who can use innovation creates an isolated group of teachers rather than innovation leaders (Elmore, 2004).

Answer	RD 1	RD2	RD3
1	2	3	5
2	6	4	8
3	7	6	6
4	7	5	2
Min Value	1	1	1
Max Value	4	4	4
Mean	2.86	2.72	2.24
Variance	0.98	1.15	0.89
Standard Deviation	0.99	1.07	0.94
Total Responses	22	18	21

Q 36a. Identifying teacher leaders within a district works if leadership provides time for teacher collaboration.

Answer	RD 1	RD2	RD3
1		0	0
2		1	2
3		6	5
4		12	14
Min Value		2	2
Max Value		4	4
Mean		3.58	3.57
Variance		0.37	0.46
Standard Deviation		0.61	0.68
Total Responses		19	21

Q 36b. Teachers need to lead by example.

Answer	RD 1	RD2	RD3
1		0	0
2		1	0
3		5	7
4		13	14
Min Value		2	3
Max Value		4	4
Mean		3.63	3.67
Variance		0.36	0.23
Standard Deviation		0.60	0.48
Total Responses		19	21

36c. Leaders should be selected anonymously by stakeholders, not principals.

Answer	RD 1	RD2	RD3
1		2	2
2		7	12
3		5	0
4		5	6
Min Value		1	1
Max Value		4	4
Mean		2.68	2.50
Variance		1.01	1.11
Standard Deviation		1.00	1.05
Total Responses		19	20

Q 37. Professional development programs aimed at integrating technology in the classroom should be based on each teacher's needs (Uslu & Bumen, 2012).

Answer	RD 1	RD2	RD3
1	1	0	0
2	3	2	2
3	10	11	13
4	8	5	6
Min Value	1	2	2
Max Value	4	4	4
Mean	3.14	3.17	3.19
Variance	0.69	0.38	0.36
Standard Deviation	0.83	0.62	0.60
Total Responses	22	18	21

Q 37a. Professional development programs aimed at integrating technology in the classroom should be based on district needs.

Answer	RD 1	RD2	RD3
1		1	1
2		5	6
3		9	11
4		4	3
Min Value		1	1
Max Value		4	4
Mean		2.84	2.76
Variance		0.70	0.59
Standard Deviation		0.83	0.77
Total Responses		19	

Q 38. Professional development aimed at integrating technology in the classroom should be based on each teacher's abilities (Uslu & Bumen, 2012).

Answer	RD 1	RD2	RD3
1	1	2	0
2	8	5	6
3	7	7	11
4	6	4	3
Min Value	1	1	2
Max Value	4	4	4
Mean	2.82	2.72	2.85
Variance	0.82	0.92	0.45
Standard Deviation	0.91	0.96	0.67
Total Responses	22	18	20

38a. Teacher's needs are more important than teacher's abilities when providing professional development. Abilities are enhanced during process.

Answer	RD 1	RD2	RD3
1		2	0
2		3	3
3		6	14
4		8	4
Min Value		1	2
Max Value		4	4
Mean		3.05	3.05
Variance		1.05	0.35
Standard Deviation		1.03	0.59
Total Responses		19	21

38b. All teachers should be expected to have a certain level of technology skills.

Answer	RD 1	RD2	RD3
1		0	0
2		2	1
3		7	12
4		10	8
Min Value		2	2
Max Value		4	4
Mean		3.42	3.33
Variance		0.48	0.33
Standard Deviation		0.69	0.58
Total responses		19	21

38c. Abilities are enhanced through professional development.

Answer	RD 1	RD2	RD3
1		0	0
2		0	1
3		9	9
4		10	11
Min Value		3	2
Max Value		4	4
Mean		3.53	3.48
Variance		0.26	0.36
Standard Deviation		0.51	0.60
Total Responses		19	21

Q 39. Professional development needs to be anchored in teacher participation (Gu Xiaodong, Wang, Qin, & Lindberg, 2012).

Answer	RD 1	RD2	RD3
1	1	0	0
2	1	2	0
3	7	5	10
4	12	11	11
Min Value	1	2	3
Max Value	4	4	4
Mean	3.43	3.50	3.52
Variance	0.66	0.50	0.26
Standard Deviation	0.81	0.71	0.51
Total Responses	21	18	21

Q 40. Professional development needs to be anchored in collaborative activities (Gu et al., 2012).

Answer	RD 1	RD2	RD3
1	0	0	1
2	1	1	1
3	13	10	15
4	8	7	4
Min Value	2	2	3
Max Value	4	4	4
Mean	3.32	3.33	3.05
Variance	0.32	0.35	0.45
Standard Deviation	0.57	0.59	0.67
Total Responses	22	18	21

Q 40a. Professional development needs to be anchored in both individual and collaborative activities.

Answer	RD 1	RD2	RD3
1		0	0
2		1	0
3		5	9
4		13	12
Min Value		2	3
Max Value		4	4
Mean		3.63	3.57
Variance		0.36	0.26
Standard Deviation		0.60	0.51
Total Responses		19	21

Q 41. Professional development needs to be anchored in dialogue (Gu et al., 2012).

Answer	RD 1	RD2	RD3
1	0	1	
2	5	3	
3	7	7	
4	9	7	
Min Value	2	1	
Max Value	4	4	
Mean	3.19	3.11	
Variance	0.66	0.81	
Standard Deviation	0.81	0.90	
Total Responses	21	18	

Q 42. Train teachers to gain instructional design skills (Mkhize & Huiseman, 2013).

Answer	RD 1	RD2	RD3
1	2	0	0
2	5	4	2
3	6	6	12
4	9	8	7
Min Value	1	2	2
Max Value	4	4	4
Mean	3.00	3.22	3.24
Variance	1.05	0.65	0.39
Standard Deviation	1.02	0.81	0.62
Total Responses	22	18	21

Q 42a. Teachers gain instructional design skills through collaborative work.

Answer	RD 1	RD2	RD3
1		0	0
2		3	1
3		7	11
4		9	9
Min Value		2	2
Max Value		4	4
Mean		3.32	3.38
Variance		0.56	0.35
Standard Deviation		0.75	0.59
Total Responses		19	21

Q 42b. When teachers know how to use the educational technologies they can work collaboratively.

Answer	RD 1	RD2	RD3
1		0	1
2		1	0
3		9	12
4		9	8
Min Value		2	1
Max Value		4	4
Mean		3.42	3.29
Variance		0.37	0.51
Standard Deviation		0.61	0.72
Total Responses		19	21

Q 43. When teachers are able to experience a more personalized approach to learning that incorporates technologies, they are more likely to take a similar approach with their students (Brooks & Gibson, 2012).

Answer	RD 1	RD2	RD3
1	0	0	0
2	0	0	0
3	9	8	9
4	13	10	12
Min Value	3	3	3
Max Value	4	4	4
Mean	3.59	3.56	3.57
Variance	0.25	0.26	0.26
Standard Deviation	0.50	0.51	0.51
Total Responses	22	18	21

Q 44. When teachers are able to experience a more personalized approach to learning that makes authentic connections to their practice, they are more likely to take a similar approach with their students (Brooks & Gibson, 2012).

Answer	RD 1	RD2	RD3
1	0	0	0
2	0	1	0
3	6	6	10
4	15	11	11
Min Value	3	2	3
Max Value	4	4	4
Mean	3.59	3.56	3.52
Variance	0.25	0.38	0.26
Standard Deviation	0.50	0.62	0.51
Total Responses	21	18	21

Q 45. Educators' Professional Learning Network (PLN) should provide online spaces where teachers can learn new information (Trust, 2012).

Answer	RD 1	RD2	RD3
1	2	2	0
2	3	0	10
3	6	13	8
4	10	3	3
Min Value	1	1	2
Max Value	4	4	4
Mean	3.14	2.94	2.67
Variance	1.03	0.64	0.53
Standard Deviation	1.01	0.80	0.73
Total Responses	21	18	21

Q 45a. Educators' Professional Learning Network (PLN) should be an option for teachers to access to learn new information.

Answer	RD 1	RD2	RD3
1		1	0
2		2	1
3		9	14
4		7	6
Min Value		1	2
Max Value		4	4
Mean		3.16	3.24
Variance		0.70	0.29
Standard Deviation		0.83	0.54

Q 45b. Teachers should be provided time to access professional learning networks.

Answer	RD 1	RD2	RD3
1		0	0
2		3	1
3		10	12
4		6	8
Min Value		2	2
Max Value		4	4
Mean		3.16	3.33
Variance		0.47	0.33
Standard Deviation		0.69	0.58
Total Responses		19	21

Q 46. Educators' Professional Learning Network (PLN) should provide online spaces where teachers can connect with other individuals worldwide who can offer support (Trust, 2012).

Answer	RD 1	RD2	RD3
1	0	0	0
2	5	2	1
3	7	13	14
4	9	4	6
Min Value	2	2	2
Max Value	4	4	4
Mean	3.19	3.11	3.24
Variance	0.66	0.32	0.29
Standard Deviation	0.81	0.57	0.54
Total Responses	21	19	21

Q 47. Educators' Professional Learning Network (PLN) should provide online spaces where teachers can connect with other individuals worldwide who can offer advice (Trust, 2012).

Answer	RD 1	RD2	RD3
1	0	0	0
2	4	2	5
3	9	12	10
4	8	4	5
Min Value	2	2	2
Max Value	4	4	4
Mean	3.19	3.11	3.00
Variance	0.56	0.34	0.53
Standard Deviation	0.75	0.58	0.73
Total Responses	21	18	20

Q 48. Educators' Professional Learning network (PLN) should provide online spaces where teachers can connect with other individuals worldwide who can offer feedback (Trust, 2012).

Answer	RD 1	RD2	RD3
1	1	0	1
2	2	4	6
3	12	11	9
4	5	3	5
Min Value	1	2	1
Max Value	4	4	4
Mean	3.05	2.94	2.86
Variance	0.58	0.41	0.73
Standard Deviation	0.76	0.64	0.85
Total Responses	20	18	21

Q 49. Educators' Professional Learning Network (PLN) should provide online spaces where teachers can connect with other individuals worldwide who can offer collaboration opportunities (Trust, 2012).

Answer	RD 1	RD2	RD3
1	0	0	0
2	3	3	6
3	11	10	10
4	7	5	5
Min Value	2	2	2
Max Value	4	4	4
Mean	3.19	3.11	2.95
Variance	0.46	0.46	0.55
Standard Deviation	0.68	0.68	0.74

Total Responses	21	18	21

Q 50. Provide more technical support (Mkhize & Huiseman, 2013).

Answer	RD 1	RD2	RD3
1	0	0	0
2	1	1	1
3	8	11	13
4	13	6	7
Min Value	2	2	2
Max Value	4	4	4
Mean	3.55	3.28	3.29
Variance	0.35	0.33	0.31
Standard Deviation	0.60	0.57	0.56
Total Responses	22	18	21

Q 50a. The state should provide more technical support to districts.

Answer	RD 1	RD2	RD3
1		1	0
2		2	3
3		7	8
4		9	9
Min Value		1	2
Max Value		4	4
Mean		3.26	3.30
Variance		0.76	0.54
Standard Deviation		0.87	0.73
Total Responses		19	20

Q 50b. The state should provide more technical support to teachers.

Answer	RD 1	RD2	RD3
1		2	0
2		2	3
3		7	13
4		8	5
Min Value		1	2
Max Value		4	4
Mean		3.11	3.10
Variance		0.99	0.39
Standard Deviation		0.99	0.62
Total Responses		19	21

Q 51. Information about real action in the classroom requires more than teachers' self-reported answers (Pan & Franklin, 2011).

Answer	RD 1	RD2	RD3
1	0	0	0
2	1	2	1
3	6	11	12
4	15	4	8
Min Value	2	2	2
Max Value	4	4	4
Mean	3.64	3.12	3.33
Variance	0.34	0.36	0.33
Standard Deviation	0.58	0.60	0.58
Total Responses	22	17	21

Q 51a. Information about real action in the classroom requires student samples, data, etc.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		11	10
4		8	11
Min Value		3	3
Max Value		4	4
Mean		3.42	3.52
Variance		0.26	0.26
Standard Deviation		0.51	0.51
Total Responses		19	21

Q 52. Post adoption implementation activities help to ensure that the innovation becomes routine (Hazen et al., 2012).

Answer	RD 1	RD2	RD3
1	1	0	0
2	2	1	1
3	10	10	13
4	9	6	7
Min Value	1	2	2
Max Value	4	4	4
Mean	3.23	3.29	3.29
Variance	0.66	0.35	0.31
Standard Deviation	0.81	0.59	0.56
Total Responses	22	17	21

Q 53. Post adoption evaluation ensures that the innovation becomes routine (Hazen et al., 2012).

Answer	RD 1	RD2	RD3
1	2	1	0
2	1	2	2
3	9	9	13
4	10	5	6
Min Value	1	1	2
Max Value	4	4	4
Mean	3.23	3.06	3.19
Variance	0.85	0.68	0.36
Standard Deviation	0.92	0.83	0.60
Total Responses	22	17	21

Q 54. Post adoption review using quantitative data ensures that the innovation becomes routine (Hazen et al., 2012).

Answer	RD 1	RD2	RD3
1	3	2	0
2	0	2	6
3	9	10	11
4	10	4	4
Min Value	1	1	2
Max Value	4	4	4
Mean	3.18	2.89	2.90
Variance	1.01	0.81	0.49
Standard Deviation	1.01	0.90	0.70
Total Responses	22	18	21

Q 54a. Post evaluation, discussion, and assessment tools will aid in increased utilization and implementation.

Answer	RD 1	RD2	RD3
1		0	0
2		3	2
3		9	16
4		7	3
Min Value		2	2
Max Value		4	4
Mean		3.21	3.05
Variance		0.51	0.25
Standard Deviation		0.71	0.50
Total Responses		19	21

Q 55. Post adoption review using teacher feedback ensures that the innovation becomes routine (Hazen et al., 2012).

Answer	RD 1	RD2	RD3
1	1	0	0
2	2	4	2
3	9	10	16
4	10	4	3
Min Value	1	2	2
Max Value	4	4	4
Mean	3.27	3.00	3.05
Variance	0.68	0.47	0.25
Standard Deviation	0.83	0.69	0.50
Total Responses	22	18	21

Q 55a. Post adoption review should not be based only on teacher feedback.

Answer	RD 1	RD2	RD3
1		1	3
2		2	1
3		9	11
4		7	6
Min Value		1	1
Max Value		4	4
Mean		3.16	2.95
Variance		0.70	0.95
Standard Deviation		0.83	0.97
Total Responses		19	21

Q 56. The adoption rate would increase if the relative advantage of educational technologies innovation was communicated to students (Mkhize & Huiseman, 2013).

Answer	RD 1	RD2	RD3
1	0	0	0
2	9	6	7
3	7	7	11
4	6	4	3
Min Value	2	2	2
Max Value	4	4	4
Mean	2.86	2.88	2.81
Variance	0.69	0.61	0.46
Standard Deviation	0.83	0.78	0.68
Total Responses	22	17	21

Q 56a. Students should be viewed as partners.

Answer	RD 1	RD2	RD3
1		0	0
2		4	2
3		7	11
4		8	8
Min Value		2	2
Max Value		4	4
Mean		3.21	3.29
Variance		0.62	0.41
Standard Deviation		0.79	0.64
Total Responses		19	21

Q 56b. When students know why they are doing something, the outcomes are generally better.

Answer	RD 1	RD2	RD3
1		0	0
2		1	0
3		8	11
4		10	10
Min Value		2	3
Max Value		4	4
Mean		3.47	3.48
Variance		0.37	0.26
Standard Deviation		0.61	0.51
Total Responses		19	21

Q 56c. Educator buy-in is generally more difficult than student buy-in.

Answer	RD 1	RD2	RD3
1		0	0
2		0	0
3		9	9
4		10	11
Min Value		3	3
Max Value		4	4
Mean		3.53	3.55
Variance		0.26	0.26
Standard Deviation		0.51	0.51
Total Responses		19	20

Q 56d. Students do not always know the most effective way to use technology for learning.

Answer	RD 1	RD2	RD3
1		0	0
2		2	1
3		8	14
4		9	6
Min Value		2	2
Max Value		4	4
Mean		3.37	3.24
Variance		0.47	0.29
Standard Deviation		0.68	0.54
Total Responses		19	21

Appendix F: Strategies and Guidelines for Implementing Educational Technologies

The expert panelists agreed that educators have a responsibility to show today's students how to use available technology, that teachers should have access to the digital instructional tools that they need (see Bill & Melinda Gates Foundation, 2014; Borrego, Froyd, & Hall, 2012; Drape et al., 2013), and that educational technologies should be considered one tool in an array of devices.

Strategies and Guidelines

To Increase Potential for Successful Implementation

State responsibilities:

- Develop effective funding mechanisms to provide access and support for the use of technology in an educational setting.
- Develop effective funding mechanisms to provide time for the use of technology in an educational setting.
- Make recommendations for educators' use of educational technologies rather than mandate use.
- Develop a sense of best practices and communicate those results. Policies to provide support for the use of technology in an education setting are best formed at the district level.
- Maintain equity by working with districts to develop effective funding mechanisms to provide training for educators in the use of educational technologies. The unique nature of each district requires unique support from the state.

- Provide more technical support to districts and teachers.
- Include education and technology experts when evaluating the direction for educational technologies.

Implementation Strategies and Guidelines to Increase Innovation Adoption

Stage 1: Knowledge

- Educators should be aware that an educational technologies exists before being asked to adopt.
- Educators should be trained in the use of educational technologies innovation.
- The educational technologies must be (a) easy to use, (b) easy to understand, and (c) reliable. Classroom use of educational technologies must not interfere with the original goal of why it is being implemented.
- Educational technologies should be evaluated as a teaching tool.
- Teachers need to be able to see numerous examples of success with the innovation. Demonstrating how a technology can help a teacher meet their goals is more useful than telling them that technology can help them reach their goals.

Stage 2: Persuasion

- Teachers should be able to experiment with the innovation before deciding to adopt.

- Leadership need to focus on teachers' needs and student achievement over promotions of a specific innovation. Educators want to see leadership identify educational technologies solutions that meet a real need.

Stage 3: Decision

- Teachers follow leadership who understand and model use of the educational technologies innovation.
- Teachers follow leadership who communicate why the educational technologies is important and how it will work.
- Teachers follow leadership who have a clear picture of how the educational technologies can be implemented.
- Teachers should work with district and technology experts when identifying resources for their classrooms.

Stage 4: Implementation

- Professional development needs to be anchored in teacher participation.
- Professional development needs to be anchored in both individual and collaborative activities.
- Teachers should decide if an online learning community meets their needs.
- Provide more technical support.

Stage 5: Confirmation

- The method of evaluation should be defined before implementation.

- Post adoption implementation activities help to ensure that the innovation becomes routine.
- Post evaluation, discussion, and assessment tools will aid in increased utilization and implementation. Information about real action in the classroom requires students' samples, data, and teacher feedback.
- Post adoption review using quantitative data and teacher feedback ensures that the innovation becomes routine.