A CASE STUDY OF AN INTERACTIVE WHITEBOARD DISTRICT-WIDE TECHNOLOGY INITIATIVE INTO MIDDLE SCHOOL CLASSROOMS

by

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A Dissertation
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DEDICATION

This is dedicated to my family who has done just as much work as I have to earn this degree.

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ABSTRACT

A CASE STUDY OF AN INTERACTIVE WHITEBOARD DISTRICT-WIDE TECHNOLOGY INITIATIVE INTO MIDDLE SCHOOL CLASSROOMS

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This study examined the impact that a district-wide technology initiative involving interactive whiteboards had on teachers' attitudes, beliefs, and practices and whether this impact was consistent with the overall goals of the initiative. Using the Unified Theory of Acceptance and Use of Technology (UTAUT) as its framework, this case study using a mixed methods design examined a district-wide interactive whiteboard technology initiative in middle schools. This study occurred in two phases. Phase one occurred during the semesters when the initiative occurred and captured data that described how the initiative manifested itself in teachers' attitudes, beliefs, and instructional practices. This was followed 18 months later by phase two which captured data that examined the intent of the initiative and how this intent was interpreted by all stakeholders. Combining a quantitative and qualitative analysis of the data provided a more complete representation of how a district-wide technology initiative involving

Promethean boards manifested itself in the classroom, how its intent was interpreted by multiple stakeholders, and possible reasons why the initiative manifested the way it did.

Findings of this study examined patterns of use that emerged when a district-level Promethean board initiative was implemented, teachers' attitudes and beliefs related to the initiative, contextual influences on adoption of the innovation, and factors of social influence which impacted the initiative. The first goal established by the district for use of the Promethean board was generally met with some variations at the school and individual levels. However, the second goal directed at student achievement was poorly communicated and largely unmet. Patterns of use and teacher attitudes and beliefs were most strongly reflected in and influenced by four factors: professional development, school-based leadership, communication channels, and peer interactions. Together, these four factors were identified as the primary influences in the initiative's successes and limitations.

1. INTRODUCTION

Technology use in education continuously evolves as improvements in technology are paired with changes in instructional practices. With this constant evolution, districts implement technology initiatives that they believe bring beneficial technologies to the classroom for the benefit of their student population. The successful integration of a new technology is the goal of any educational technology initiative and is especially critical when the initiative has substantial budgetary impact.

There are multiple technology acceptance/adoption models that seek to predict the successful or unsuccessful acceptance of new technologies by individuals. Most are born from the field of information systems and center around constructs that are experimentally calculated to predict behavioral intention or usage of new technologies. These constructs are often measurements of beliefs regarding technology use that can predict a user's use of new technology. Initial models such as the Technology Acceptance Model (TAM) and the Theory of Reasoned Action (TRA) centered on measuring perceived usefulness (PU) and perceived ease-of-use (PEOU). The first, "perceived usefulness (PU), the degree to which a person believes that using a particular system would enhance his/her job performance" (Davis, 1989, p. 982), is a reflection of the value that the technology adds for end users. The second, "perceived ease-of-use (PEOU), the degree to which a person believes that using a particular system would be free from effort" (Davis, 1989, p. 982), is a reflection of the amount of work that the end users think it will take to learn the new technology.

Rogers' (2003) Diffusion of Innovations and Bandura's (1977) Social Cognitive Theory (SCT) recognized the power of social interaction and user self-efficacy as powerful motivating factors when learning and using new technologies. These theories recognized that successful adoption of any technology requires individual actions manifested from beliefs and attitudes of end users as well as influences of the environment (Lai & Chen, 2011). Lewis, Agarwal, and Sambamurthy (2003) found that top management commitment and support, and the individual factors of computer self-efficacy and personal innovativeness, collectively accounted for 40% of the variance in the dependent variable perceived usefulness.

Venkatesh, Morris, Davis, and Davis (2003) evaluated eight of the key models and formulated a Unified Theory of Acceptance and Use of Technology (UTAUT). This Unified Theory of Acceptance and Use of Technology (UTAUT) is the basis for much of the conceptual framework for the current study. It identifies four constructs—performance expectancy, effort expectancy, social influence, and facilitating conditions—as having a direct role in determining users' acceptance and usage behavior (Venkatesh et al., 2003).

The Innovation

The *America's Digital Schools 2008* report (The Greaves Group, 2008) identified interactive whiteboards (IWB) as one of the six technology trends districts should be investigating. The report acknowledged that interactive whiteboards have been used in schools worldwide with some of the largest installations occurring in the United Kingdom. It reported that installations in the United States are growing with 12% of classrooms containing IWBs. However, this number is small compared to the presence of IWBs in 60% of the classrooms in the United Kingdom (Davis, 2007). Decision Tree Consulting, a London-based market-research company that tracks whiteboard sales in 66 countries, believes that this technology will be in 14% of classrooms by 2011 (Davis, 2007).

The Information and Communication Technology (ICT) Impact Report published by European Schoolnet (Balanskat, Blamire, & Kafala, 2006) specifically identified this type of technology and emphasized the value IWBs bring to the classroom. The review of research focused on the impact of ICT on learning outcomes and learners and teaching methodologies and teachers. It also identified the positive instructional benefits of IWBs as increased student motivation and skills and increased classroom interactions. Schrum and Levin (2009) similarly believe that IWB technology enables teachers to create interactive lessons that can accommodate multiple learning styles.

The District

"Liberty District" (a pseudonym) is a large suburban school district located near a large metropolitan area of the central East Coast. As of 2010, it was one of the fastest-growing in the United States and had one of the highest medium incomes of any county in the United States of America. The district had 79 schools as of the 2010-2011 school year and served 63,220 students.

Liberty District's investment in instructional technology started when it placed four computers in every classroom in 1997. This large infusion of technology was accompanied by additional support to ensure that the technology was used effectively by teachers. This plan changed slightly in 2002 when the number of computers in classrooms at middle and high schools was changed from four to two with the addition of laptop carts. In 1997, the district placed Technology Resource Teachers (TRTs) in schools to support the technology and provide technology professional development for faculty and staff. TRTs are educators who have either a master's in Education or a certificate in instructional technology and a proven record of effectively using technology in instruction. As funding increased, a TRT position was allocated for every school in 1998. The pairing of this level of staffing with the budgetary commitment to provide equal access to technology in their schools reflected the level of importance that the district places on technology use in the classroom.

Every five years the state requires school districts to present a Technology Plan. A central theme in the *2004-2009 Liberty District Technology Plan* was student access to ubiquitous computing (District Website, 2004). Liberty District experimented with multiple technologies that could enhance instruction in the classroom and bring the school division closer to a ubiquitous environment including Dell Axims, individual laptops, and interactive whiteboards (IWBs).

History of the Initiative

The interactive whiteboard initiative started in this district at the school level. Teachers were lobbying parent–teacher organizations to purchase this new technology.

Some schools were purchasing Smart's brand of boards, and some schools were purchasing Promethean's brand of boards. Recognizing the growing demand from teachers and the impact managing multiple hardware and software platforms was having on support staff, the Department of Instructional Services sought to standardize on one board and its software.

The department formulated an ad hoc hardware review committee in the fall of 2005 to review the IWB technologies and additional hardware. This committee was composed of teachers, technology resource teachers, administrators, and curriculum supervisors. This committee ultimately recommended Smart as the preferred technology. Instructional services agreed to support the technology and established goals and revised the district's technology plan to reflect this commitment. Seven schools (six elementary and one middle) built during the 2006-2007 school year were outfitted completely with Smart boards.

With the revised goals and commitment within the district's technology plan came the financial commitment from instructional services to continue to purchase and support this technology. It was prudent for the district to revisit the two dominant companies in the marketplace and do a more in-depth comparison. Several Smart and Promethean boards were placed in multiple classrooms within an elementary and high school for a semester. Multiple stakeholders were invited into those classrooms to interact with and evaluate the technology. The results were balanced, with elementary teachers slightly preferring Smart boards and secondary teachers slightly preferring Promethean boards. Therefore, the purchasing decision would be based solely on price.

Promethean's response to the request for price (RFP) was substantially lower than that for Smart. The contract was awarded to them. During the 2007-2008 school year, a Promethean board was placed in the majority of classrooms in every high school within the district. This case study follows the 2008-2009 school year installation of Promethean boards in the majority of classrooms in every middle school within the district but one. Since one middle school had been built during the 2006-2007 school year and outfitted completely with Smart boards, this middle school was not part of the initiative.

An IWB in every secondary classroom influences the learning of 25,000 students with another 25,000 possible if the initiative is expanded to the elementary level. The potential to change instruction and the large budgetary commitment to fund these tools warranted an investigation into the impact these boards have on the classrooms where they were installed.

The Case

This study employed case study research using a mixed methods approach. The case is a district's implementation of a technology initiative that placed interactive whiteboards in middle school classrooms and prepared teachers to use them. This study examined teacher beliefs, attitudes, and practices in regard to the use of the interactive whiteboard technology and the school division's policy leaders' expectations of the impact of the interactive whiteboard technology.

A case study was selected for this research design because it allowed the researcher to retain the holistic and meaningful characteristics of the initiative at multiple levels as it unfolded throughout the organization. Many of the research questions required an in-depth description of some social phenomenon (Yin, 2009). The study was designed using an embedded case study design where the focus was on the district-wide initiative but attention was also given to how the initiative manifested itself at the school level (Yin, 2009). The mixed methods interactive design approach (Maxwell, 2005) focused on integrating inquiry design in a networked or web-like association (Greene, 2007).

Research Goal

The goal of this study was to better understand the impact a district-wide technology initiative involving interactive whiteboards had on teachers' attitudes, beliefs, and practices and whether this impact was consistent with the overall goals of the initiative.

Research Questions

The study was conducted in two phases. Phase one occurred during the spring and summer 2009 semesters and phase two occurred approximately 18 months later. The following research questions framed phase one of the study:

1. Are there changes in teachers' observed instructional practices from the beginning to the end of the semester when an interactive whiteboard initiative is rolled out, and if so what are they?
2. What changes do teachers report in their instructional practices as a result of a district-wide technology initiative involving interactive whiteboards?

a. If no changes are reported, what reasons are given?

b. Are these changes consistent with observed instructional practices?

3. What do teachers report as having impacts on their adoption of new technology?

The following research questions framed phase two of the study:

4. What did school leaders report as their role in a technology initiative and what actions did they take to support it?

5. What do different stakeholders of a technology initiative report as its intent?

   a. Are their interpretations consistent with the district's intent? If not what are the inconsistencies?

Significance of the Study

The Project RED study (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2010) of 997 schools reported that daily use of technology is one of the top five indicators of better discipline, better attendance, and increased college attendance. Additionally, the *America's Digital Schools 2008* report (The Greaves Group, 2008) identified interactive whiteboards (IWB) as one of the six technology trends which districts should be investigating. Successful systemic change requires collaboration at all levels from superintendent and school board to classroom (Greaves et al., 2010). The report's findings suggested that districts need to plan for systemic change management and establish processes and procedures for its implementation. Large-scale technology initiatives require substantial funding and instructional support. However, when done correctly, these initiatives appear to provide immediate short-term savings (Greaves et al., 2010). This requires districts to understand the issues that arise during implementation of district-wide initiatives (independent of the technology) and to identify and use best practices for implementation. Research that provides school districts with knowledge about issues and awareness of practices that support successful implementation of a district-level initiative is necessary to better inform and guide future initiatives.

Conceptual Framework

Teacher adoption of new technology is a complicated process, built on current and past technology experiences, social relationships, and environmental factors that influence and shape instructional decisions (Bandura, 1977, 1986; Compeau & Higgins, 1995; Compeau, Higgins, & Huff, 1999; Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Horton, Buck, Waterson, & Clegg, 2001; Karahanna, Straub, & Chervany, 1999; Leh & Grafton, 2008; Lewis et al., 2003; Rogers, 2003; Windschitl & Sahl, 2002; Venkatesh et al., 2003). Therefore, the study of a district's technology initiative should take a comprehensive approach and include examination of strategies that leverage the multiple influences on teachers' practice. Figure 1 summarizes the influences on teacher technology use in a district-wide technology initiative.

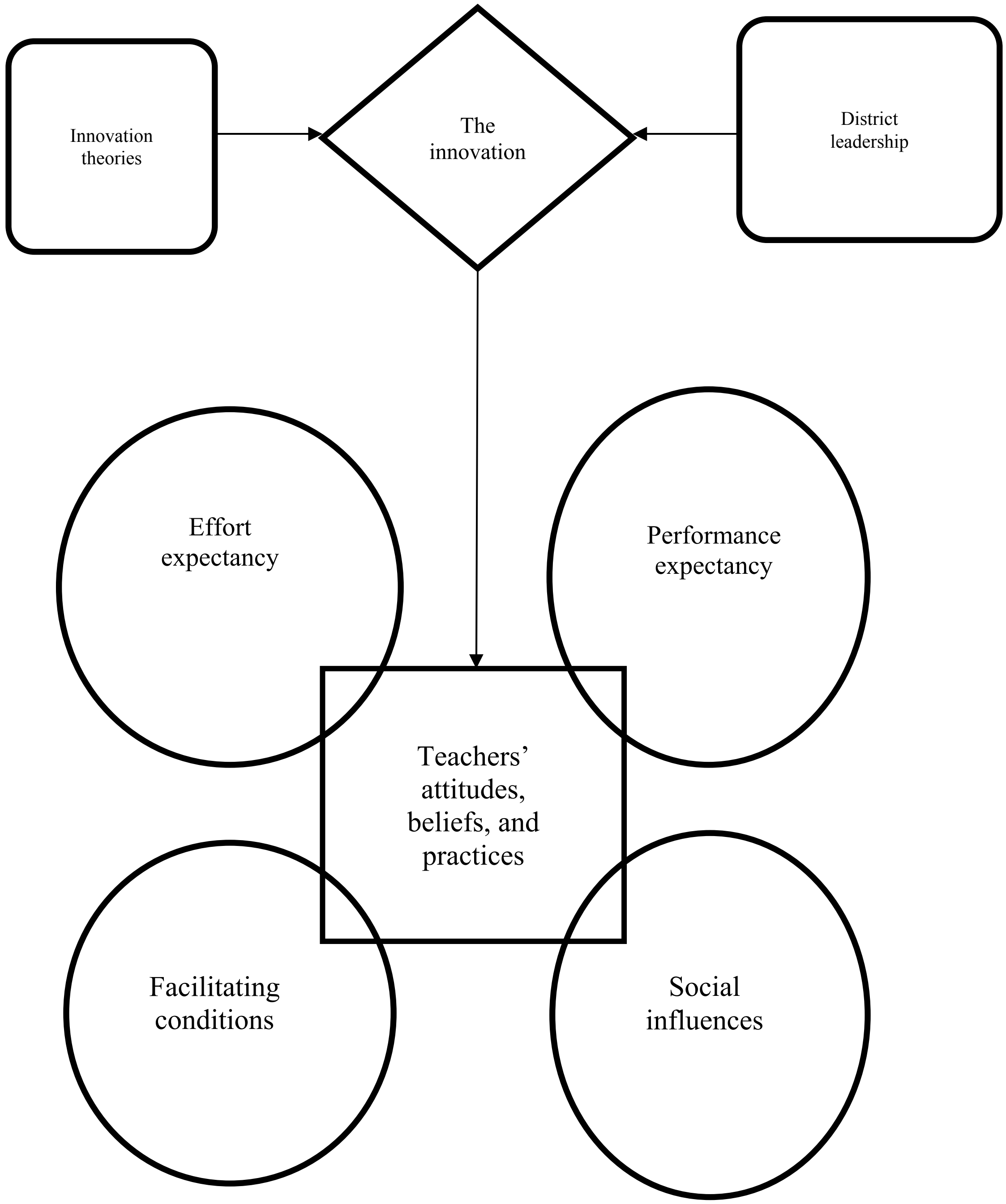

Figure 1. Influences on teacher technology use in a district-wide technology initiative.

Venkatesh et al.'s (2003) examination of eight of the key technology adoption models resulted in the formulation of the Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT is the basis for much of the conceptual framework for the current study. It identified four constructs—performance expectancy, effort expectancy, social influence, and facilitating conditions—as having a direct role in determining users' acceptance and usage behavior.

Performance Expectancy

Performance expectancy refers to the extent that an end user believes that adopting a technology will improve their job performance (Venkatesh et al., 2003). This construct is the strongest predictor of behavioral intention in UTAUT and was based on the constructs of perceived usefulness, extrinsic motivation, job-fit, relative advantage, and outcome expectations from contributing models. Indirectly included in this construct and effort expectancy is attitude toward using technology (Venkatesh et al., 2003). Therefore, this study gathered data that reflected teachers' beliefs about how the interactive whiteboards impacted their instructional practices.

Effort Expectancy

Effort expectancy refers to how easy end users believe a technology is to use (Venkatesh et al., 2003). This construct was based on perceived ease of use, complexity, and ease of use from contributing models. References to self-efficacy and anxiety in the data were considered contributing factors reflected in teachers' beliefs about the degree of ease associated with using the interactive whiteboard technology (Venkatesh et al., 2003).

Social Influence

Social influence is the extent that an end user believes his or her peers believe he or she should use a new technology (Venkatesh et al., 2003), and was based on the constructs of subjective norm, social factors, and image from contributing models. Expectations about use/adoption are important in measuring the success of an initiative. Successful classrooms have clear expectations. The power of institutional culture is clearly reflected in its staff when clear expectations about desired behaviors and practices are presented and embedded in all aspects of the culture (Bandura 1986, 2001; Venkatesh et al., 2003; Windschitl & Sahl, 2002). The power of this institutional influence is reflected when individuals conform to the expectations of others and is "an effective mechanism to overcome adopter initial inertia in adopting it" (Karahanna et al., 1999, p. 199).

Facilitating Conditions

Facilitating conditions refers to the extent that an end user believes organizational structures are supportive of their adoption of technology (Venkatesh et al., 2003) and was based on the constructs of perceived behavioral control, facilitating conditions, and compatibility from contributing models. Central to the success of a technology initiative is putting equipment in place that operates at optimal levels and then addressing any hardware/software issues quickly in order to minimize disruption of the instructional process.

Shaping teacher attitudes, beliefs, and practices is a complicated process and predicting them is difficult. Thus, it is important to look at multiple factors that could be influencing teacher practices in the classroom and the underlying attitudes and beliefs that drive them. Focusing on these four constructs and their influence on teachers' attitudes, beliefs, and practices along with how technology initiatives are diffused within organizations center this study in existing literature.

Scope of the Study

This case study employed an embedded design that focused on the district-wide initiative with particular emphasis on how the initiative manifested itself at the school level. Initially, the study was intended to analyze data that was captured during the rollout of the initiative. However, analysis of this data led to further research questions which resulted in the development of phase two in order to collect additional data to better examine the initiative and its impact. Data were collected in two phases. Phase one occurred during the semester in which the initiative was rolled out. Phase two occurred 18 months later.

Phase One

Data in phase one were collected during the rollout of the initiative in the spring and summer 2009 semesters. Data collected during this phase was quantitative and qualitative and centered on teachers' technology usage, instructional practices, instructional strategies, and attitudes, beliefs, and practices. There were several instruments utilized during this phase: a walk-through form, an observation form, an online teacher survey, and a teacher interview protocol. The walk-through and observation forms captured data that measured technology usage in the classroom along with instructional organization. Additional data collected using the observational form included instructional strategies, percentage of time using technology, and the teacher's demonstrated technology levels. The online teacher survey was used to capture data on teacher demographics, professional development, and beliefs regarding the Promethean board. Finally, the interview protocol was used to capture qualitative data on teachers' attitudes, beliefs, and practices towards instruction using the Promethean board, and the intent of the initiative. Analysis of phase one data raised additional questions that warranted further analysis. This prompted the expansion of the study to answer those questions and resulted in the development of phase two.

Phase Two

Data in phase two were collected during the summer and fall semesters of 2010, approximately 18 months after the initiative rollout. This lag in data collection was partially accounted for by the research process, which included time for analysis and the researcher's university's Human Subjects Review Board process. Allowing this time to pass distanced participants from the initial rollout and provided time for them to reflect on the process. Data collected during this stage was qualitative and centered on how the initiative's intent was interpreted at multiple levels from the district's leaders down to the classroom. There were several data sources analyzed during this phase: School Board meeting notes, School Board members' blogs, school-based professional development plans, and interviews with instructional technology administrators, middle school principals, and technology resource teachers. The School Board meeting notes and members' blogs were analyzed to capture qualitative data about the board's views regarding the intent of the initiative. The school-based professional development plans were used to capture data about the professional development that was planned at the school level. These data reflected how school leaders prepared their teachers to use the Promethean board. Finally, interviews with instructional technology administrators, middle school principals, and technology resource teachers were analyzed to capture stakeholders' views regarding the intent of the initiative and how these views manifested in actions. Table 1 summarizes research questions, participants, instrumentation, and time frames.

Table 1
Summary of Phase One and Phase Two

Research questions	Participants	Instrument	Time frame
Phase one			
Are there changes in teachers' observed instructional practices from the beginning to the end of the semester when the Promethean board initiative is rolled out, and if so what are they?	1,127 teachers from walk-through 97 teachers from observations 10 teachers from interviews	Walk-through form Observation form Teacher interview protocol	Spring 2009 semester Walk-throughs and observations occurred at approximately 1, 6, and 13 weeks post-Promethean board installation Interviews occurred at the end of spring 2009 semester and over summer 2009
What changes do teachers report in their instructional practices as a result of a district-wide technology initiative involving Promethean boards? If no changes are reported, what reasons are given? Are these changes consistent with observed instructional practices?	97 teachers from observations 10 teachers from interviews	Observation form Teacher interview protocol	Spring 2009 semester Observations occurred at approximately 1, 6, and 13 weeks post-Promethean board installation Interviews occurred at the end of spring 2009 semester and over summer 2009

(continued)

Table 1 (continued)

Research questions	Participants	Instrument	Time frame
What do teachers report as having impacts on their adoption of new technology?	97 teachers from observations 10 teachers from interviews 72 teachers from survey	Observation form Teacher interview protocol Teacher survey	Spring 2009 semester Observations occurred at approximately 1, 6, and 13 weeks post-Promethean board installation Interviews occurred at the end of spring 2009 semester and over summer 2009 Survey was open April 13, 2009 to May 21, 2009
<u>Phase two</u>			
What did school leaders report as their role in a technology initiative and what actions did they take to support it?	2 technology administrators from interviews 2 middle school principals from interviews 2 technology resource teachers from interviews 11 school Promethean board professional development plans	Technology administrator interview protocol Middle school principal interview protocol Technology resource teacher interview protocol School-based professional development plan template	Interviews occurred at the end of summer 2010 semester and over the fall 2010 semester

(continued)

Table 1 (continued)

Research questions	Participants	Instrument	Time frame
What do different stakeholders of a technology initiative report as its intent? Are their interpretations consistent with the district's intent? If not, what are the main inconsistencies?	2 technology administrators from interviews 2 middle school principals from interviews 2 technology resource teachers from interviews 11 school Promethean board professional development plans	Technology administrator interview protocol Middle school principal interview protocol Technology resource teacher interview protocol School-based professional development plan template	Interviews occurred at the end of summer 2010 semester and over the fall 2010 semester

Definition of Terms

- *Attitudes*: "A subset of a group of constructs that name, define, and describe the structure and content of mental states that are thought to drive a person's actions" (Richardson, 2003, p. 22).
- *Beliefs*: the psychological state in which an individual holds "suppositions, commitments, and ideologies to be true" (Ertmer, 2005, p. 28).
- *Effort expectancy*: "The degree of ease associated with the use of the system" (Venkatesh et al., 2003, p. 450) based on the constructs of perceived ease of use, complexity, and ease of use from contributing models.

- *Facilitating conditions*: "The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" (Venkatesh et al., 2003, p. 453) based on the constructs of perceived behavioral control, facilitating conditions, and compatibility from contributing models.
- *Interactive whiteboard*: a large interactive display that connects to a computer and projector. A projector projects the computer's desktop onto the board's surface, where users control the computer using a pen, finger, or other device. Starting in Chapter 3, *Promethean board* will be used in place of the generic term interactive whiteboard. *ActivStudio* is the software that is used with the Promethean board. This software is not required to use the Promethean board but is the focus of the professional development that occurred as part of the initiative. *ActiVotes* are Promethean's individual response system (aka "clickers") that work within the ActivStudio software to deliver assessments and capture results instantaneously.
- *Performance expectancy*: "The degree to which an individual believes that using the system will help him or her to attain gains in job performance" (Venkatesh et al., 2003, p. 447). This construct is the strongest predictor of behavioral intention in UTAUT and was based on the constructs of perceived usefulness, extrinsic motivation, job-fit, relative advantage, and outcome expectations from contributing models

- *Self-Efficacy*: an individual's beliefs about their capabilities to produce designated levels of performances that exercise influence over events that affect their lives (Bandura, 1977).
- *Social influence*: "The degree to which an individual perceives that important others believe he or she should use the new system" (Venkatesh et al., 2003, p. 451) based on the constructs of subjective norm, social factors, and image from contributing models.

Summary

This chapter presented an introduction to this study. The introduction included discussion of technology initiatives and the interactive whiteboard technology. It provided contextual information by including a description of the district where the initiative took place and a brief history of the initiative prior to the start of the study. An overview of the study was included along with its scope and significance. The research questions and conceptual framework were outlined and anchored in the literature. This review of the literature is the focus of chapter two which follows.

2. LITERATURE REVIEW

Guided by the research goal and questions presented in Chapter one, this chapter explores the literature relevant to technology innovations and technology adoption models. Using the conceptual framework and constructs that predict use, an analysis of existing research was conducted. The analysis provided guidance for planning the data collection methods which follow in Chapter 3.

Literature Search Procedures

Using *technology innovation*, *technology adoption model*, *teacher beliefs*, *self-efficacy*, *teacher technology adoption*, and *interactive whiteboard* as keywords, ERIC, EBSCO, EdITLib Digital Library, JSTOR, and Dissertation Abstracts were searched from 1980 to the present. The initial searches resulted in roughly 200 articles. These titles were reviewed and narrowed according to their relevancy to the topic. A further search of relevant journals and organizations was conducted resulting in an additional selection of relevant articles. These were the *Journal of Interactive Learning Research*, *Management Information Systems Quarterly*, and the International Society for Technology in Education. Additionally, an ancestry search of references was done. Finally, an Internet search was conducted resulting in additional sources such as BECTA and the State Educational Technology Directors Association (SETDA).

Industry Trends

Technology in education is in constant evolution, challenging policy decision makers to predict what software/hardware will best meet the needs of their teachers and student population while being fiscally responsible. Sponsored by Pearson Education, Advanced Micro Devices (AMD), Promethean, and Qwest Communications, and supported by the American Association of School Administrators (AASA), the National School Boards Association (NSBA), the Consortium for School Networking (CoSN), the State Educational Technology Directors Association (SETDA), the Software and Information Industry Association (SIIA), and the International Society for Technology in Education (ISTE), the *America's Digital Schools 2008* report (The Greaves Group, 2008) identifies interactive whiteboards (IWB) as one of the six technology trends districts should be investigating. Included in the report is the acknowledgement that interactive whiteboards have been used in schools worldwide with some of the largest installations occurring in the United Kingdom. Installations in the United States are growing with 12% of classrooms containing IWBs. However, this number is small compared to the presence of IWBs in 60% of the classrooms in the United Kingdom (Davis, 2007). Decision Tree Consulting, a London-based market-research company that tracks whiteboard sales in 66 countries, "predicts that one of every seven classrooms in the world will feature an interactive whiteboard by 2011" (Davis, 2007, para. 5).

The *Information and Communication Technology (ICT) Impact Report* (Balanskat et al., 2006) specifically identifies this type of technology and emphasizes the value IWBs bring to the classroom. Balanskat et al.'s review of research focused on the impact of ICT on learning outcomes and learners and teaching methodologies and teachers. They cite multiple studies supporting the positive instructional benefits of IWBs including increasing student motivation and skills and increasing classroom interactions. Schrum and Levin (2009) similarly state that IWB technology enables teachers to create more interactive lessons and has "the potential to accommodate different learning styles" (p. 66).

The Innovation

Interactive whiteboards have been part of a nationwide ICT initiative in Great Britain for several years with national studies funded by the British Educational Communications and Technology Agency (BECTA) starting in 2003-2004. Recent studies examining IWB use in the classroom and its impact on pedagogy are based on BECTA's three levels of IWB use: supported didactic, interactive, and enhanced interactive (Glover, Miller, Averis, & Door, 2007; Miller, Averis, Door, & Glover, 2005) or the features of this technology and their use in the classroom (Glover et al., 2007; Miller et al., 2005). Kennewell, Tanner, Jones, and Beauchamp (2008) identified the benefits that IWBs bring to a classroom and the reason a teacher gives for their adoption based on a case study of a mathematics classroom with an interactive whiteboard. They included flexibility and versatility, multimedia/multisensory presentation, saving and printing work, efficiency, planning and saving lessons, teaching ICT, and interactivity and participation (Kennewell et al., 2008). These are more a reflection of the benefits of the technology and, with the exception of the last, do not reflect pedagogical approaches.

The focus on increased interactivity is seen as the ultimate evolution of instructional pedagogical approaches with or without ICT use. Miller et al. (2005) suggested a developmental instructional approach that had teachers progressing through stages until reaching a point where changes in teachers' thinking results in technology becoming an integral part of lessons. Technology would be integrated based on how well its characteristics fit with the instructional goals of the lesson. Embedded in instruction designed for greater interactivity would be increased time for reflection and extended responses to teacher-posed questions. Yet Kennewell et al. (2007) found in their classroom case study that the teacher using IWB provided more traditional teacher-centered approaches, and Kennewell and Beauchamp (2007) found when the teacher used the IWB he or she actually increased the pace of instruction which allowed for less time for interaction. Although both of these studies are richly descriptive, their reliance on a single classroom provides little opportunity for transferability and understanding how teachers and their instructional beliefs, attitudes, and practices transition to higher levels of integration.

Managing Change

What is an innovation? Traditionally, *innovation* has been defined as a "relatively discrete practice, product, process, or organizational arrangement that is to be diffused, disseminated, or introduced to users throughout the system" (Sherry, 2002, p. 212). The implementation of any widespread innovation requires a comprehensive plan that starts at the highest levels and is outlined and supported at the multiple levels where implementation occurs. Support of an initiative is achieved by leveraging the social systems present in any organization to create and communicate norms addressing behavior patterns (Rogers, 2003). Frank, Zhao, and Borman (2004) analyzed survey results from 143 teachers in eight schools (70% response rate) and recommended, "Change agents should attend to local social capital processes that are related to the implementation of educational innovations or reforms" (p. 148). This analysis focused on responses designed to capture teachers' perceived social pressures to use computers. Although a good response rate, concern regarding the validity of the results was raised because schools were only financially compensated for response rates that exceeded 85%.

Rogers (2003) defined *diffusion* as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (p. 35). He pointed out that problems often occur in any organizational implementation when the decision makers are a different set of people from those involved in the implementation process. Therefore, attention must be focused on establishing central goals and expected outcomes at the classroom level.

Regardless of the intent of the initiative, ultimately the outcome is determined by the classroom teacher's commitment to the new technology (Parrish, 2010). Passey (2010) identifies several key areas to manage change when instituting an ICT initiative in the *MathsAlive Evaluation Study: An Evaluation of Impacts on Learning* (MAESTRO). Areas include managing change at the teacher level, managing change at the department level, and managing change at the school level. Schachter (2010) reinforced this systems approach when he described how an ISD in Texas incorporated expectations in official district documentation: "The subject area coordinators have sought to embed the new whiteboards into classroom culture by including them in the district's curriculum framework" (p. 48). However, Frank et al. (2004) cautioned about trying to implement too much at one time when they stated, "Change agents should be aware of other innovations that schools are implementing that may compete with their own and thus overdraw the stores of social capital" (p. 163).

Rolling out a large-scale initiative is complicated. Therefore, for this current study exploration and analysis of the literature relevant to theories that support successful innovations was warranted. By researching theories and models of technology adoption the researcher gained an understanding of the multiple factors that influence the success or failure of a technology initiative. This analysis of research on technology adoption models and the constructs that contribute to them is detailed below, and it further guided the design and implementation of this case study.

Technology Adoption Models

The successful adoption of a new technology is the goal of any initiative and is especially critical when the initiative has substantial budgetary impact. There are multiple acceptance/adoption models that seek to predict the successful or unsuccessful acceptance of new technologies by individuals. Most are born from the field of information systems and center around constructs that are experimentally calculated to predict behavioral intention or usage of new technologies.

The Technology Acceptance Model (TAM) is based on the Theory of Reasoned Action (TRA) and identifies two factors that can predict whether an innovation will be adopted by end users. The first, perceived usefulness (PU), is a reflection of the value that the technology adds for end users. The second, perceived ease-of-use (PEOU), is a reflection of the amount of work that the end users think will take to learn the new technology (Davis, 1989).

The Diffusion of Innovations model, also known as the Innovation Diffusion Theory (IDT), was first presented by Rogers in 1962 and focused on four main elements: the innovation, communication channels, time, and a social system. The innovation itself is broken down into five attributes when predicting implementation success or technology adoption: relative advantage which is similar to perceived usefulness, compatibility, trialability, observability, and complexity which is similar to perceived ease of use (Rogers, 2003). This process centers on utilizing existing communication and social channels within the organization. This theory recognized that successful adoption of any technology requires individual actions manifested from beliefs and attitudes of end users and influences of the environment (Lai & Chen, 2011).

Often TAM and research using this model are applied to business technology. However, there are an increasing number of studies that apply this model to technologies used in education. Horton et al. (2001) studied the use of an intranet (a private network that resides within a firewall of an organization and serves to share information) in two organizational settings. The first was a banking corporation where 386 employees out of 600 (64%) completed a questionnaire, and the second was an engineering company where 65 engineers out of 80 (81%) completed a similar questionnaire; data were captured regarding their actual intranet usage. Horton et al. discovered inconsistencies between self-reported data and actual intranet use in the second organization studied, as participants self-reported higher intranet use than was documented via server logs. Server data showing actual intranet use were collected 1 month prior to the survey, and 2 and 5 months post survey. Their data showed a positive correlation only between PEOU and use, not PU. Karahanna et al. (1999) paired TAM with Rogers' Diffusion of Innovations theory to look at pre- and post-adoption beliefs in order to explain organizational adoption of Microsoft Office in a cross-sectional field study conducted in a large financial institution in 1993. They found that PEOU was a concern with potential adopters but after adoption these concerns resolved themselves, reflecting the users' increased confidence using the technology. Perceived usefulness, reflected in relativity and compatibility, was important to both potential adopters and users of the technology. Concerns about data validity arise in the Karahanna et al.'s study because the survey response rates were only 28.2%. Their interpretations of the findings also suggested the additional influence of social factors, and they recommended that to "encourage adoption, emphasis may be given to mobilizing such social networks as one's occupational and departmental social worlds" (Karahanna et al., 1999, p. 202). Davis et al. (1989) compared TAM and TRA using questionnaires delivered to 107 full-time MBA students at the beginning and end of a semester-long word processing course, followed by interviews with 40 MBA students from the course. They found that perceived usefulness was a major determinant and perceived ease of use was a secondary determinant of people's intention to use technology. Finally, Lai and Chen (2011) paired TAM with diffusion of innovation when studying 325 secondary school teachers' adoption of teaching blogs. Lai and Chen found similar results with school support positively affecting decisions regarding adoption of teaching blogs. However, this did not extend to supervisor influence when the position was located at the district level. All four studies showed a positive relationship between the PU and PEOU and the adoption of the technology when data were self-reported. Similar findings in studies that span business and educational settings demonstrate that models of technology adoption and usage can be applied across multiple settings.

The importance of social influence on technology use is a major component of diffusion of innovation. Social influence's impact on beliefs about information technology use was central to Lewis et al.'s (2003) study. They stated, "Social norms alone induce initial adoption while sustained usage decisions, when non-mandated, are based solely on attitudinal considerations" (p. 203). Lewis et al. analyzed 161 university faculty's self-reported use of the Internet and technology. They examined multiple levels of institutional influence including top management, local management, and peers. In addition to including the key components of TAM (PU and PEOU), they included influences on actions that more closely mirrored Rogers' Diffusion of Innovations and focused on "those emanating from the institutional environment, a set of social influences and a set of characteristics internal to the individual" (Lewis et al., 2003, p. 664). They found that top management commitment and support and the individual factors of computer self-efficacy and personal innovativeness collectively accounted for 40% of the variance in the dependent variable perceived usefulness (Lewis et al., 2003). Although a large sample (161 faculty members), this represented a response rate of 14% and relied only on self-reported data. This low response rate could result in data that applies only to a small population more likely to complete the survey, such as faculty who were comfortable with the use of the Internet and technology.

Expanding upon the examination of PU and PEOU, Lewis et al. (2003) included self-efficacy in their study. Their focus on social influences infused Social Cognitive Theory (SCT) into the researchers' framework although not directly stated in the justification. Most of the prior theories view causal relationships as unidirectional where the environment influences beliefs which then influence attitudes and direct behaviors. Social Cognitive Theory views these relationships as reciprocal.

Compeau et al. (1999) incorporated SCT's view of self-efficacy as a predictor of technology use in their longitudinal survey study of 394 subscribers to a Canadian business periodical. Results showed self-efficacy to be a strong predictor of affect, anxiety, and use 1 year later. They found an individual who feels confident using technology (high self-efficacy) will most likely adopt new technologies.

All of these theories (TAM, TRA, diffusion of innovation, and SCT) have identified components that predict technology use. Comparisons between and combinations of two different models are the central focus of several studies. Davis et al. (1989) compared TAM and TRA with 107 MBA students in a word processing course with perceived usefulness and perceived ease of use analyzed using each theory. They found that combining the beliefs of TRA and TAM into a single analysis may yield a better perspective on the determinants of behavioral intent than that provided by either model alone. Karahanna et al. (1999) combined TRA with diffusion of innovation when studying the rollout of Microsoft Office in a corporation. They found that perceived usefulness forms user attitude and that five beliefs (image, visibility, result demonstrability, ease of use, and trialability) underlie adoption attitude. Lai and Chen (2011) also looked to combine TAM with diffusion of innovation when determining factors that influenced 325 teachers' adoption of teaching blogs. Using questionnaires, they found that PU and PEOU were positively related to adoption of technology. Thus, if teachers believed the blog technology was easy to use and would benefit their instruction, they were more likely to adopt its use. When examining social influences, Lai and Chen did not find a relationship between management influence or peer influence on teachers' adoption of blogs. These studies incorporate multiple theories and methodologies—suggesting the need to conduct a more comprehensive study that incorporates multiple theories.

Venkatesh et al. (2003) examined eight of the key models and formulated a Unified Theory of Acceptance and Use of Technology (UTAUT). They built this theory after recognizing the need for a unified model of user acceptance of technology. They sought to provide an alternative for researchers who are often required to choose among a multitude of models and pick and choose constructs across the models, or select a favored model which can result in ignoring the contributions from alternative models. Venkatesh et al.'s research identified key similarities of prominent adoption models and they built their model after conceptual and empirical analysis of these similarities. The resulting model is presented below.

UTAUT

The Unified Theory of Acceptance and Use of Technology (UTAUT) is the basis for much of the conceptual framework for this current study. It identified four constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions as having a direct role in determining users' acceptance and usage behavior. Three other constructs, attitude toward using technology, self-efficacy, and anxiety, are indirect determinants of intention. Performance expectancy is the extent to which an end user believes that using a new initiative will improve his or her job performance (Venkatesh et al., 2003). This construct was the strongest predictor of behavioral intention in this unified theory and was based on the constructs of perceived usefulness, extrinsic motivation, job-fit, relative advantage, and outcome expectations from contributing models. Effort expectancy, the extent to which an end user believes an initiative is easy to use (Venkatesh et al., 2003), was based on the constructs of perceived ease of use, complexity, and ease of use from contributing models. They believed "self-efficacy and anxiety to be distinct from effort expectancy and have no direct effect on intention above and beyond effort expectancy" (p. 455). Understanding that attitude is an underlying influence on an individual's technology adoption. Venkatesh et al. (2003) define attitude toward using technology as "an individual's overall affective reaction to using a system" (p. 455) and it is reflected in the constructs of performance and effort expectancies.

Social influence is the extent to which others in the environment influence end users and was based on the constructs of subjective norm, social factors, and image from contributing models (Venkatesh et al., 2003). Facilitating conditions are the extent that organizational and technical structures support end users' adoption of initiatives. It is based on the constructs of perceived behavioral control, facilitating conditions, and compatibility from contributing models (Venkatesh et al., 2003). Examples of facilitating conditions include technology hardware and software support, network infrastructure, technology assistance, and professional development.

Venkatesh et al. (2003) tested and validated UTAUT by conducting longitudinal field studies at four organizations among individuals being introduced to a new technology in the workplace. The study's comprehensive questionnaire and its administration across four organizations at three intervals—one post-initial training on the technology then one 3 months post-implementation—allowed for a diverse longitudinal sample. The surveys contained items validated with prior research studies and contained items that represented TRA, TAM, diffusion of innovation, SCT, and three other models. Although the overall sample size (215) was large, the response rate was not reported (Venkatesh et al., 2003). The result of the study was the identification of seven key constructs that were statistically significant determinants of teacher adoption of technology. The UTAUT model supports only four (performance expectancy, effort expectancy, social influence, and facilitating conditions) as having a direct role in determining users' acceptance and usage behavior. The other three (attitude toward using technology, self-efficacy, and anxiety) are theorized not to be direct determinants of intention even though they were demonstrated to be statistically significant. The resultant model reflects the complicated and overlapping influences on an individual's adoption of technology that resonate from multiple levels within the organization and warrant further investigation into these influences. Findings from research that examined technology common in both business and educational settings (Horton et al., 2001; Karahanna et al., 1999; Lai & Chen, 2011; Lewis et al., 2003) suggest that models developed to study adoption in business can be applied to technology adoption in education. Many of the constructs analyzed are not unique to the setting and are instead tied to the individual user's beliefs and practices.

It is valuable for institutions to have tools that are able to predict new technology acceptance/adoption since most technology initiatives have a substantial budgetary impact. These models (TRA, TAM, diffusion of innovation, SCT, and UTAUT) identify valuable determinants and validated instruments for institutional use. Most of the research on adoption models embodies an overreliance on self-reported data, which can impact the validity and reliability of the data. This focus on a single data source demonstrates the need to collect corroborating data representing actual use and improve validity and reliability as demonstrated in Horton et al. (2001).

Teacher Attitudes, Beliefs, and Practices

Most current educators were raised using the traditional industrial instructional model where the teacher is the center of all instruction. Conversely, current educational reform where student-centered instruction and technology are used to support active student learning has been proposed by organizations such as those in the International Society for Technology in Education's National Educational Technology Standards for Teachers (NETS-T) (International Society for Technology in Education [ISTE], 2007). Given the call for reform, it is important to recognize that "beliefs about teaching and learning play an important role in transforming classrooms through the use of technology" (Bai & Ertmer, 2008, p. 94).

Change needs to begin somewhere. Guskey (2002) believed that changes in beliefs follow rather than precede changes in practice. When teachers successfully adopt a new technology, their attitudes toward that practice and their beliefs about the benefits of that practice become more positive. Zhao and Frank (2003) outlined factors that influence teacher technology adoption in two phases from their analysis of technology initiatives in four Midwestern school districts. "In phase one the teacher's perception of the value of the technology may reflect his or her history, pedagogical practices, and so forth, and may include an assessment of the costs associated with use" (Zhao & Frank, 2003, p. 828). Following the Diffusion of Innovations model and the influence of time on adoption and teacher practices they follow, "In the second phase, the teacher and the technology change shapes as they co-evolve. Note that the teacher's modifications are influenced by the help received and by perceived pressure from others" (Zhao & Frank, 2003, p. 828).

Second-order barriers to technology integration identified by Bai and Ertmer (2008) reflected the teachers' belief systems about teaching and learning and their familiar teaching practices. Ertmer (2005) presented three strategies that hold promise for promoting change in teacher beliefs about teaching and learning and beliefs about technology: "(a) personal experiences, (b) vicarious experiences, and (c) social-cultural influences" (p. 32). These reflect the need to engage not just the user but to create an environment that facilitates that engagement when rolling out an initiative.

Performance Expectancy

Performance expectancy is the strongest predictor of behavioral intention in UTAUT (Venkatesh et al., 2003). This was based on the constructs of perceived usefulness, extrinsic motivation, job-fit, relative advantage, and outcome expectations from contributing models. Indirectly included in this construct and effort expectancy is attitude toward technology (Venkatesh et al., 2003). These are expanded below.

Perceived usefulness. Lai and Chen (2011), using a combination of diffusion of innovations and TAM, looked at perceived usefulness as a predictor of technology adoption using blogs. This is a reflection of the value that the technology adds for end users (Davis, 1989). In Lai and Chen's (2011) survey of 325 teachers they posed five questions to capture teachers' beliefs about how blogs enhanced their job performance. They found that the perceived usefulness of using blogs had an influence on teacher adoption of blogs. Teo (2009) found similar results when examining technology attitudes of 475 pre-service teachers in Singapore. Perceived usefulness had a direct effect on behavioral intention to use technology. To capture these data, he asked teachers to respond to three items: using computers will improve my work, using computers will enhance my effectiveness, and using computers will increase my productivity.

Effort Expectancy

Effort expectancy refers to how easy end users believe a new innovation is to use (Venkatesh et al, 2003). This construct is based on perceived ease of use, complexity, and ease of use from contributing models to UTAUT. Additional references to self-efficacy and anxiety were considered contributing factors reflected in teachers' beliefs. These constructs are expanded below.

Perceived ease of use. Lai and Chen (2011) looked at perceived ease of use as a predictor of technology adoption using blogs. This is a reflection of the amount of work that the end users think will take to learn the new technology (Davis, 1989). In Lai and Chen's (2011) survey of 325 teachers they posed four questions to capture teachers' beliefs about how easy it is to use blogs. They found that the perceived ease of use regarding blogs had an influence on teacher adoption of blogs. Teo (2009) also found perceived ease of use had an indirect effect on behavioral intention to use technology in his analysis of 475 surveys completed by pre-service teachers in Singapore. To capture these data he asked teachers to respond to three items: my interaction with computers is clear and understandable, I find it easy to get computers to do what I want them to do, and I find computers easy to use.

Self-efficacy. Self-efficacy is an individual's beliefs about his or her capabilities to produce designated levels of performance that exercise influence over events that affect his or her life (Bandura, 1977). Compeau and Higgins (1995) believed that self-efficacy influences outcome expectations. They found self-efficacy to be comprised of two distinct constructs: performance outcomes, which include items similar to those found in perceived usefulness, and personal outcomes, which are related to how the individual perceives an enhanced status within the organization. Bandura's (2001) Social Cognitive Theory points to the "anticipated self-satisfaction gained from fulfilling valued standards and discontent with substandard performances [which] serve as incentive motivators for action" (p. 267) as attitudes that are associated with self-efficacy. Compeau et al. (1999) spoke of similar beliefs: "Our beliefs about our capabilities to use technology successfully (self-efficacy) are related to our decisions about whether and how much to use technology, and the degree to which we are able to learn from training" (p. 146). This implies that an individual who feels confident in his or her knowledge and use of technology (high self-efficacy) will most likely adopt new technologies.

This relationship was statistically reflected in the findings of Compeau et al. (1999). Their study evaluated the results of a single survey administered twice over the course of a year to a random sample of subscribers to a business periodical. The results were a sample of 394 matched responses that contained data on self-efficacy and outcome expectations. Results demonstrated a positive influence of self-efficacy on performance-related and personal outcome expectations and a negative influence on anxiety. Combining direct and indirect effects, it accounted for 18% of the variance in an individual's usage (Compeau et al., 1999). The large sample size (394) and representation of multiple levels in an organization appear to offer a good sampling, however, the randomness of the selection (subscribers to a business periodical), the overreliance on self-reported data, and the subjects not being educators limit its transferability to education.

Lai and Chen (2001) and Teo (2009) examined self-efficacy in education. Teo focused on teachers' computer self-efficacy. He defined this belief specifically as it relates to computer use. Teo's definition of self-efficacy centered on the idea that this belief influences one's ability to perform a task, the degree of effort used, and the persistency of that effort. His analysis revealed self-efficacy as an influence on perceived usefulness and behavioral intention. Lai and Chen (2011) took a similar approach but focused on knowledge self-efficacy as it pertained to blogs. Their results did not support their hypothesis that knowledge self-efficacy influences blog adoption. Both of these studies relied on participants' responses to four or fewer questions with answers limited by the structure of the instrument. These studies along with those cited earlier under this topic do little to capture responses that are more qualitative in nature that can provide concrete examples supporting this belief (or lack thereof).

Facilitating Conditions

Facilitating conditions refer to the extent that an end user believes that the organization and its infrastructure are there to support the use of the initiative (Venkatesh et al., 2003). This construct is based on the constructs of perceived behavioral control, facilitating conditions, and compatibility from contributing models to UTAUT. These constructs are expanded below.

Compatibility. Rogers (2003) defines compatibility as "the degree to which an innovation is perceived as consistent with the existing values, needs, and past experiences of potential adopters" (p. 15). Zhao and Frank (2003) equate this to an ecosystem and how "the survival of an invading species (technology) is determined not only by its own life history characteristics but also by the compatibility of those characteristics with the new environment" (p. 815). "In spite of the apparent commitment to technology of some schools, it appears that many teachers use computers to support their current traditional teaching practices rather than as a tool to promote more innovative, constructivist practices" (Rakes, Fields, & Cox, 2006, p. 412).

Research suggests that exemplary technology-using educators reside on the constructivist side of the instructional continuum (Becker & Ravitz, 1999; Glover et al., 2007; Kennewell & Beauchamp, 2007; Kennewell et al., 2008) where instruction is more student-centered. However, other studies reported mixed results that suggest other factors might play a more important role in making this change happen (Palak & Walls, 2009; Windschitl & Sahl, 2002). The idea that teachers will change their instructional beliefs and practices toward a more constructivist approach with continued classroom technology use was supported by research (Becker, 1994; Becker & Ravitz, 1999; Levin & Wadmany, 2007; Rakes et al., 2006) and followed Guskey's (2002) findings that suggest changes in beliefs follow a change in practice.

Rakes et al. (2006) studied 186 fourth- and eighth-grade teachers whose school districts also received a federally funded Technology Literacy Challenge grant. Comparing teachers' technology levels (LoTi) and their Current Instructional Practices (CIP), the bivariate correlation (2-tailed) between CIP and LOTI is .40 ($p < .01$). The positive, moderate correlation between CIP and LOTI indicates that teachers who scored higher on the LOTI scored higher on the Current Instructional Practices scale. Although a positive relationship exists, it does not provide sufficient predictive power.

Becker and Ravitz (1999) conducted a large study that analyzed teacher data from 441 questionnaires returned by educators whose schools were part of the National School Network (NSN). This represented a 61% response rate. Their analysis found that for all but two of their measures, the majority of respondents reported changes in the constructivist direction over several years of teaching. Science, social studies, and other noncore teachers increased their use of projects, provided more choice for students of tasks and materials, improved their skills at handling multiple parallel activities, and saw greater student initiative outside of class time (Becker & Ravitz, 1999). This instructional transition was also reflected in data collected by Levin and Wadmany (2007) from long-term case studies (three years). "Three of the four teachers in the study changed their views and practices regarding technology use; however, only one changed from viewing information technology as a tool for supporting traditional teaching, to a view of information technology as a tool for supporting teaching" (p. 169) creating a more constructivist environment.

Supportive of this inconsistency, other researchers (Ertmer, Ottenbreit-Leftwich, & York, 2007; Kennewell et al., 2008) found that teachers who demonstrated exemplary technology use often taught using multiple instructional approaches that reflected their perception of student needs and overruled expected instructional practices. Kennewell et al. (2008) found in their case study of a classroom containing an interactive whiteboard that,

> While technical interactivity is a valuable feature of ICT resources, and can motivate the repetitive practice of skills when the teacher is not present, it is the characteristics of pedagogical interactivity that are more important in stimulating the reflection and intentionality of higher-order learning. (p. 71)

In fact, their findings indicated that the installation of the interactive whiteboard led to more teacher-centered instruction, a move away from constructivism.

Two studies contradict the belief that over time teachers who use technology naturally migrate to a more constructivist approach. Windschitl and Sahl (2002) and Palak and Walls (2009) do not deny that the change occurred. Rather, they simply believe that technology was not the driving force. Windschitl and Sahl (2002) found in their 2-year longitudinal study of three teachers that beyond the actual use of technology, the following had a more powerful influence on teacher beliefs and practices: (a) institutional expectations for technology use, (b) teachers' beliefs about learners and learning, and (c) the host of informal ways in which teachers learn to use technology. Palak and Walls (2009) concluded that in order for teacher beliefs and practices to become more student-centered, the focus on technology integration also needs to incorporate student-centered pedagogy. They theorized that one of the reasons that teachers continue to use teacher-centered practices is because they lack models of technology use to facilitate student-centered learning.

Professional development. Policy makers in the U.S. Department of Education's Office of Educational Technology recognized the importance of professional development on teacher practices in their National Educational Technology Plan. They saw it as having a major role in building the capacity of educators by enabling a shift to a model of connected teaching. In the plan they stated, "Episodic and ineffective professional development needs to be replaced by professional learning that is collaborative, coherent, and continuous" (U.S. Department of Education Office of

Educational Technology, 2010, p. xii). They stated this can be achieved by using online and blended learning systems, on-demand courses, and other self-directed learning opportunities. They recommended that any new implementation of technology follow a program that uses a repeating cycle of implementation, observation and assessment, and improvement.

Mills and Tincher's (2003) evaluation of a technology professional development initiative centered on the practice of setting initiative goals and measuring progress towards meeting those goals. Data were collected from 147 certified teachers via a teacher-completed rubric. This rubric captured self-reported technology integration in classrooms at the beginning and end of the school year. Of the 147 teachers, 46 completed the rubric at the beginning and the end of the year, providing longitudinal data. The rubric contained standards contextualized for the school but based on local, state, and national technology standards and included examples of educational best practices to support these standards. The results showed that teachers used computers to prepare for instruction but there was limited use of computers by teachers to deliver instruction or integrate technology in the classroom. These findings resulted in a change in the district's professional development from skill-based training at multiple levels to a focus on integration skills embedded in operations training (Mills & Tincher, 2003).

Osterman and Kottkamp (2004) explained the disconnect between what we say and what we do using two theories of personal action: espoused theories and theories-in-use. Espoused theories reflect teachers' ideas, intentions, and beliefs. Assumptions are made that a teacher's espoused beliefs guide their actions. If teachers speak about their constructivist beliefs, it is expected that this transfers to their instructional practice. However, we know this is often not the case. Osterman and Kottkamp (2004) believed that, “While it is easy to develop new ways of thinking, these new ideas often remain distanced from and independent of our practice” (p. 9).

The challenge facing those who design and offer professional development is to translate the more explicit espoused theories into implicit theories-in-use. “Theories-in-use directly, persistently, and consistently influence behavior” (Osterman & Kottkamp, 2004, p. 10) and are developed through acculturation. Organizations have expected norms and behaviors. Members of these organizations begin to use these implicit theories-in-use in their practices without full awareness of what they are doing and its effects. “They no longer focus consciously on many of their behaviors or the assumptions behind them” (Osterman & Kottkamp, 2004, p. 10).

An example of the challenge of moving from espoused theories to theories-in-use is highlighted in Holland’s (2001) case study of a middle school that focused their staff development in the areas of technology. Data consisted of field observations and interviews with 61 teachers. Her observations indicated that teachers (especially lower-level technology users) developed their “awareness and knowledge of technology from clearly directive administrative policies and practices” (Holland, 2001, p. 250). In the school studied, the principal had unequivocal expectations that all teachers would learn and use technology and provided release time for their training. Holland believed that professional development for educators at all levels of the integration continuum should be based on what are currently construed as best practices for teachers’ professional development and focus on effective integration over basic skills. Most of the school's professional development at the middle school in her case study focused on skill development. Assumptions were made by the school that once teachers had these skills (espoused) they would naturally integrate (theories-in-use) them into their instruction. Conversely, Holland found that teachers who demonstrated mastery with particular technologies rarely used these technologies in their instruction, identifying the need for professional development to focus on integration verses operational skills. This research and others reinforce that technology use must be supported with professional development and clear expectations of use (Ertmer et al., 2007; Glover et al., 2007; Holland, 2001).

Although workshops are the predominant format for professional development, having choice and flexibility in format and delivery is important to teachers. Ertmer et al. (2007) found in their survey research of 25 educators (52% response rate) that, "more than 76 percent of the teachers (n = 19) in this study identified workshops, seminars, or conferences as their preferred professional development approach. Participants emphasized that these choices were based on relevance and flexibility" (p. 59).

Supporting the idea of focusing on curriculum and not technology skills, Sandholtz and Reilly (2004) concluded that, "while learning about hardware may seem like a logical place to begin, our research suggests that spending as little time as possible on the technology itself leads teachers more quickly to greater and more interesting uses of technology" (p. 507). This is supported by their 5-year case study of a district-wide professional development program that emphasized technology integration over specific technology skills and utilized multiple data sources: documents, surveys, teacher journals, interviews, and observations. This is mirrored in Palak and Walls' (2009) findings from their mixed methods study. After analyzing 138 surveys (82% response rate) of technology-using teachers in technology-rich schools, Palak and Walls conducted a more thorough follow-up with four of these teachers. They analyzed data from a classroom observation, an interview, a lesson plan, and their written reflections to four open-ended questions about their educational beliefs and practices: "We conclude that future technology professional development efforts need to focus on integration of technology into curriculum via student-centered pedagogy while attending to multiple contextual conditions under which teacher practice takes place" (Palak & Walls, 2009, p. 417).

Glover et al. (2007) stated that "Technology alone cannot support educationally effective change" (p. 5), identifying a need for professional development that focuses on changing teachers' pedagogical approaches to a more student-centered approach and includes opportunities for observing practices in action based on their interviews with 27 teachers and their instructional practices with interactive whiteboards. Continued professional development that is designed to support continued teacher growth is supported by many (Ertmer, Gopalakrishnan, & Ross, 2001; Ertmer et al., 2007; Gonzales, Picket, Hupert, & Martin, 2002; Holland (2001); Leh & Grafton, 2008; Passey, 2010). Ertmer et al. (2007) suggested that when facilitating change it might be more practical to start with simple uses of the technology and then build on those successes to achieve more substantial instructional change. Increased confidence in the use of the technology and sharing strategies for use may stimulate teachers to investigate other learning styles. This new wave of professional development in IWBs should take the features of IWBs and embed them into teachers' pedagogical knowledge and reasoning (Kennewell et al., 2008).

In this current study, the train-the-trainer model was the primary professional development method used by the Liberty District to deliver widespread professional development to their faculty and staff. In this model, technology resource teachers (TRTs) were trained on the software and returned to their individual schools to train faculty. Lawless and Pellegrino (2007) supported this model as a way to scale-up interventions in their review of 20 research studies on technology integration professional development. In particular, they singled out the study by Gonzales et al. (2002) on the evaluation of the Regional Technology Assistance Program (RETA).

The Regional Technology Assistance Program (RETA) focused on modeling constructivist practice and integrating technology. This program provided professional development opportunities for teachers and administrators to improve teaching performance, educational leadership, and student learning (Gonzales et al., 2002). Their evaluation of the effects of the RETA program on the teaching practices of 190 teachers revealed that a greater number of teachers (n = 97) changed their instructional practices to include technology as an integrated part of learning compared to 42 at the beginning of the program. A teacher in the study pointed to instruction within the program as a model that she could then "apply in her classroom" (Gonzales et al., 2002, p. 9). Teachers' newfound skills created a desire to expand their instructional collaborations with their peers and assist others with technical problems, furthering the implementation of the instructional model covered in the program.

Environment. Bai and Ertmer (2008) identified lack of access to hardware and software, time, and support as a first-order barrier to integrating technology. However, Ertmer et al. (2007) found that, “Even when resources and time are limited, exemplary teachers achieve effective use, quite possibly because of their strong beliefs, personal visions, and commitment to using technology” (p. 57).

Li (2007) explored environmental influences and their effect on teacher beliefs. She interviewed 15 math and science teachers in Canada about their professional experience integrating technology into teaching and their beliefs about the role of technology in education. These teachers had regular access to technology yet routinely provided excuses as to why they did not use it. “Limited resources and fear that technology would take away ‘real learning’, were two arguments cited by 12 teachers to explain the ‘oversold and underused’ phenomenon” (Li, 2007, p. 377).

Social Influence

Becker (1994) sought to identify characteristics of teachers who were considered exemplary computer users. The Center for Social Organization of Schools at Johns Hopkins University conducted a national probability sample survey of teachers and administrators in roughly 1,400 schools in the United States. Becker pulled data representing 3^{rd}- through 12^{th}-grade teachers of academic subjects from these survey results. Forty-five teachers out of 516 were identified as being exemplary computer-using teachers. He determined that exemplary computer users are more likely to be present where there is, “collegiality among users, school support for using computers for consequential activities, resources allocated to staff development and computer coordination, and smaller class sizes” (p. 291). These findings identified some key environmental and social impacts on teacher technology use that warrant further investigation, including leadership at multiple levels and the influence of peers.

Leadership. Leadership in a district-wide initiative is present at multiple levels within an organization. Additional leaders may emerge in formal and informal ways. In a technology initiative, it is important for leadership to establish goals and communicate those goals throughout the organization (Rogers, 2003). Osterman and Kottkamp (2004) and Bolman and Deal (2003) pointed to challenges to leaders that occur when discrepancies exist between explicit (espoused) and implicit (theories-in-practice) goals in a school. Espoused goals are what individuals say they are doing and why, and theories-in-practice are what individuals are actually doing. Although Bolman and Deal (2003) believed leader’s self-descriptions are often unconnected to their actions, Osterman and Kottkamp (2004) stated that a key to instructional change is the identification assessment of these theories-in-use and changing them to better match the espoused theories and goals.

District level. District technology leadership may have various roles depending on the size of the district. Sugar and Holloman (2009) sought to quantify the leadership responsibilities of a technology coordinator by conducting a mixed method case study of a technology coordinator. Their data consisted of shadowing observations of a school-based technology coordinator conducted by two evaluators during nine separate sessions followed by 35 teacher surveys from those served by the coordinator. The leadership responsibilities of the technology coordinator supported by their findings were resource management and servant leadership, organizational communications, development of others and student centeredness, and systems thinking and corporate vision (Sugar & Holloman, 2009). Although their study focused on a school-based coordinator, they pointed to these criteria being applicable to a district-level coordinator since they identified these responsibilities through a review of the literature that applied to district- and school-level technology coordinators.

School level. Expectations of use become part of the school culture and can be established by the administration but reinforced through structure and faculty and staff interactions. The Project RED (Greaves et al., 2010) study surveyed technology practices in 997 schools during 2009-2010. Their results indicated that the principal is the single most important variable across many of the Education Success Measures analyzed in the study. The principals' impact increases when they are trained in teacher buy-in, best practices, and technology-transformed learning. Greaves et al.'s research methodology consisted of a self-selected sample of public and private schools that responded to a variety of solicitations including a booth at the ISTE conference in 2009, an interview and advertisement in *eSchool News*, and messaging to the Tech and Learning list of education technology readers. Although effort was made to scrub the data and the quantity of responses was substantial, the focus on technology forums and publications to advertise the survey could have resulted in a sample of schools on the higher end of the technology integration continuum. The limitations noted the large number of principals

(485) who served as the primary survey respondent and thus provided a large sample of data tied to this educational role as it relates to technology integration: 48.6% of the total respondents.

Flanagan and Jacobsen (2003) examined the needed for changes in principals' leadership responsibilities in their contextual framework of technology integration leadership. They pointed to a lack of professional development and informed leadership in preparing principals for the new role of technology leaders. They identified several emerging principal responsibilities, including being the leader of learning, student entitlement, capacity building, community, and resource management. They based these responsibilities on the Calgary Board of Education's Leadership Development Program (Flanagan & Jacobsen, 2003).

Moos, Krejsler, and Kofod (2008) conducted a cross-cutting text analysis of case studies from eight countries. They found that principals in countries with tight accountability systems, like the U.S., have leadership styles that tend to focus on direct influence and on institutionalized forms of power. In other words, the principals do more "telling" when it comes to directing practices in their schools. This could reflect their lack of participation in technology policy making. Nance (2003) found in his survey study of 258 (60% response rate) Midwestern school administrators that although principals were "moderately involved in educational technology policy making in their buildings, they have little to moderate involvement in their districts" (p. 457).

It is not enough to be in charge; principals also need support during technology initiatives. Hayes (2006) found in her five longitudinal case studies of the principal's role in information and communication technology (ICT) integration that "ICT integration is highly dependent upon strong social and professional networks between school leaders" (p. 576). Additionally Dawson and Rakes (2003) identified professional development needs of principals to prepare them to be implementation leaders for initiatives. This professional development should also be responsive to contextual challenges at their individual schools.

Lai and Chen (2011) included supervisor influence in their analysis of influences on teacher adoption of blogs. Their study showed that, "supervisor influence did not affect the decision to adopt teaching blogs" (p. 957). However, teachers in Ertmer et al.'s (2007) survey felt that in being the educational leaders within their school, principals need to support teachers' technology use through the provision of "relevant training opportunities and ongoing support" (p. 59). Windschitl and Sahl (2002) reported similar needs for support from participants who, at the beginning of a ubiquitous initiative were empowered by "explicitly formal institutional support for technology" (p. 198), but when that leadership left, found that support was continued through a "network of informal social interaction among faculty" (p. 198).

Peers. "A critical mass of adopters is needed to convince 'mainstream' teachers of the technology's efficacy, regular and frequent use is needed to ensure appropriate success" (Schrum & Levin, 2009, p. 105). Gladwell (2002) in *The Tipping Point*, identified similar paths of social adoption when innovations break at the national level. Gladwell's Law of the Few describes how the "success of any kind of social epidemic is heavily dependent on the involvement of people with a particular and rare set of social gifts" (p. 33). Ertmer et al. (2001) observed and interviewed 17 teachers who were identified as exemplary technology-using teachers by their principals. They found that teachers who demonstrated exemplary technology skills helped to create collaborative working environments within their schools which in turn brought other colleagues on board.

Windschitl and Stahl (2002) found in their 2-year ethnographic study of three middle school teachers that school culture and expectations are powerful motivators of instructional change. These environmental influences were described by a seventh-grade social studies teacher as "an institutional memory that seems alive and well and is passed along by all the building's teachers—the more senior teachers" (p. 176). Although not always a direct communication, the power of social interactions and observations can change teacher beliefs and practices. That same teacher spoke about how after arriving at the school she began to question her views on assessments and whether they were adequate measures of her students' learning (Windschitl & Sahl, 2002). Zhao and Frank (2003) found similar influences in their examination of four districts in the Midwest that were implementing new technology initiatives: "Teachers who perceived pressure from colleagues were more likely to use computers for their own purposes, and teachers who received help from colleagues were more likely to use computers with their students" (p. 825).

Communication

Rogers' (2003) definition of *communication* relies on a system of communication channels and how they work: "The nature of the information exchange relationship between a pair of individuals determines the conditions under which a source will or will not transmit the innovation to the receiver and the effect of such a transfer" (p. 18). The research examined for this current literature review often included the Diffusion of Innovations model but no studies addressed the role communication channels had in the success or failure of technology adoption. There were, however, multiple instances where participants pointed to sharing with their peers as a supportive measure for technology adoption (Glover et al., 2007; Moos et al., 2008; Windschitl & Sahl, 2002; Zhao & Frank, 2003).

Expanded Conceptual Framework

Based on this review of literature, the conceptual framework from Chapter 1 was expanded to reflect a comprehensive lens to guide the study. In order to understand the Liberty District's innovation, the literature points to four areas of importance: the innovation; teachers' beliefs, attitudes, and practices; the context of the innovation; and the communication process. Figure 2 highlights the expanded influences on teacher technology use in a district-wide technology initiative derived from the literature reviewed.

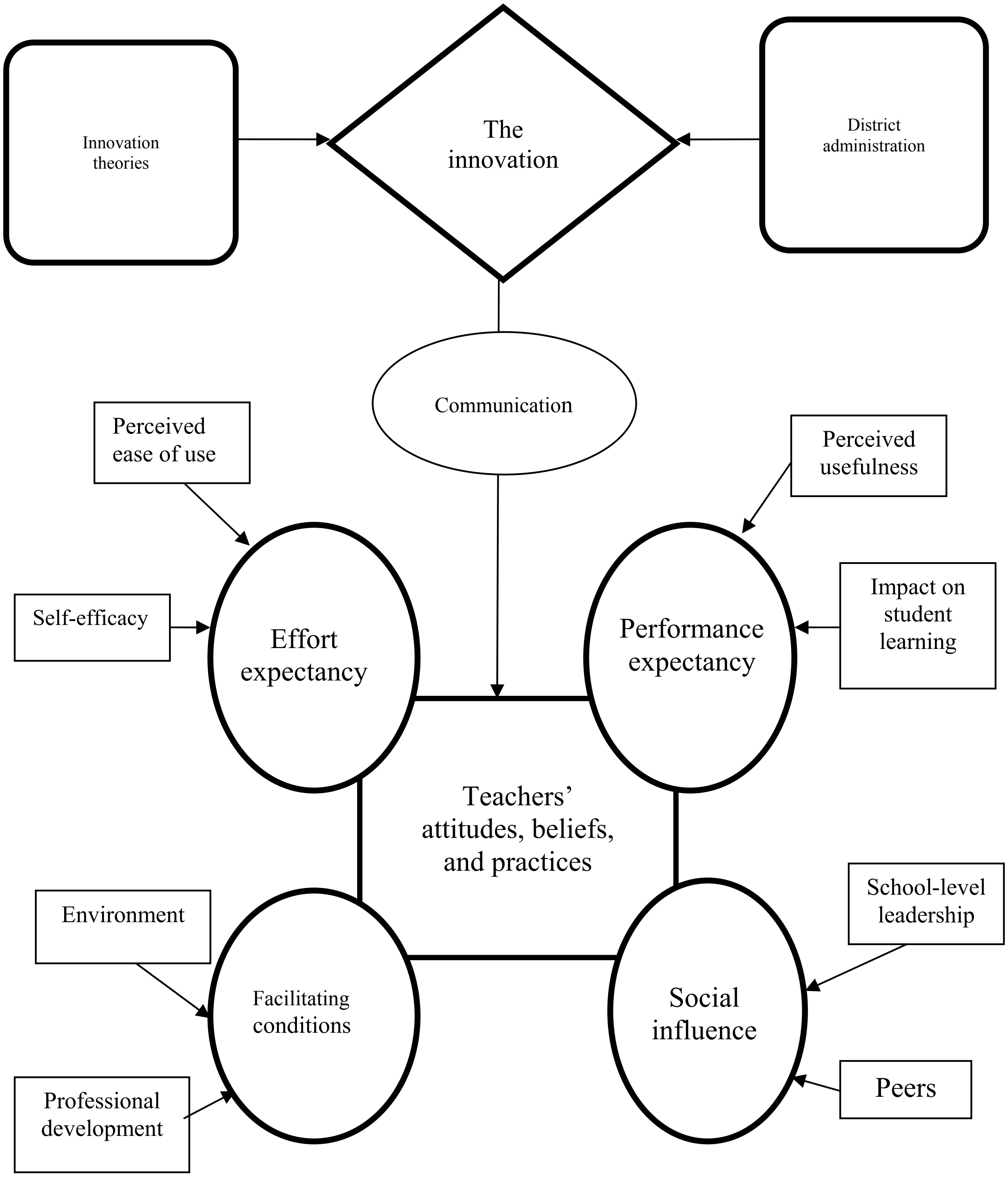

Figure 2. Expanded influences on teacher technology use in a district-wide technology initiative.

The Innovation

In order to understand a technology initiative, initial attention must be focused on what occurred as a result of the initiative. Was the technology used? Research on interactive whiteboard use points to its impact on teacher pedagogy, moving towards a more interactive environment (Glover et al., 2007; Miller et al., 2005). It cautions that many of the observed uses of the interactive whiteboard are tied to the technology's functionality and not to pedagogical approaches.

Other research on educational technology suggests that exemplary technology-using teachers reside on the constructivist side of the instructional continuum, resulting in a more student-centered approach to instruction (Becker & Ravits, 1999; Glover et al., 2007; Kennewell & Beauchamp, 2007; Kennewell et al., 2008). Contrary to those findings, other research suggests that use is tied to compatibility (Rogers, 2003) and often results in teachers using technology to support their current traditional practices instead of moving to a more innovative and constructivist approach (Rakes et al., 2006). Therefore, this current study focused not only on whether teachers were using the technology (use and practices), but how they were using the technology to support their instruction (instructional organization and instructional strategy use). Guskey (2002) believed that changes in beliefs follow rather than precede changes in practice, contradicting the research of Bai and Ertmer (2008) and Zhao and Frank (2003). Therefore, a second area of focus for this study was the influences of the technology on teachers' beliefs and attitudes and how those beliefs and attitudes shaped practices.

Teachers' Beliefs, Attitudes, and Practices

Once it is understood what happened during an initiative, it is important to understand why it happened. In order to change teachers' practices, Bai and Ertmer (2008) and Zhao and Frank (2003) believed it was important to first change teachers' beliefs and attitudes, although Guskey (2002) believed that the flow of change starts with a change in practices. Venkatesh et al.'s (2003) research on technology adoption models identified two constructs that represented end users' beliefs and attitudes as part of their comprehensive theory predicting technology adoption. The Unified Theory of Acceptance and Use of Technology (UTAUT) identified performance expectancy and effort expectancy (Venkatesh et al., 2003) as having direct roles in determining end users' acceptance and usage behavior.

Performance expectancy is the strongest predictor and represents those beliefs that an end user has about how the technology will support or improve his or her job performance (Venkatesh et al., 2003). Lai and Chen's (2011) and Teo's (2009) research identified perceived usefulness as an important component in determining performance expectancy. Venkatesh et al.'s (2003) research suggests that data used to evaluate performance expectancy can be captured by focusing on the contributions of perceived usefulness, extrinsic motivation, job-fit, relative advantage, and outcome expectations.

Effort expectancy is a more complex construct. Perceived ease of use and self-efficacy were two main contributing factors that influenced an end user's belief about how easy a new technology was to use (Venkatesh et al., 2003). Lai and Chen (2011) and Teo (2009) found that the higher the perceived ease of use, the higher the teacher adoption of a new technology (i.e. the less work it would take the teacher to adopt the technology). Teachers' high self-efficacy beliefs were found by Bandura (1977), Compeau and Higgins (1995), and Compeau et al. (1999) to be a predictor of end user adoption and were partially based on their past experiences with technology. Teo's (2009) research determined that end users' beliefs in their ability to perform a task, the degree of effort used, and the persistency of that effort were good measures of self-efficacy.

The Context of the Innovation

Teacher practices do not happen in isolation. They are a part of a larger social structure and are influenced by their environment. Venkatesh et al.'s (2003) UTAUT identified facilitating conditions and social influence as two contextual constructs that have direct influence on end users' adoption of technology. Therefore, for this current study it was important to look at the context of the innovation and how that impacted teachers' beliefs, attitudes, and practices.

Facilitating conditions are a representation of how well the organizational infrastructure supports the initiative (Venkatesh et al., 2003). Important in understanding facilitating conditions is the evaluation of the technology's compatibility with existing structures, the role of professional development, and the impact of the physical environment on teacher's practices.

Rogers (2003) believed that the compatibility of a technology to fit within the existing values, needs, and past experiences of potential end users is a major contributor to the adoption process. Zhao and Frank (2003) and Rakes et al. (2006) agreed and found that problems arose when the new technology was in contrast to the existing environment. Therefore, this current study examined how well the new technology fit within existing practices and whether changes reflected a change in existing norms. A caution was raised from Ertmer et al.'s (2007) and Kennewell et al.'s (2008) research which found that teachers often used multiple instructional approaches, making assumptions about changes in practices difficult.

A challenge facing those who design and offer professional development is to translate explicit espoused theories into implicit theories-in-use (Osterman & Kottkamp, 2004). The majority of professional development on educational technology is focused on skills acquisition and not instructional integration. This results in teachers who know how to use the technology but do not use it in their instruction (Glover et al., 2007; Holland, 2001; Leh & Grafton, 2008; Palak & Walls, 2009; Sandholtz & Reilly, 2004). Therefore, this current study looked at the design of the professional development delivered during the initiative and how it impacted teacher beliefs, attitudes, and practices—and whether these outcomes fit with the goals of the initiative.

Bai and Ertmer (2008) identified lack of access to hardware and software, time, and support as a first order barrier to integrating technology. If the technology is not functional, teachers will not use it; if no one is around to help they will discard it for something with which they are more comfortable. Therefore, it was important in this current study to look at what kind of support was available to the end users and what kind of structures were in place to assist teachers in using the technology.

Social influence is the impact that end users' peer groups and extended social environment have on their technology adoption (Venkatesh et al., 2003). Expectations of use become part of the school culture and can be established by the administration but reinforced through structure and faculty and staff interactions. Windschitl and Sahl (2002) and Palak and Walls (2009) found that beyond the actual use of technology there were additional influences on teachers' beliefs and practices. Ertmer et al. (2007) and Windschitl and Sahl (2002) pointed to principals and other school leaders as having a major role in supporting technology use in their schools, although Lai and Chen's (2011) findings revealed no such evidence.

Although not always a direct communication, the power of social interactions and observations can change teacher beliefs and practices (Windschitl & Stahl, 2002). Zhao and Frank (2003) and Ertmer et al. (2001) reported that in schools where teachers supported each other's use of technology there were a higher number of technology-using educators. Often this is predicated on the ability of a few influential individuals to motivate the masses (Gladwell, 2002). Therefore, this current study looked at how interactions with peers influenced teachers' adoption of the interactive whiteboard.

Communication Process

The Diffusion of Innovations model identified communication and the establishment and use of clear communication channels as essential to the successful rollout of any initiative (Rogers, 2003). Gladwell (2002) spoke of similar pathways to implementation and adoption. Frank et al. (2004) highlighted the need for any innovation to take advantage of established social capital processes, and Rogers (2003) additionally included addressing the needs and support required at multiple levels within the organization. Therefore, this current study looked at how the communication process was initiated and what channels and existing structures were utilized throughout the implementation to ensure success.

Explained and anchored in the literature, this chapter reviewed and concluded with the comprehensive conceptual framework that guided this current research study. The framework incorporated the UTAUT model for technology adoption and its constructs, which guided the methods and analysis for this study. Phase one's methods and results are detailed in chapters three and four and phase two's methods and results are detailed in chapters five and six.

3. METHODS FOR PHASE ONE

Chapter three outlines the methods for phase one of this study. Analysis of these data follows in chapter four. The methods in this chapter were centered on establishing instruments for collecting data that helped answer research questions one, two, and three. Data collection methods were designed to generate multiple measures of teachers' beliefs, attitudes, and practices and were the product of a mixed methods approach.

Design

This was a case study of a district-wide technology initiative that installed interactive whiteboards in all classrooms in 11 middle schools in Liberty District. A case study was selected for this research design because it allowed the researcher to retain the holistic and meaningful characteristics of the initiative at multiple levels as it unfolded throughout the organization. Many of the research questions required an in-depth description of some social phenomenon (Yin, 2009). The study was designed using an embedded case study design where the focus was on the district-wide initiative but attention was also given to how the initiative manifested itself at the school level (Yin, 2009). The mixed methods interactive design approach (Maxwell, 2005) focused on integrating the "primary components of inquiry design (inquiry purposes, conceptual framework, inquiry questions, validity strategies, and methods) in a networked or web-like association" (Greene, 2007, p. 130).

Driving this methodology was a focus on obtaining complementary sources of valid and reliable data (Yin, 2009) that best answered the research questions with quantitative data representing what was happening in the classrooms as a result of this initiative and rich qualitative data that helped to theorize why it happened. This blending of variance theory with process theory provided a more complete representation of the initiative's impact (Maxwell, 2005). This case study was designed to capture data that described how the initiative manifested itself in teachers' attitudes, beliefs, and instructional practices followed by data that explained the intent of the initiative and how this intent was interpreted by all stakeholders. Important at each level was examination of the initiative from existing documents, observable actions, and the perspective of stakeholders.

Liberty District is a technology leader in K-12 education, named by the National School Board Association as a School to Watch in 2006. My position as a Staff Development Trainer within the Instructional Services Department allowed me to be involved in this initiative as it rolled out. Since this was Liberty's second such interactive whiteboard initiative, there was a desire to capture data on how the initiative progressed, and my position within the department positioned me to capture these data.

This study was conducted in two phases. Phase one examined how the initiative manifested itself in the schools. This phase was completed during the spring and summer semesters of 2009, the first semesters of the initiative's implementation. It used walk-throughs, observations, teacher interviews, and teacher survey data. Phase two examined how the initiative was interpreted by multiple levels of stakeholders and whether these interpretations were consistent with the intent of the initiative. This phase occurred 18 months after the initiative's implementation. It was developed as a result of analyses of phase one data and used technology administrator interviews, middle school principal interviews, technology resource teacher interviews, follow-up teacher interviews, and supporting documents.

Phase one's examination of the initiative's manifestation required a comprehensive look at what happened in classrooms and examined possible reasons why. Walk-throughs were completed to capture data descriptive of technology use within all of the schools. To expand on the brevity of classroom exposure in the walk-throughs, additional data on classroom practices were collected. This supportive evidence was achieved through extended observations (20 minutes) of purposely selected classrooms representing teachers at different technology levels (novice, intermediate, and advanced). Data that described teachers' beliefs and attitudes were captured with an online survey and follow-up interviews with a selected number of observed teachers. This provided teacher perspectives about their behaviors in the classroom and additional insight into how the initiative was interpreted at the classroom level. Phase one methods are outlined below.

Phase two used findings from phase one to examine the initiative and its impacts through the lens of those stakeholders who initiated and supported the initiative. Focus on determination of the initiative's intent required a review of the School Board's meeting notes and interviews conducted with the initiative's key decision makers including the Director of Instructional Technology and the Supervisor of Technology

Resource Teachers. Selected middle school principals and technology resource teachers were interviewed to examine how the initiative was communicated and interpreted at the school level and further disseminated to individual staff. By capturing these data, depictions were made about administrative expectations for the initiative and how it would manifest in the classroom. Examination of the communication process and views of the stakeholders at this level provided evidence reflecting how this vision was communicated from administration to individual schools and their teachers. Phase two methods are outlined in Chapter 5. Since the initiative focused on the rollout of the Promethean brand of interactive whiteboard, from this point hence the generic term *interactive whiteboard* will be replaced with the *Promethean board*.

Research Questions

In order to address the goal of this study to better understand the impact a district-wide technology initiative involving Promethean boards had on teachers' attitudes, beliefs, and practices and whether this impact was consistent with the overall goals of the initiative, hypotheses were formulated. The research questions and hypotheses that informed phase one of this study were:

1. Are there changes in teachers' observed instructional practices from the beginning to the end of the semester when a Promethean board initiative was rolled out, and if so, what are they? In order to answer this question, six hypotheses were formulated:

   H1. As the initiative proceeded, use of the Promethean board by teachers would increase.

H2. As the initiative proceeded, overall use of competing presentation tools would decrease.

H3. As the initiative proceeded, overall use of other technology tools would remain constant.

H4. As the initiative proceeded, a higher percentage of teacher time would be spent using the Promethean board

H5. Teacher instructional activity organization would not change as a result of the initiative.

H6. Teacher instructional strategy use would not change as a result of the initiative.

2. What changes do teachers report in their instructional practices as a result of a district-wide technology initiative involving Promethean boards?

   a. If no changes are reported, what reasons are given?

   b. Are these changes consistent with observed instructional practices?

   H1. Teacher use of Safari Montage would increase over the course of the initiative.

3. What do teachers report as having impacts on their adoption of new technology?

Participants/Data

Data needed to be collected to reflect how the initiative translated into teacher beliefs and attitudes and how these manifested in their behaviors. The goal was to gather as large a data set as possible. Time constraints and feasibility resulted in a top-down data collection method where sample size and quantity of data collected were inversely related. A large proportion of the data consisted of periphery walk-throughs of each school where the majority of classrooms (1,127) were observed at three different times over the semester. This was followed by a smaller, purposeful sample of 97 teachers whose classrooms were observed for 20 minutes at three different times over the semester. These teachers were selected by the school principal and TRT to equally represent teachers who demonstrate novice, intermediate, and advanced technology skills in their school. The majority of these teachers (74%) also completed an online survey. Finally, a selected teacher from each school was interviewed for 20 to 45 minutes. Complete descriptions about how these samples were selected are included in the descriptions of the individual data sets which follow.

Walk-Through Data Set

Getting a snapshot of what was going on in each school was best achieved by observing as many classrooms as possible. Thus, walk-throughs were completed at each school. The walk-through focused on quickly gathering a small amount of observable data from every classroom during an instructional period. The sample for the walk-through data set consisted of all of the teachers in 11 middle schools who were teaching during the identified instructional block when the walk-through was scheduled. Teachers had one 90-minute planning period scheduled during each instructional day, which contained four instructional 90-minute blocks. Therefore, the observed faculty sample represented approximately three quarters of the instructional staff at the school.

The researcher observed a total of 1,127 classrooms: 303 language arts classrooms, 221 math classrooms, 218 science classrooms, 183 social studies classrooms, and 202 classrooms teaching subjects other than the four core curriculum. Training for completing these walk-throughs consisted of reviewing the protocols established by SETDA with the Instructional Services Department leadership and establishing procedures for notifying the schools and conducting the walk-throughs. The protocols required the researcher to spend approximately one to two minutes observing each classroom and marking fields on the walk-through form that captured technology use. These classrooms are presented in Table 2.

Table 2

Walk-Through Classrooms

Middle School	Language Arts	Math	Science	Social Studies	Other	Total
01	24	19	14	11	27	95
02	30	15	24	19	20	108
03	26	26	20	18	14	114
04	29	23	27	22	25	126
05	23	16	21	17	25	102
06	29	16	21	15	20	101
07	26	9	18	15	19	87
08	28	16	20	9	12	85
09	24	27	26	18	9	104
10	29	31	14	16	15	105
11	25	23	13	23	16	100
Totals	303	221	218	183	202	1,127

Observation Data Set

Capturing what was going on in each of the entire schools was important. Gathering more in-depth data over a longer instructional period of time (20 minutes) to provide a richer data set that included additional instructional context and a more complete picture of teacher behaviors was also necessary. The sample in the observation data set consisted of 97 teachers selected by the school's principal and technology resource teacher (TRT) at 11 middle schools. This purposeful sample of teachers was made to ensure composition represented three levels of technology skills equally: novice (31 teachers), intermediate (33 teachers), and advanced (33 teachers) as measured by the principal and TRT's professional opinion. No external standard was used to differentiate these levels.

Each of the 11 schools' TRTs and principals were asked by the researcher to select three teachers who represented each of the technology skill levels (advanced, intermediate, and novice) and to make sure that the majority of the nine teachers selected represented the four core curriculum areas (math, language arts, science, and social studies). Technology levels were assigned based upon the recommendations of the principal and school's TRT. Each TRT's advanced education (most hold a master's in Education with an emphasis on instructional technology) and experience working with technology provide contextual knowledge of the characteristic traits of a novice, intermediate, and advanced user of technology in their school. This, along with their working relationship with teachers and their primary role as a professional developer (especially with technology), made them the most informed about their staff's current technology levels. The building principal and TRT assisted the researcher in obtaining permission from these teachers to allow the researcher to observe their classrooms at three different periods over the course of the spring 2009 semester.

The researcher observed 97 teachers: 23 math teachers, 25 social studies teachers, 16 science teachers, 25 language arts teachers, and 8 teachers who taught something other than the four core curriculum areas. These eight teachers included a gifted teacher, an art teacher, an ESL teacher, a reading specialist, and four foreign language teachers. These data are presented in Table 3. Training for completing these observations consisted of reviewing the protocols established by SETDA with the Instructional Services Department leadership and establishing procedures for notifying the schools and conducting the observations. The protocols required the researcher to spend approximately 20 minutes observing each classroom and marking fields on the observation form that captured technology use and instructional practices.

Table 3

Observation Classrooms

Academic subject and number of classrooms (97)	Teacher a novice technology user (31)	Teacher an intermediate technology user (33)	Teacher an advanced technology user (33)
Math (23)	8	3	12
Social Studies (25)	7	13	5
Science (16)	3	7	6
Language Arts (25)	10	8	7
Other (8)	3	2	3

Teacher Survey Data Set

Demographic background information on the observational data set, along with preliminary data on teacher beliefs and attitudes, were not captured during the observations. Therefore, an online survey was created in consultation with the Instructional Services Department of Liberty District to gather information that better described the observation data set. The sample in the teacher survey data set consisted of 72 of the 97 teachers from the observation data set who completed a 15-question online survey at the end of the observation period (a 74.2% response rate). These data are presented in Table 4.

Table 4

Survey Respondents

Academic subject and number of teachers (72)	Teacher a novice technology user (21)	Teacher an intermediate technology user (23)	Teacher an advanced technology user (28)
Math (18)	4	3	11
Social Studies (17)	4	10	3
Science (10)	2	3	5
Language Arts (19)	8	5	6
Other (8)	3	2	3

Teacher Interview Data Set

The walk-throughs and observations captured a rich picture of teacher practices but further study was needed to obtain insight into the beliefs and attitudes that drove those practices and could not overtly be observed. Building on the survey results, interviews with selected participants were conducted in order to reveal the underlying beliefs and attitudes that shaped teachers' practices. The sample for the teacher interviews was selected from the 97 teachers who were part of the population observed regularly over the semester. The interview data set consisted of 10 teachers representing 10 of the 11 middle schools. These 10 teachers agreed to be interviewed about their experiences with the Promethean board initiative at the conclusion of the spring 2009 semester.

The initial sample was purposely selected to equally represent teachers at the three technology levels (novice, intermediate, and advanced) and represent each of the schools. An inadequate response rate required expansion of the sample set. Equal representation of the technology levels was dropped as selection criteria in order to achieve an adequate sample size that represented each of the schools. Middle school 04 did not have a teacher representative in the interview sample set.

The researcher interviewed 10 teachers: 4 teachers with high technology skills, 5 teachers with intermediate technology skills, and 1 teacher with novice technology skills. Three of these teachers taught science, 5 taught social studies, 1 taught math, and 1 taught language arts. These data are presented in Table 5. Training for completing these interviews consisted of reviewing the protocols established by SETDA with the Instructional Services Department leadership and establishing procedures for notifying the teachers and conducting the interviews. The researcher had previously been trained to conduct interviews by the Research Department of Liberty District.

Table 5

Interview Participants

Academic subject and number of teachers (10)	Teacher a novice technology user (1)	Teacher an intermediate technology user (5)	Teacher an advanced technology user (4)
Math (1)	0	1	0
Social Studies (5)	0	3	2
Science (3)	1	0	2
Language Arts (1)	0	1	0
Other (0)	0	0	0

Instruments

Walk-Through and Observation Instrument

The walk-through and observation instruments (Appendices A and B) used for the Liberty District walk-through data collection were adapted from a comprehensive suite of tools developed by The Metiri Group for the State Educational Technology Directors Association (SETDA) to capture technology use in schools. The initial walk-through instrument captured room number, subject, teacher using technology, student using technology, and the type of software technology(ies) used (State Educational Technology Directors Association [SETDA], 2004). The initial observation instrument captured school, date, grade level, subject area(s), description of the unit, duration (start and stop time), participant numbers, technology used by teachers and students, types of software used by teachers and students, classroom setting, pattern of access to technology, average length of time using technology, proportion of students using technology, and summary description of the lesson and major activities (SETDA, 2004).

These tools were designed to collect technology use as part of a technology audit and did not include measures for instructional practices or instructional organization. Therefore, modifications were made using fields to measure instructional practices and organization based on Leh and Grafton's (2008) instrument developed by the American Institute of Research and modified for their study. These modifications are specified in the descriptions of each instrument.

The original instruments were field tested by SETDA in 14 schools from three states. Site visitors were trained on the protocols (walk-throughs and observations) and scoring guidelines and went into schools as pairs and independently rated each indicator. Comparison of the ratings revealed that, on average, the reviewers agreed on 29 of the 34 indicators and agreed within one point on virtually every indicator (all but three of the 476 pairs) (SETDA, 2004). No documentation of field testing was contained in Leh and Grafton's (2008) summary of their research. The modified SETDA instruments were not field tested for this study.

Walk-through form. Two additions were made to the walk-through form based on a data collection instrument developed by the American Institute of Research and modified by Leh and Grafton (2008). The added fields enabled the capture of data that provided further classroom details at the time of the walk-through. The fields added were the organization of the activity (teacher-led, student-led, small group or pair cooperative, or independent activity) and the organization of the classroom (traditional rows, small clusters of three to five desks, a lab, desks arranged so that students face each other, or desks in circles or semicircles).

Additional descriptive fields were added to the walk-through form in consultation with Liberty District's Instructional Services Department leadership and Dr. Priscilla Norton of George Mason University. These fields included the grade level being observed, the time of the observation, and the hardware used. Collection of data regarding grade level supported a breakdown of the data beyond school and subject area. The time documentation of the observation supported an analysis of technology use at different points in the instructional period (beginning, middle, and end of the instructional block), and the type of hardware informed Instructional Services whether the Promethean board or other hardware were being used.

No additional statistical tests were done to assess validity. It was assumed that adding the five data fields had minimal impact on the reliability and validity of the instrument since the protocol for collecting the data was not impacted and the collected data served to create a richer picture of what was observed about technology use and instructional organization in the classroom.

Observation form. Five additions were made to the observation form based on a data collection instrument developed by the American Institute of Research and modified by Leh and Grafton (2008). The added fields enabled the capture of data that provided further classroom details at the time of the observation. The fields added were the organization of the activity (teacher-led, student-led, small group or pair cooperative, or independent activity), teacher activities (presenting information, leading student work, supporting student work, providing feedback for students, and evaluating progress), student focus (whole class led by instructor, whole class interactive, student or group presentation, individual reading or work, pair work, and interactive group work on a project), technology use by teachers (no technology used, 1-25% teacher time using technology use, 25-50% teacher time using technology, 51-75% teacher time using technology, or 76-100% teacher time using technology), and technology use by students (no technology used, 1-25% student time using technology use, 25-50% student time using technology, 51-75% student time using technology, or 76-100% student time using technology).

Two additional descriptive fields were added to the observation form in consultation with the Liberty District's Instructional Services Department and Dr. Priscilla Norton of George Mason University. These fields included teacher demonstrated technology skills and specifics regarding evidence of research-based practices. The teacher demonstrated technology skills (teacher demonstrated novice technology skills, teacher demonstrated moderate technology skills, or teacher demonstrated advanced technology skills) were used to capture each teacher's level of technology use during the observed lesson. The use of research-based instructional strategies used by teachers was expanded beyond a simple yes/no to include specific strategies identified by Marzano, Pickering, and Pollock (2001) that are widely accepted and emphasized in the district. They include identifying similarities and differences; summarizing and note taking; reinforcing effort and providing recognition; homework and practice; nonlinguistic representations; cooperative learning; setting objectives and providing feedback; generating and testing hypothesis; and cues, questions and advanced organizers (Marzano et al., 2001).

No additional statistical tests were done to assess validity. It was assumed that adding the five data fields had minimal impact on the reliability and validity of the instrument since the protocol for collecting the data was not impacted and the collected data served to create a richer picture of what was observed about technology use and instructional practices in the classroom.

Several data fields were removed from the observation protocol since they did not collect evidence relative to the county's purpose and observation time was insufficient to capture data reflective of the entire lesson. These fields included: classroom management, effective practice indicators, educator proficiencies, robust access indicators, impact on student learning (21^{st} century skills, proficiencies, or dispositions), and student impact indicators.

Teacher Survey

The teacher survey (Appendix C) was designed to capture demographic data from the teachers who were part of the observation data sample, a quick snapshot of the professional development that was used by the participant, and to allow a second competing measure of the teachers' beliefs, attitudes, and behaviors regarding the Promethean board that could be used in conjunction with the observations and teacher interviews to provide a more robust data set.

The 15-question survey was approved by Liberty District's Instructional Services Department for construct validity by examining the questions and their intended purpose (Creswell, 2008). Questions 1 through 4 asked basic demographic data about the participants and did not serve to answer a specific research question but could be used to provide a richer description of the participants. Questions 5, 6, and 7 asked for self-reported attendance in professional development activities which could be verified if needed by cross-checking with workshop sign-in sheets and course completion verification from the vendor. Information from these questions provided a fairly complete reflection of what district-sponsored professional development activities were used by the participant. Questions 8, 9, and 10 asked teachers to self-report on their technology skill level and their use of the hardware and software associated with the IWB. These data served as a comparison to the observation data set. Consistencies or inconsistencies in these two data sets served as starting points for further investigation. Questions 11 through 15 of the survey captured teachers' self-reported attitudes, beliefs, and practices when using the IWB. These data served as a supplement to the interview data set. Consistencies or inconsistencies in these two data sets served as starting points for further investigation.

Teacher Interview Protocol

The interview protocol (Appendix D) was developed in consultation with Liberty District's Instructional Services Department to capture qualitative data on teachers' attitudes, beliefs, and practices towards instruction and Promethean boards. Interviews were structured to last between 15 and 45 minutes and were conducted at the end of the 2009 spring semester and during the 2009 summer semester using a LiveScribe pen to capture audio and interview notes. The interview was designed to capture teacher experiences that influenced teacher beliefs and attitudes towards instructional technology. These influences included but were not limited to expectations regarding use, actions and performances of their peers, professional development opportunities, teachers' self-efficacy beliefs, prior experiences with technology, and the functionality of the technology. The questions were designed to spark conversations. Therefore, additional clarifications and changes in protocol occurred during the interviews when further exploration and explanation were warranted.

The first question captured what expectations the teacher was aware of regarding his or her use of Promethean boards. Question two and its subquestions captured specifics about the teacher's instructional beliefs and practices with technology in the past and the technology associated with the Promethean. Question three and its subquestions captured specifics about the teacher's self-efficacy beliefs, prior experiences with technology, performance of their peers, and professional development opportunities. Questions four, five, and six and their subquestions captured specifics about instructional beliefs and practices with technology and the teacher's interpretations about how the initiative was being adopted in his or her particular school.

Data Collection

The phase one data set was collected as part of my role as a Staff Development Trainer with the Liberty District. This data collection and its processes occurred under the supervision of the Department of Instructional Services and its leadership. During this study's Human Subjects Review Board (HSRB) process for George Mason University, permission was asked of Liberty District to use this existing data set. Permission was granted by the Liberty District's Research Department and Assistant

Superintendent for Instruction. This permission, along with an explanation of the data, was submitted to George Mason University's HSRB and approved for use in this study.

Walk-Through Data Collection

The walk-through process was initiated by an email sent from the Director of Instructional Services and the Supervisor of Technology Resource Teachers to the middle school principals informing them of the process and containing a sample message (Appendix E) they could send to their staff clarifying the process and the intent of the study.

The walk-throughs occurred at three intervals throughout the spring 2009 semester. The first walk-though occurred within the 2-week interval surrounding the board installations. This window allowed the observation of classrooms when teachers had little or no experience and training on using the Promethean boards and was a reflection of their teaching practices prior to their adoption of this new technology. The second walk-through occurred between weeks 5 and 7 of the initiative. The exception was school 01 which had its second walk-through 3 weeks after the first. The third walk-though occurred at all schools approximately 12 to 14 weeks after the first walk-through. The walk-through schedule for the schools is presented in Table 6.

Table 6

School Walk-Throughs Schedule

School	Interactive Whiteboard (IWB) installation	First walk-through	Second walk-through	Third walk-through
01	1/5/09-1/13/09	1/13/09	2/3/09 (3 weeks)	4/14/09 (13 weeks)
02	1/5/09-1/13/09	1/12/09	2/19/09 (5 weeks)	4/15/09 (13 weeks)
03	1/14/09-1/20/09	1/14/09	3/9/09 (7 weeks)	4/16/09 (13 weeks)
04	1/14/09-1/21/09	1/15/09	3/10/09 (7 weeks)	4/17/09 (13 weeks)
05	1/21/09-1/27/09	1/24/09	3/4/09 (6 weeks)	4/27/09 (14 weeks)
06	1/22/09-1/29/09	1/26/09	3/5/09 (6 weeks)	4/28/09 (14 weeks)
07	1/28/09-2/3/09	2/2/09	3/16/09 (6 weeks)	4/29/09 (13 weeks)
08	1/30/09-2/6/09	2/5/09	3/18/09 (6 weeks)	4/30/09 (12 weeks)
09	2/9/09-2/17/09	2/9/09	3/19/09 (5 weeks)	5/01/09 (12 weeks)
10	2/9/09-2/16/09	2/11/09	3/23/09 (6 weeks)	5/04/09 (12 weeks)
11	2/17/09-2/24/09	2/17/09	3/25/09 (5 weeks)	5/5/09 (12 weeks)

Approximately 24 to 48 hours prior to each walk-through, an email message (Appendix E) was sent from the researcher to the school's principal and TRT notifying them of the day of the walk-through and expectations. They were given the option to forward the message to their faculty. On the day of the walk-through, the researcher signed into the school's visitor's log and checked in with the school's TRT.

Each walk-through was conducted during a 30- to 45-minute interval in the instructional day. Care was taken to identify whether the block of time observed reflected the beginning, middle, or end of the instructional period since it is recognized that instruction and technology use might look different at these points.

The researcher conducted all walk-throughs by walking through the instructional areas of the school and looking into every classroom where students were present, observing activities for approximately one to two minutes. The walk-through instrument was completed based on what could be observed from the doorway with minimal interruption to the instructional process. If the process could not be observed adequately from the doorway, the researcher entered the classroom.

Observation Data Collection

The observation process was initiated by an email sent from the Director of Instructional Services and the Supervisor of Technology Resource Teachers to the middle school principals informing them of the process and containing a sample notification message (Appendix F) that could be sent to the staff selected for the observations.

The observations were scheduled to occur at three intervals throughout the spring 2009 semester and occurred on the same dates as the walk-throughs. The first observation occurred within the 2-week interval surrounding the board installations. This window allowed the observation of classrooms when teachers had little or no experience and training on using the Promethean boards and was a reflection of their teaching practices prior to their adoption of this new technology. The exception was school 01 which did not have any observations occur during the installation period. The second observation occurred approximately five to seven weeks after the first observation. The exception was school 01 which had this round of observations occur approximately three weeks after the installation. The third observation occurred at all schools approximately 12 to 14 weeks after the first observation.

Approximately 24 to 48 hours prior to each observation, an email message (Appendix F) was sent from the researcher to the school's principal, TRT, and all observed teachers notifying them of the day of the observation and expectations. On the day of the observation, the researcher signed into the school's visitor's log and checked in with the school's TRT. The goal of the observations was to capture what occurred on a typical instructional day. Providing only short notice ensured that teachers did not prepare model lessons for the observation. Only school 01 objected to this short notice, feeling that they could not adequately prepare for the visitation.

The observations occurred over the course of an instructional day. Care was taken to identify whether the block of time observed reflected the beginning, middle, or end of the instructional period since it is recognized that instruction and technology use might look different at these points. Teachers who were absent or who were otherwise unavailable to be observed on the identified days were observed on later dates as schedules permitted.

The researcher entered each classroom and located an empty desk or chair close to the doorway and sat. Observations lasted for a 20-minute period with start and stop times indicated on the observation form. The observation form was completed during the observation with anecdotal notes made regarding the lesson and classroom experience. If non-disruptive, the teacher was thanked for their time when the researcher exited the room. This process was repeated for the second and third observations.

Teacher Survey Data Collection

The teacher survey was created in Zoomerang, an online survey tool, and launched on April 13, 2009. A link to the survey was emailed to the 97 teachers who were observed over the course of the semester and contained the message, “Please take a few minutes to complete the following survey to help Instructional Services capture some additional information regarding your experience with the Promethean board and assist us in identifying additional professional development needs and opportunities.” Two reminder emails were sent on April 29, 2009 and May 10, 2009 with the same initial message to teachers who had not completed the survey as of that date. The survey was closed on May 21, 2009 with 72 of the 97 teachers from the observation data set completing it for a 74.2% response rate.

Teacher Interview Data Collection

The selected teacher at each school was sent an email (Appendix G) from the researcher requesting an interview. Upon agreement via email, an interview was scheduled and conducted at various locations including a classroom, a planning room, Panera, Starbucks, and Atlanta Bread. The interviews were guided by the interview protocol (Appendix D) with audio captured using a LiveScribe pen and notebook. Interviews lasted between 20 and 45 minutes. These data are summarized in Table 7.

Table 7

Teacher Interview Details

School	Interview date	Interview Location	Interview duration
01	7/9/09	Atlanta Bread	23.38 min:sec
02	6/22/09	Teacher's classroom	24.26 min:sec
03	7/13/10	Teacher's classroom	21:23 min:sec
04	No interview	No interview	No interview
05	7/01/09	Starbucks	24.14 min:sec
06	6/22/09	Teacher's classroom	26.36 min:sec
07	6/29/09	Starbucks	15.02 min:sec
08	6/23/09	Teacher's classroom	17.11 min:sec
09	7/10/09	Atlanta Bread	46:51 min:sec
10	6/22/09	Teacher's classroom	17.02 min:sec
11	7/14/10	Panera	15:58 min:sec

Data Analysis

Quantitative Data

The quantitative data served to provide a summary of overall trends or tendencies (Creswell, 2008) that occurred regarding the Promethean board during the initiative. Therefore, the quantitative data which includes the walk-through data, classroom observations, and the teachers' survey were first treated descriptively with percentages and totals tallied and presented in tables. Because most of the data captured was nominal, nonparametric tests were appropriate to examine the differences between groups. Many of the questions contained hypotheses that compared data from the beginning of the initiative to different points throughout the initiative. Therefore, the chi-square goodness-of-fit was used to analyze how closely observed frequencies compared to expected frequencies (Dimitrov, 2008). These quantities were based on a theoretical distribution determined at the beginning of each studied interval. When the chi-square goodness-of-fit test was used, the following assumptions were met: Each observation is independent of all the others, "no more than 20 percent of the expected counts are less than five and all individual expected counts are 1 or greater" (Yates, Moore & McCabe, 1999, p. 734), and all expected frequencies should be 10 or greater. In cases where the expected frequencies did not meet the assumptions, a simple descriptive comparison of the raw scores was made with no statement made regarding significance.

Qualitative Data

The qualitative data provided an in-depth exploration of the Promethean board initiative and its impact on teachers' beliefs, attitudes, and practices (Creswell, 2008). Qualitative analysis procedures emphasized the view of the participant and interpreted the subject of study from his or her perspective. This process was inductive in that themes emerged during the process of coding and organizing data.

As a first step in analysis, the researcher used a categorizing process identified by Maxwell (2005) as coding. Driven by the expanded conceptual framework in chapter two of this document, the qualitative data which included observation notes and interview recordings and notes were initially coded into the categories identified there: performance expectancy, effort expectancy, social influence, and facilitating conditions.

As a second step, data were fractured (separated from their context) and rearranged into the preestablished organizational topics anticipated by the researcher. As a third step, each organizational topic was coded into substantive categories as the researcher used the organized data to describe each teacher's perceptions about each of the categories. Finally, the researcher examined the substantive categories and identified central themes.

Summary

Table 8 provides a summary of the phase one research questions and hypotheses as well as the data, instruments, and methods used to answer them.

Table 8

Summary of Methods Section of Phase One

Research questions/hypotheses	Participants	Instrument	Method
1. Are there changes in teachers' observed instructional practices from the beginning to the end of the semester when Promethean board initiative is rolled out, and if so what are they?			
H1. As the initiative proceeded, use of the Promethean board by teachers would increase.	1,127 teachers from walk-through 97 teachers from observations	Walk-through form Observation form	Chi-square goodness of fit was conducted on all data that met assumptions. Examination of raw data was conducted on data that did not meet the assumptions for chi-square.
H2. As the initiative proceeded, overall use of competing presentation tools would decrease.	1,127 teachers from walk-through 97 teachers from observations	Walk-through form Observation form	Examination of raw data was conducted when expected frequencies did not meet the assumptions for chi-square.

(continued)

Table 8 (continued)

Research questions/hypotheses	Participants	Instrument	Method
H3. As the initiative proceeded, overall use of other technology tools would remain constant.	1,127 teachers from walk-through 97 teachers from observations	Walk-through form Observation form	Examination of raw data was conducted when expected frequencies did not meet the assumptions for chi-square.
H4. As the initiative proceeded; a higher percentage of teacher time would be spent using the Promethean board.	97 teachers from observations	Observation form	Chi-square goodness of fit was conducted on all data that met assumptions.
H5. Teacher instructional activity organization would not change as a result of the initiative.	97 teachers from observations 10 teachers from interviews	Observation form Teacher interview protocol	Chi-square goodness of fit was conducted on all data that met assumptions.

(continued)

Table 8 (continued)

Research questions/hypotheses	Participants	Instrument	Method
H6. Teacher instructional strategy use would not change as a result of the initiative.	97 teachers from observations 10 teachers from interviews	Observation form Teacher interview protocol	Chi-square goodness of fit was conducted on all data that met assumptions. Categorization of teacher responses based upon the conceptual framework with additional coding when appropriate
2. What changes do teachers report in their instructional practices as a result of a district-wide technology initiative involving Promethean boards? a. If no changes are reported, what reasons are given? b. Are these changes consistent with observed instructional practices?	10 teachers from interviews	Teacher interview protocol	Categorization of teacher responses based upon the conceptual framework with additional coding when appropriate

(continued)

Table 8 (continued)

Research questions/hypotheses	Participants	Instrument	Method
H1. Teacher use of Safari Montage would increase over the course of the initiative.	97 teachers from observations	Observation form	Chi-square goodness of fit was conducted on all data that met assumptions.
3. What do teachers report as having impacts on their adoption of new technology?	97 teachers from observations 10 teachers from interviews 72 teachers from survey	Observation form Teacher interview protocol Teacher survey	Chi-square goodness of fit was conducted on all data that met assumptions. Categorization of teacher responses based upon the conceptual framework with additional coding when appropriate. Survey data was presented descriptively using percentages.

Limitations for Phase One

My role as a Staff Development Trainer within the Instructional Services Department placed me in an optimal position to capture data for this study. In this position, I was a resource for the district on technology issues. I held no supervisory or evaluative responsibilities over faculty or staff. However, my location in Instructional Services at the administrative building often led others to believe I was an administrator. Recognizing my position within the district might have implications for the validity of the data, I took the following actions when collecting it and recognized the following limitations.

Walk-throughs. Notifications to principals regarding the study were sent by the Director of Instructional Services with the Supervisor of Technology Resource Teachers, and my name was listed as a point of contact regarding questions and specifics. The instruments were made available to the principals for review. Although I was available to answer questions and provide details, the message regarding the intent of the study and its procedures came from the Director of Instructional Services with my role simply as the data collector. Principals were notified by me via email approximately 48 hours prior to each visit. That notice, if shared with staff, informed them that I would be in the building. Although the notification requested that nothing be done in preparation for my visit, advanced knowledge of my presence may have resulted in changes to instructional practices during my visit.

Observations. During the observations, I wore my official badge and recorded observed data on the observation instrument with notes made when appropriate to describe the type of technology used and the instructional activities. The form was not modified during the course of phase one, ensuring that the same level of detail captured for observation one was captured for observations two and three. The only subjective portion of the observation instrument was the assignment of observed teacher technology level. I used the following guidelines in assigning these levels based on my training with the Promethean board technology and my understanding of instructional design:

- Novice – a teacher who used the Promethean board at the minimal level, writing on a white screen with the pens with no use of the software beyond that. This also included teachers who displayed existing Word documents and annotated over them using the pens with the Promethean board.
- Intermediate – a teacher who used the Promethean board in conjunction with the ActivStudio software incorporating flash elements and/or tools that created customized backgrounds and made an attempt to incorporate multimedia into the content.
- Advanced – a teacher who used advanced tools in ActivStudio such as containers with assigned actions that acknowledge correct and incorrect responses, layers that enable hiding and revealing of correct and incorrect answers, and any content design that built in activities that were interactive for student use.

My interactions with teachers during the observations were minimal. However, in order to build relationships and present myself as an instructional resource and a welcomed visitor in the classroom, I offered assistance when I observed technology difficulties and answered any questions that were asked. Principals and teachers were notified by me via email approximately 48 hours prior to each visit. That notice informed them that I would be conducting observations in the upcoming days. Although the notification requested that nothing be done in preparation for my visit, advanced knowledge of my presence may have resulted in changes to instructional practices during my visit. My 20-minute observations in each classroom collected data representing instructional practices during that time frame. Assumptions were made that this was a representation of what occurred in that classroom during the rest of the instructional day. However, additional data were not available to verify this.

It is important to note that out of 97 teachers observed there was a subgroup of teachers not observed using technology during two or more observations. This impacted results because a disproportionate number of those teachers were at the novice level, skewing data toward the higher end of the technology skills continuum. Data contained in Table 9 show the number of teachers and their initial designated technology levels who were not observed using technology in two or more observations. One teacher was never observed using technology during any of the three observations. That teacher was designated a novice by the school's TRT and principal. There were 13 teachers who were not observed using technology during two of the three observations. Of that subgroup, 10 were designated as novice, 1 was designated as intermediate, and 2 were designated as advanced by the school's TRT and principal. The large proportion (78.6%) of novice technology users in this subgroup likely reflects that novice teachers are less likely to use technology in their classroom instruction and are slower to adopt a new technology.

Table 9

Teacher Not Observed Using Technology on Two or More Visits

Teacher technology level	Number of teachers
Novice use	11
Intermediate use	1
Advanced use	2
Total	14

Interviews. Requests for interviews were sent by the researcher to teachers with information about the goals Liberty District's Instructional Services had for the interview and a statement that the interview was voluntary. Although I had prior professional relationships with at least one teacher in each school, I made an attempt to select and interview teachers who did not have a prior working relationship with me. The only interviewed teachers with whom I had prior experiences were teachers from school 03 and school 06. Interviews were done at locations the teachers selected and at their convenience. Although interviews were voluntary, my position within the organization and knowledge that administration was capturing data on Promethean board use could have influenced teachers to present a more positive picture, although those interviewed offered criticisms and/or concerns which led me to believe that these teachers were honest in their responses.

The high number of teachers who represented intermediate and advanced technology levels in the interview sample may have resulted in an emphasis on experiences from teachers who referenced higher confidence levels with and higher uses of technology. This likely minimized the voice of teachers who were at the lower end of technology use. Initial interview requests were made to teachers with the goal of creating a sample that reflected equal representation of teachers who demonstrated novice, intermediate, and advanced technology skills with at least one teacher coming from each of the schools participating in the initiative. The intent was to capture evidence that reflected teachers at all levels and from all of the schools. Teachers who responded to initial interview requests resulted in an inadequate sample to represent technology levels and schools. Therefore, the criteria for teacher sampling was modified with technology levels dropped in favor of the need to have one teacher representing each school in the initiative. The resulting sample represented 10 of the 11 schools in the initiative and included only one teacher who was initially rated at the novice level by the school's principal and TRT.

Methods to Results

This chapter focused on establishing methods for collecting data on teacher beliefs, attitudes, and practices. The methods were framed by the UTAUT model for technology adoption outlined in chapter two. Central to designing the methods for this study was the use of existing instruments created by SETDA and modified by the researcher. These modifications allowed the capture of additional data used to answer research questions one, two, and three. Analysis of this data follows in chapter four.

4. RESULTS OF PHASE ONE

Chapter three outlined the methods that were used to collect and analyze data to answer research questions one, two, and three. These questions examined teacher beliefs, attitudes, and practices. Using the lens of the expanded conceptual framework presented in chapter two, those results are presented here.

Research Question 1

As the technology initiative proceeded, it was hypothesized that participant use of that Promethean board would increase over time. Initial success was measured by increases in participant use of the Promethean board. This increased use was due to multiple factors including experience using the technology, professional development, teacher self-efficacy, the environment, expectations of use, and peer influence. The data used to answer research question one, “Are there changes in teachers’ observed instructional practices from the beginning to the end of the semester when a Promethean board initiative is rolled out, and if so what are they?” were obtained from the walk-throughs, observation data sets, and teacher interviews.

Statistical analyses were completed using a chi-square goodness-of-fit test to determine whether changes in the proportion of teacher use of Promethean boards and overall technology use and percentage of time using the Promethean board were statistically significant over the semester in which the rollout occurred. The initial baseline for use was set using data from the initial walk-through and observations which occurred within a 2-week interval surrounding the board installations. This window allowed the observation of classrooms when teachers had little or no experience and training using the Promethean boards and was a reflection of their technology use prior to adoption of this technology. Two intervals were then analyzed. The first examined changes in use that occurred between the initial and second walk-through and observation, and the second examined changes in use that occurred between the second and third walk-through and observation.

Technology Use

Teacher use of technology during the rollout of the initiative was hypothesized to increase as participants obtained experience and participated in professional development using the Promethean board. It was hypothesized that teachers' overall use of technology, in this case the Promethean board, would increase over time.

Teacher use of the Promethean board in the walk-throughs and observations was recorded as either yes or no. Data from observations captured the percentage of time that teachers used the Promethean board during the 20-minute observation. Percentage of use was recorded using the intervals: 0% of the time, 1-25% of the time, 26-50% of the time, 51-75% of the time, and 76-100% of the time. Since data representing technology use was categorical, a nonparametric test was used for its analysis. The chi-square goodness-of-fit test was used to determine whether changes in use of the Promethean boards that occurred over the course of the semester were statistically significant.

Teacher use of the Promethean board. The technology initiative focused on the use of the Promethean board and its accompanying software ActivStudio. It was hypothesized that as the initiative proceeded, use of the Promethean board by teachers would increase. Data collected on teacher use of the Promethean board during phase one were obtained from walk-throughs and observations. The initiative was rolled out across 11 middle schools. Although initiative-wide data reflected the intent of the initiative and its manifestation across the population, it was valuable to determine how the initiative manifested itself at the school level. Therefore, analyses were conducted on district-wide data and then further examined at the school level.

Walk-through data. Walk-through data was compiled from brief classroom visits collected on three different occasions in each school throughout the spring 2009 semester. A total of 1,127 classrooms were visited in this process. Data from walk-throughs were analyzed using the chi-square goodness-of-fit test. With two categories ($k = 2$), there was one degree of freedom (df = k-1 = 2-1 = 1). The χ^2 critical value with $df = 1$ and $\alpha = .05$, was $\chi^2 = 3.84$. Findings were considered statistically significant if the calculated χ^2 exceeded the χ^2 critical value. In these cases, the null hypothesis was rejected.

Initial to second walk-through. Using the chi-square goodness-of-fit test and walk-through one data contained in Table 10 as the baseline, the null hypothesis stated there would be no change in the proportion of teachers using the Promethean board from the initial to the second walk-through. The expected proportion of teachers using the Promethean board (P_{iwb}) initiative-wide during walk-through two was .307, at School 01 was .333, at School 02 was .289, at School 03 was .222, at School 04 was .068, at School 05 was .382, at School 06 was .528, at School 07 was .406, at School 08 would was .667, at School 09 was .027, at School 10 was .216, and School 11 was .405 during walk-through two. The observed and expected quantities of teacher Promethean board use during walk-through two are displayed in Table 11. Walk-through data were separated by school, and separate chi-square goodness-of-fit tests were conducted for teacher Promethean board use initiative-wide and at each school.

Table 10

Number of Teachers Using Promethean Boards During Walk-Throughs

School	Walk-though 1 (388 classes)		Walk-though 2 (378 classes)		Walk-though 3 (361 classes)	
01	10	33.3%	12	35.3%	7	22.6%
02	11	28.9%	19	52.8%	23	67.6%
03	8	22.2%	16	42.1%	17	42.5%
04	3	6.8%	25	58.1%	28	71.8%
05	13	38.2%	15	44.1%	17	50.0%
06	19	52.8%	16	50.0%	18	54.5%
07	13	40.6%	7	25.9%	14	50.0%
08	18	66.7%	16	50.0%	15	57.7%
09	1	2.7%	20	54.1%	19	63.3%
10	8	21.6%	24	70.6%	25	73.5%
11	15	40.5%	19	61.3%	23	71.9%
Initiative-wide	119	30.7%	189	50.0%	206	57.1%

Table 11

Observed and Expected Number of Teachers Using Promethean Boards During Walk-Through Two

School	Observed *n*	Expected *n*	Residual
01 (34 classes)			
Yes*	12	11	1.0
No**	22	23	-1.0
02 (36 classes)			
Yes	19	10	9.0
No	17	26	-9.0
03 (38 classes)			
Yes	16	8.5	7.5
No	22	29.5	-7.5
04 (43 classes)			
Yes	25	3	22.0
No	18	40	-22.0
05 (34 classes)			
Yes	15	13	2.0
No	19	21	-2.0
06 (32 classes)			
Yes	16	17	-1.0
No	16	15	-1.0
07 (27 classes)			
Yes	7	11	-4.0
No	20	16	4.0
08 (32 classes)			
Yes	16	19	-3.0
No	16	13	3.0
09 (37 classes)			
Yes	20	1	19.0
No	17	36	-19.0
10 (34 classes)			
Yes	24	7	17.0
No	10	27	-17.0
11 (31 classes)			
Yes	19	12.5	6.5
No	12	18.5	-6.5
Initiative-wide (378 classes)			
Yes	189	116.0	73.0
No	189	262.0	-73.0

Note. * Yes = teacher used Promethean board during walk-through two; ** No = teacher did not use Promethean board during walk-through two.

A summary of the calculated chi-square test statistics for teacher Promethean board use by school during walk-through two appears in Table 12. Teacher use of the Promethean board increased initiative-wide by 19.3%, at School 02 by 23.9%, at School 03 by 19.9%, at School 04 by 51.5%, at School 09 by 51.4%, at School 10 by 49%, and School 11 by 20.8% from the initial to the second walk-through and were statistically significant. There was no evidence that teacher Promethean board use changed from the initial to the second walk-through at Schools 01, 05, 06, 07, and 08.

Table 12

Summary of Chi-Square Statistics for Number of Teachers Using Promethean Boards During Walk-Through Two

School	Chi-square χ^2	*df*	Asymp. Sig	
01 (*n*=34)	.134[a]	1	.174	
02 (*n*=36)	11.215[a]	1	.001	*
03 (*n*=38)	8.524[a]	1	.004	*
04 (*n*=43)	173.433[a]	1	.000	*
05 (*n*=34)	.498[a]	1	.480	
06 (*n*=32)	.125[a]	1	.723	
07 (*n*=27)	2.455[a]	1	.117	
08 (*n*=32)	1.166[a]	1	.280	
09 (*n*=37)	371.028[a]	1	.000	*
10 (*n*=34)	51.989[a]	1	.000	*
11 (*n*=31)	5.664[a]	1	.017	*
Initiative-wide (N=378)	66.279 [a]	1	.000	*

Note. * $p < .05$.

Second to third walk-through. Using the chi-square goodness-of-fit test and walk-through two data contained in Table 11, the null hypothesis stated there would be no change in the proportion of teachers using the Promethean board between the second and third walk-through. The expected proportion of teachers using the Promethean board (P_{iwb}) initiative-wide was .500, at School 01 was .353, at School 02 was .528, at School 03 was .421, at School 04 was .581, at School 05 was .441, at School 06 was .500, at School 07 was .259, at School 08 was .500, at School 09 was .541, at School 10 was .706, and at School 11 was .613 during walk-through three. The observed and expected quantities of teacher Promethean board use during walk-through three are displayed in Table 13.

Table 13

Observed and Expected Teachers Using Promethean Boards During Walk-Through Three

School	Observed *n*	Expected *n*	Residual
01 (31 classes)			
Yes*	7	11	4.0
No**	24	20	-4.0
02 (34 classes)			
Yes	23	18	5.0
No	11	16	-5.0
03 (40 classes)			
Yes	17	17	.0
No	23	23	.0
04 (39 classes)			
Yes	28	23	5.0
No	11	16	-5.0
05 (34 classes)			
Yes	17	15	2.0
No	17	19	-2.0
06 (33 classes)			
Yes	18	16.5	1.5
No	15	16.5	-1.5
07 (28 classes)			
Yes	14	21	-7.0
No	14	7	7.0
08 (26 classes)			
Yes	15	13	2.0
No	11	13	-2.0
09 (30 classes)			
Yes	19	16	3.0
No	11	14	-3.0
10 (34 classes)			
Yes	25	24	1.0
No	9	10	-1.0
11 (32 classes)			
Yes	23	19.5	3.5
No	9	12.5	-3.5
Initiative-wide (361 classes)			
Yes	206	180.5	25.5
No	155	10.5	-25.5

Note. * Yes = teacher used Promethean board during walk-through two; ** No = teacher did not use Promethean board during walk-through two.

A summary of the calculated chi-square test statistics for teacher Promethean board use during walk-through three appears in Table 14. Teacher use of the Promethean board increased initiative-wide by 7.1% and at School 07 by 24.1% from the second to the third walk-through and were statistically significant. There was no evidence that teacher Promethean board use changed from the second to the third walk-through at schools 01, 02, 03, 04, 05, 06, 08, 09, 10, and 11.

Table 14

Summary of Chi-Square Statistics for Teachers Using Promethean Boards by School During Walk-Through Three

School	Chi-square χ^2	*df*	Asymp. Sig	
01 (*n*=31)	2.255[a]	1	.133	
02 (*n*=34)	2.951[a]	1	.086	
03 (*n*=40)	.000[a]	1	1.000	
04 (*n*=39)	2.649[a]	1	.104	
05 (*n*=34)	.477[a]	1	.490	
06 (*n*=33)	.273[a]	1	.602	
07 (*n*=28)	9.333[a]	1	.002	*
08 (*n*=26)	.615[a]	1	.433	
09 (*n*=30)	1.205[a]	1	.272	
10 (*n*=34)	.142[a]	1	.707	
11 (*n*=32)	1.608[a]	1	.205	
Initiative-wide (*N* = 361)	7.205 [a]	1	.007	*

Note. * $p < .05$.

Observations. Observation data was compiled from 20-minute classroom observations collected on three different occasions in each school throughout the spring 2009 semester. Eight to nine classrooms (total 97 classrooms) were observed in each school resulting in a total of 282 classroom observations in this process.

Initiative-wide data from observations were analyzed using the chi-square goodness-of-fit test. With two categories ($k = 2$), there was one degree of freedom ($df = k-1 = 2-1 = 1$). The χ^2 critical value with $df = 1$ and $\alpha = .05$, was $\chi^2 = 3.84$. Findings were considered statistically significant if the calculated χ^2 exceeded the χ^2 critical value. In these cases, the null hypothesis was rejected. The school-level data were analyzed separately. The observation sample size for each school was either eight or nine teachers. Data representing school-level Promethean board use during observations were insufficient in size to statistically analyze using chi-square goodness-of-fit test because most expected frequencies were less than five. Therefore, analysis was based on changes in raw counts of each sample.

Initial to second observations. Using the chi-square goodness-of-fit test and observation one data contained in Table 15 as the baseline, the null hypothesis stated there would be no change in the proportion of teachers using the Promethean board initiative-wide from observation one to observation two. The expected proportion of teachers using the Promethean board (P_{iwb}) was .659 during observation two. The observed and expected quantities of teacher Promethean board use during observation two are displayed in Table 16.

The number of teachers at each school observed using the Promethean board during the observations is contained in Table 15. School 02 (44.4%), School 09 (44.4%) and School 10 (44.4%) demonstrated the lowest percentage of teachers using the Promethean board during observation one. School 08 (100%) showed the highest percentage of teachers using the Promethean board during observation one.

Table 15

Number of Teachers by School Using Promethean Boards During Observations

School	Observation 1		Observation 2		Observation 3	
01 (9 classes)			6	66.7%	4	44.4%
02 (9 classes)	4	44.4%	9	100.0%	7	77.8%
03 (9 classes)	5	55.6%	7	77.8%	7	77.8%
04 (9 classes)	7	77.8%	8	88.9%	9	100.0%
05 (9 classes)	6	66.7%	7	77.8%	7	77.8%
06 (8 classes)	7	87.5%	7	87.5%	7	87.5%
07 (9 classes)	6	66.7%	6	66.7%	8	88.9%
08 (8 classes)	8	100.0%	8	100.0%	7	87.5%
09 (9 classes)	4	44.4%	7	77.8%	7	77.8%
10 (9 classes)	4	44.4%	7	77.8%	9	100.0%
11 (9 classes)	7	77.8%	7	77.8%	9	100.0%
Initiative-wide	58	65.9%	79	81.4%	81	83.5%

Table 16

Initiative-Wide Teacher Use of Promethean Board During Observation Two

Promethean board use	Observed *n*	Expected *n*	Residual
Yes	79	64.0	15.0
No	18	33.0	-15.0
Total	97		

Initiative-wide data. The calculated chi-square test statistic for teacher Promethean board use initiative-wide during observation two was χ^2 (1, N = 97) = 10.334, p = .001. The increase in observed teacher use of the Promethean board initiative-wide by 15.5% from the initial to the second observation was statistically significant.

School-level data. Examination of school-level data of teachers who were observed using the Promethean board during observation one and observation two showed increased teacher use at School 02 by five teachers, School 03 by two teachers, School 04 by one teacher, School 05 by 1 teacher, School 09 by three teachers, and School 10 by three teachers. These data are presented in Figure 3. There was no change in the number of teachers observed using the Promethean board from observation one to observation two at School 06, School 07, School 08, and School 11. School 01 did not participate in observation one, and therefore is not included in this portion of the analysis.

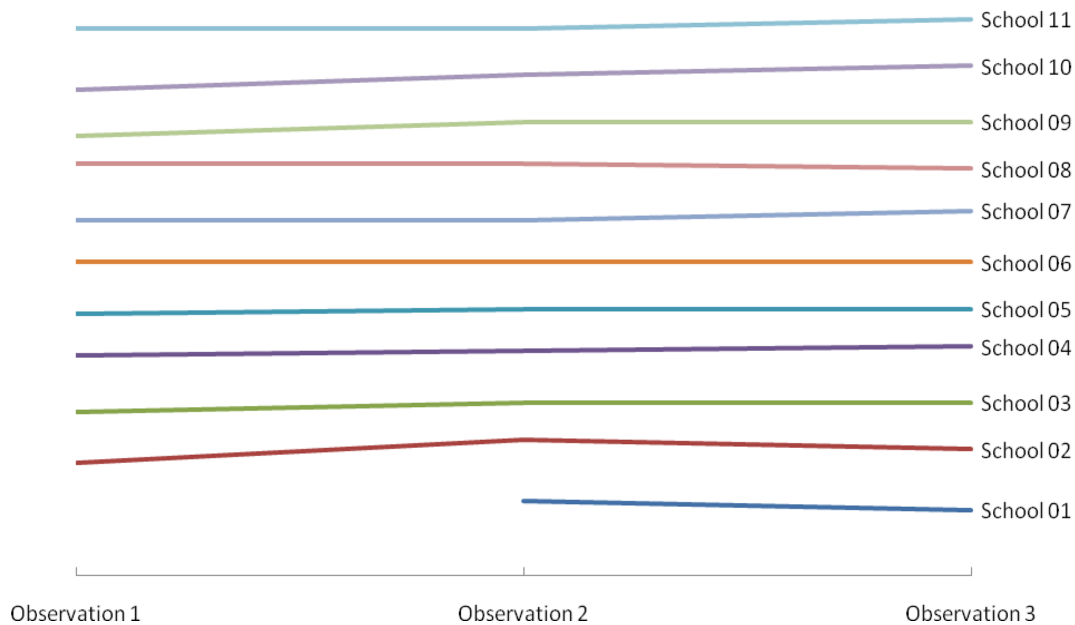

Figure 3. Changes in school-level teachers using Promethean boards during observations. *Note*. School 01 did not participate in observation one.

Second to third observations. Using the chi-square goodness-of-fit test and building from observation two data contained in Table 15, the null hypothesis stated there would be no change in the proportion of teachers initiative-wide using the Promethean board from observation two to observation three. The expected proportion of teachers using the Promethean board (P_{iwb}) was .814 during observation three. The observed and expected quantities of teacher Promethean board use during observation three are displayed in Table 17.

Table 17

Teacher Use of Promethean Board During Observation Three

Promethean board use	Observed *n*	Expected *n*	Residual
Yes	81	79.0	2.0
No	16	18.0	-2.0
Total	97		

Schools with the lowest percentage of teachers using the Promethean board during observation two were School 01 (66.7%) and School 07 (66.7%). The schools with the highest percentage of teachers using the Promethean board during observation two were School 02 (100%) and School 08 (100%).

Initiative-wide data. The calculated chi-square test statistic for initiative-wide teacher Promethean board use during observation three was χ^2 (1, N = 97) = .273, p = .601. There was no evidence that observed teacher use of the Promethean board initiative-wide changed from the second to the third observation.

School-level data. Examination of school-level data of teachers who were observed using the Promethean board during observation two and observation three showed increased teacher use at School 04 by one teacher, School 07 by two teachers, School 10 by two teachers, and School 11 by two teachers. There was no change in the number of teachers observed using the Promethean board from observation two to observation three at School 03, School 05, School 06, and School 09. There was a decrease in the number of teachers using the Promethean board from observation two to observation three at School 01 by two teachers, at School 02 by two teachers, and at School 08 by one teacher.

Teacher use of other technologies. In phase two, School 03's TRT mentioned that one of their strategies to increase teacher use of the Promethean board was to remove overhead projectors from the classroom. There were 24 documented uses of the overhead projector during walk-through one which dropped to 7 documented uses of the overhead projector during walk-through three, and 7 documented uses of the overhead projector during observation one—which dropped to 0 documented uses during observation three. There is no data about strategies that other schools used to encourage Promethean board use. This decline could have been the result of other schools implementing a similar process to remove competing technologies. Supportive of this assumption, two teachers' interview responses (School 08 and School 09) included references about their overhead projectors eventually being removed, implying that other schools were implementing similar practices. This raised questions regarding the validity of observations concerning the use of other technologies in the results. Thus, it was not practical to answer hypothesis two and three for research question one because of the questionable data and contamination of that data by policies and practices implemented at the school level.

Teacher percent of time using interactive whiteboards. Professional development requirements and expected use were central to the implementation of the initiative. The amount of time a teacher uses technology is a reflection of his or her confidence with the technology (Karahanna et al., 1999). Since skill development increases with practice and professional development, it was hypothesized that as the initiative proceeded a higher percentage of teacher time would be spent using the Promethean board.

Observation data. Observation data were compiled from 20-minute classroom observations collected on three different occasions in each school throughout the spring 2009 semester. Teachers were informed of the observation 24 to 48 hours in advance. Eight to 9 classrooms (total 97 classrooms) were observed in each school resulting in a total of 282 classroom observations during this process. Data from observations were analyzed using the chi-square goodness-of-fit test. With five categories in this case (k = 5), there were four degrees of freedom (df = k-1 = 5-1 = 4). The χ^2 critical value with df = 4 and α = .05, was χ^2 = 9.49. Findings were considered statistically significant if the calculated χ^2 exceeded the χ^2 critical value. In these cases, the null hypothesis was rejected.

Initial to second observation. Using the chi-square goodness-of-fit test and observation one data contained in Table 18 as the baseline, the null hypothesis stated there would be no change in the percentage of time teachers used the Promethean board from the initial to the second observation. During observation two, the expected proportion of teachers using a Promethean board 0%of the time (P_0) was .341, the expected proportion of teachers using a Promethean board up to 25% of the time (P_{25}) was .216, the expected proportion of teachers using a Promethean board up to 50% of the time ($P5_0$) was .148, the expected proportion of teachers using a Promethean board up to

75% of the time (P_{75}) was .114, and the expected proportion of teachers using a Promethean board up to 100% of the time (P_{100}) was .182. For Table 18, teachers who were using technology other than the Promethean board were represented in the first group, 0% of time using a Promethean board. The observed and expected quantities of the percentage of teacher time using Promethean boards during observation two are displayed in Table 19 and represent the percentage of time teachers used technology over the 20-minute observation period.

Table 18

Percentage of Teacher Time Using Promethean Boards During Observations

Percentage of time using interactive whiteboard	Observation 1 (88 classes)		Observation 2 (97 classes)		Observation 3 (97 classes)	
0%	30	34.1%	18	18.6%	14	14.4%
1-25%	19	21.6%	25	25.8%	31	32.0%
26-50%	13	14.8%	24	24.7%	15	15.5%
51-75%	10	11.4%	12	12.4%	11	11.3%
76-100%	16	18.2%	18	18.6%	26	26.8%

Table 19

Percentage of Teacher Time Using Promethean Boards During Observation Two

Percentage of time	Observed *n*	Expected *n*	Residual
0%	18	33.0	-15.0
1-25%	25	21.0	4.0
26-50%	24	14.3	9.7
51-75%	12	11.0	1.0
76-100%	18	17.7	.3
Total	97		

The calculated chi-square test statistic for percentage of teacher time using the Promethean board during observation two was χ^2 (4, N = 97) = 14.256, p = .007. There is statistically significant evidence that the percentage of teacher time using the Promethean board changed from the initial to the second observation. The data reflected a decrease of 15.5% in the number teachers using technology 0% of the time which means that more teachers were using technology for a larger percentage of the time during observation two. There was an increase of 4.2% in teachers using the Promethean board up to 25% of the time, an increase of 9.9% in teachers using the Promethean board up to 50% of the time, an increase of 1.0% in teachers using the Promethean board up to 75% of the time, and an increase of 0.4% in teachers using the Promethean board up to 100% of the time.

Second to third observation. Using the chi-square goodness-of-fit test and building on observation two data contained in Table 18, the null hypothesis stated there would be no change in the percentage of time teachers used the Promethean board from the second to the third observation. During observation three, the expected proportion of teachers using the Promethean board 0% of the time (P_0) was .186, the expected proportion of teachers using the Promethean board up to 25% of the time (P25) was .258, the expected proportion of teachers using the Promethean board up to 50% of the time ($P5_0$) was .247, the expected proportion of teachers using the Promethean board up to 75% of the time (P_{75}) was .124, and the expected proportion of teachers using the Promethean board up to 100% of the time (P_{100}) was .186. The observed and expected quantities of the percent of teacher time using the Promethean boards during observation three are displayed in Table 20 and represent the percentage of time teachers used technology over the 20-minute observation period.

Table 20

Percentage of Teacher Time Using Promethean Board During Observation Three

Percentage of time	Observed *n*	Expected *n*	Residual
0%	16	18.0	-2.0
1-25%	31	25.0	6.0
26-50%	14	24.0	-10.0
51-75%	11	12.0	-1.0
76-100%	25	18.0	7.0
Total	97		

The calculated chi-square test statistic for percentage of teacher time using the Promethean board during observation three was χ^2 (4, N = 97) = 8.634, p = .071. There is no evidence that the percentage of teacher time using the Promethean board changed from the second to the third observation.

Instructional activity organization. Prior data focused on Promethean board use and made no attempt to describe instructional practices. Although use is an important indicator of success in any initiative, it is also valuable to examine whether this use resulted in changes to instructional practices. Changes to instructional practices are the result of changes in teachers' instructional beliefs and attitudes and require time (Bai & Ertmer, 2008; Ertmer, 2005; Zhao & Frank, 2003). Due to the short time frame of data collection for phase one of this case study (one semester), it was hypothesized that teacher instructional activity organization would not change as a result of the initiative.

Measurement of instructional activity organization was based on walk-through and observational data. Since data representing instructional activities are categorical, a nonparametric test was used in its analysis. The chi-square goodness-of-fit test was used to determine whether changes in instructional activities over the course of the semester were statistically significant. Activities were categorized into one of four instructional activity models: teacher-led whole group, student-led whole group, small group or pair cooperative, and independent activity. These activity types were identified in Leh and Grafton (2008) and were based on an instrument developed by the American Institute for Research.

Walk-through data. Walk-through data were compiled from brief classroom visits on three different occasions in each school throughout the spring 2009 semester. Walk-through data identified one instructional activity per classroom due to the short time visiting each classroom. These data represented 100% of the classrooms with student activity taking place in them during the time of the walk-through. A total of 1,127 classrooms were visited in this process.

Data from walk-throughs were analyzed using the chi-square goodness-of-fit test. With four categories in this case ($k = 4$), there were three degrees of freedom (df = k-1 = 4-1 = 3). The χ^2 critical value with $df = 3$ and $\alpha = .05$, was $\chi^2 = 7.82$. Findings were considered statistically significant if the calculated χ^2 exceeded the χ^2 critical value. In these cases, the null hypothesis was rejected.

Initial to second walk-through. Using the chi-square goodness-of-fit test and walk-through one data contained in Table 21 as the baseline, the null hypothesis stated there would be no change in instructional activity organization from the initial to the second walk-through. During walk-through two, the expected proportion of classrooms using teacher-led whole group instruction (P_T) was .554, the expected proportion of classrooms using student-led whole group instruction (P_S) was .073, the expected proportion of classrooms using small group or cooperative instruction (P_{SG}) was .046, and the expected proportion classrooms using independent activity instruction (P_I) was .327. The observed and expected quantities of instructional activity organization during walk-through two are displayed in Table 22.

Table 21

Instructional Activity Organization During Walk-Throughs

Activity	Walk-through 1 (388 classes)		Walk-through 2 (378 classes)		Walk-through 3 (361 classes)	
Teacher-led whole group	215	55.4%	181	47.8%	195	54.0%
Student-led whole group	28	7.3%	13	3.4%	24	6.6%
Small group or pair cooperative	18	4.6%	21	5.6%	8	2.2%
Independent activity	127	32.7%	163	43.2%	134	37.2%

Table 22

Instructional Activity Organization During Walk-Through Two

Activity	Observed *n*	Expected *n*	Residual
Teacher-led whole group	181	209.4	-28.4
Student-led whole group	13	27.6	-14.6
Small group or pair cooperative	21	17.4	3.6
Independent activity	163	123.6	39.4
Total	378		

The calculated chi-square test statistic for instructional activity organization during walk-through two was χ^2 (3, N = 378) = 24.879, p = .000. There was statistically significant evidence that the instructional activity organization changed over the initial to the second walk-through. Teacher-led whole group instructional organization decreased by 7.8%, student-led whole group instructional organization decreased by 3.9%, small group or pair cooperative instructional organization increased by 1%, and independent activity instructional organization increased by 10.5% from the initial to the second walk-through.

Second to third walk-through. Using the chi-square goodness-of-fit test and building from walk-through two data contained in Table 21, the null hypothesis stated there would be no change in instructional activity organization from the second to the third walk-through. During walk-through three, the expected proportion of classrooms using teacher-led whole group instruction (P_T) was .478, the expected proportion of classrooms using student-led whole group instruction (P_S) was .034, the expected proportion of classrooms using small group or cooperative instruction (P_{SG}) was .056, and the expected proportion of classrooms using independent activity instruction (P_I) was .432. The observed and expected quantities of instructional activity organization during walk-through three are displayed in Table 23.

Table 23

Instructional Activity Organization During Walk-Through Three

Activity	Observed *n*	Expected *n*	Residual
Teacher-led whole group	195	173.0	22.0
Student-led whole group	24	12.0	12.0
Small group or pair cooperative	8	20.0	-12.0
Independent activity	34	156.0	-22.0
Total	361		

The calculated chi-square test statistic for instructional activity organization during walk-through three was χ^2 (3, N = 361) = 25.100, p = .000. There was statistically significant evidence that the instructional activity organization changed from the second to the third walk-through. Teacher-led whole group instructional organization increased by 6.2%, student-led whole group instructional organization increased by 3.2%, small group or pair cooperative instructional organization decreased by 3.4%, and independent activity instructional organization decreased by 6.0% from the second to the third walk-through.

Observation data. Observation data was compiled from 20-minute classroom observations collected on three different occasions in each school throughout the spring 2009 semester. Teachers were informed of the observation 24 to 48 hours in advance. Observation data identified at least one and possibly more instructional activities per classroom if teachers employed multiple activities during 20-minute observational window. Data from observations were analyzed using the chi-square goodness-of-fit test. Because instructional activity organization data types were collected as separate variables on the observation instrument, separate chi-square goodness-of-fit tests were done for each activity type. With two categories in this case (k = 2), there was one degree of freedom (df = k-1 = 2-1 = 1). The χ^2 critical value with df = 1 and α = .05, was χ^2 = 3.84. Findings were considered statistically significant if the calculated χ^2 exceeded the χ^2 critical value. In these cases, the null hypothesis was rejected.

Initial to second observation. Using the chi-square goodness-of-fit test and observation one data contained in Table 24 as the baseline, the null hypothesis stated there would be no change in instructional activity organization from the initial to the second observation. During observation two, the expected proportion of classrooms using teacher-led whole group instruction (P_T) was .864, the expected proportion of classrooms using student-led whole group instruction (P_S) was .148, the expected proportion of classrooms using small group or cooperative instruction (P_{SG}) was .216, and the expected proportion classrooms using independent activity instruction (P_I) was .511. The observed and expected quantities of instructional activity organization during observation two are displayed in Table 25.

Table 24

Instructional Activity Organization During Observations

Activity	Observation 1 (88 classes)		Observation 2 (97 classes)		Observation 3 (97 classes)	
Teacher-led whole group	76	86.4%	81	83.5%	87	89.7%
Student-led whole group	13	14.8%	15	15.5%	3	3.1%
Small group or pair cooperative	19	21.6%	19	19.6%	49	50.5%
Independent activity	45	51.1%	33	34.0%	19	19.6%

Table 25

Instructional Activity Organization During Observation Two

Activity	Observed *n*	Expected *n*	Residual
Teacher-led whole group			
Yes	81	84	-3.0
No	16	13	3.0
Student-led whole group			
Yes	15	14	1.0
No	82	83	-1.0
Small group or pair cooperative			
Yes	19	21	2.0
No	78	76	-2.0
Independent activity			
Yes	33	50	17.0
No	64	47	-17.0
Total	97		

A summary of the chi-square test statistics for instructional activity organization appears in Table 26. Independent activity instructional activity organization decreased by 17.1% from the initial to the second observation which was statistically significant. There was no evidence that use of teacher-led whole group, student-led whole group, and small group cooperative instructional activity organizations changed from the initial to the second observation.

Table 26

Summary of Chi-Square Statistics for Instructional Activity Organization During Observation Two

Activity Type	Chi-square χ^2	*df*	Asymp. Sig	
Teacher-led whole class (*N* = 97)	.799[a]	1	.371	
Student-led whole class (*N* = 97)	.083[a]	1	.773	
Small group cooperative (*N* = 97)	.243[a]	1	.622	
Independent activity (*N* = 97)	11.929[a]	1	.001	*

Note. * $p < .05$.

Second to third observation. Using the chi-square goodness-of-fit test and building from observation two data contained in Table 24, the null hypothesis stated there would be no change in instructional activity organization from the second to the third observation. During observation three, the expected proportion of classrooms using teacher-led whole group instruction (P_T) was .835, the expected proportion of classrooms using student-led whole group instruction (P_S) was .155, the expected proportion of classrooms using small group or cooperative instruction (P_{SG}) was .196, and the expected proportion classrooms using independent activity instruction (P_I) was .340. The observed and expected quantities of instructional activity organization during observation three are displayed in Table 27.

Table 27

Instructional Activity Organization During Observation Three

Activity	Observed *n*	Expected *n*	Residual
Teacher-led whole group			
Yes	87	81	-6.0
No	10	16	6.0
Student-led whole group			
Yes	14	15	-1.0
No	83	82	1.0
Small group or pair cooperative			
Yes	3	19	-16.0
No	94	78	16.0
Independent activity			
Yes	49	33	16.0
No	48	64	-16.0
Total	97		

A summary of the calculated chi-square test statistics for all of the instructional activity organization during observation three appears in Table 28. Changes in independent activity and small group cooperative were statistically significant. Small group cooperative instructional activity organization decreased by 16.5%, and independent activity instructional activity organization increased by 16.5% from the second to the third observation. There was no evidence that teacher-led whole group and student-led whole group instructional activity organizations changed from the second to the third observation.

Table 28

Summary of Chi-Square Statistics for Instructional Activity Organization During Observation Three

Activity Type	Chi-square χ^2	*df*	Asymp. Sig	
Teacher-led whole class (*N* = 97)	2.694[a]	1	.101	
Student-led whole class (*N* = 97)	.079[a]	1	.779	
Small group cooperative (*N* = 97)	16.756[a]	1	.000	*
Independent activity (*N* = 97)	11.758[a]	1	.001	*

Note. * $p < .05$.

The predominant instructional activity organization during all walk-throughs and observations remained teacher-led whole group instruction. Teacher-led whole group instruction was observed in 215 (55.4%) classrooms during walk-through one, 181 (47.8%) classrooms during walk-through two, 195 (54.0%) classrooms during walk-through three, 76 (86.4%) classrooms during observation one, 81 (83.5%) classrooms during observation two, and 87 (89.7%) classrooms during observation three. A summary of instructional activity organization during walk-throughs appears in Table 21 and instructional activity organization during observations appears in Table 24.

Data representing student-centered activities were varied but ultimately showed a decrease in use of these instructional activity organizations. Walk-through data showed that student-led whole group instruction and small group or pair cooperative activities decreased over the course of the initiative. Conversely, observational data showed an increase for small group or pair cooperative. Student-led whole group instruction decreased from 28 (7.3%) instances in walk-through one to 13 (3.4%) in walk-through two and 24 (6.6%) in walk-through three. Student-led whole group instruction increased from 13 (14.8%) in observation one to 15 (15.5%) in observation two, but decreased to 3 (3.1%) in observation three. None of the changes in student-led whole group instruction during the observations were statistically significant but did mirror the results from the walk-throughs. Small group or pair cooperative instruction remained constant from observation one to observation two at 19 (19.6%) but increased to 49 (50.5%) during observation three. Although small group or pair cooperative instruction increased during observation three, overall results revealed a decrease in student-centered activities and a predominance of teacher-led activities.

Marzano instructional strategy use. Research-based instructional strategies identified by Marzano et al. (2001) and widely supported within the county have been the topic of past district-wide professional development sessions. Given that changes to instructional practices are the result of changes in teachers' instructional beliefs and attitudes and require time, the short time frame of data collection for phase one (one semester) led to a hypothesis that teacher instructional strategy use would not change as a result of the initiative.

Measurement of instructional strategy use was based on observational data. Observational data identified at least one and possibly more instructional strategies per classroom if teachers employed multiple strategies during the 20-minute observational window. Since data representing instructional strategies were categorical, a nonparametric test was used. The chi-square goodness-of-fit test was used to determine whether changes in instructional strategies over the course of the semester were statistically significant. Strategies were categorized into one of nine instructional strategies: identifying similarities and differences; summarizing and note taking; reinforcing effort and providing recognition; homework and practice; nonlinguistic representations; cooperative learning; setting objectives and providing feedback; generating and testing hypothesis; and cues, questions, and advance organizers. The brief nature of the walk-throughs did not permit the opportunity to observe the instructional strategies used. Therefore, data related to instructional strategies were collected only during the 20-minute observations.

Observation data. Observation data were collected on three different occasions in each school throughout the spring 2009 semester. Eight to 9 classrooms (total 97 classrooms) were observed in each school resulting in a total of 282 classroom observations. Teachers were informed of the observation 24 to 48 hours in advance.

Data from observations were analyzed using the chi-square goodness-of-fit test. Because instructional strategy data types were collected as separate variables on the observation instrument, separate chi-square goodness-of-fit tests were done for each strategy. With two categories in this case ($k = 2$), there was one degree of freedom ($df = k-1 = 2-1 = 1$). The χ^2 critical value with $df = 1$ and $\alpha = .05$, was $\chi^2 = 3.84$. Findings were considered statistically significant if the calculated χ^2 exceeded the χ^2 critical value. In these cases, the null hypothesis was rejected.

Initial to second observation. Using the chi-square goodness-of-fit test and observation one data contained in Table 29 as the baseline, the null hypothesis stated there would be no change in instructional strategy use from the initial to the second observation. The expected proportion of classrooms for each instructional strategy was computed. Thus, the expected proportion of classrooms using identifying similarities and differences (P_{SD}) was .170; summarizing and note taking (P_{SN}) was .364; reinforcing effort and providing recognition (P_{ER}) was .432; homework and practice (P_{HP}) was .614; nonlinguistic representations (P_{NR}) was .284; cooperative learning (P_{CL}) was .159; setting objectives and providing feedback (P_{OF}) was .057; generating and testing hypothesis (P_{GT}) was .045; and cues, questions, and advance organizers (P_{CQA}) was .159. The observed and expected quantities for each instructional strategy during observation two are displayed in Table 30.

Table 29

Instructional Strategy Use During Observations

Instructional strategy	Observation 1 (88 classes)		Observation 2 (97 classes)		Observation 3 (97 classes)	
Identifying similarities and differences	15	17.0%	10	10.3%	8	8.2%
Summarizing and note taking	32	36.4%	38	39.2%	40	41.2%
Reinforcing effort and providing recognition	38	43.2%	47	48.5%	34	35.1%
Homework and practice	54	61.4%	50	51.5%	65	67.0%
Nonlinguistic representations	25	28.4%	52	53.6%	49	50.5%
Cooperative learning	14	15.9%	12	12.4%	4	4.1%
Setting objectives and providing feedback	5	5.7%	1	1.0%	1	1.0%
Generating and testing hypothesis	4	4.5%	1	1.0%	2	2.1%
Cues, questions, and advance organizers	14	15.9%	23	23.7%	9	9.3%

Table 30

Instructional Strategy Use During Observation Two

Strategy	Observed *n*	Expected *n*	Residual
Identifying similarities and differences			
Yes	10	16.5	-6.5
No	87	80.5	6.5
Summarizing and note taking			
Yes	38	35	3.0
No	59	62	-3.0
Reinforcing effort and providing recognition			
Yes	47	42	5.0
No	50	55	-5.0
Homework and practice			
Yes	50	59.5	-9.5
No	47	37.5	9.5
Nonlinguistic representations			
Yes	52	27.5	24.5
No	45	69.5	-24.5
Cooperative learning			
Yes	12	15	-3.0
No	85	82	3.0
Setting objectives and providing feedback			
Yes	1	5.5	-4.5
No	96	91.5	4.5
Generating and testing hypothesis			
Yes	1	4	-3.0
No	96	93	3.0
Cues, questions, and advance organizers			
Yes	23	15	-8.0
No	74	82	8.0

A summary of the calculated chi-square test statistics for each instructional strategy during observation two appears in Table 31. There was statistically significant evidence that the use of the instructional strategies increased for nonlinguistic representations (25.2%) and cues, questions, and advance organizers (7.8%). Conversely, the use of two instructional strategies decreased: homework and practice (9.9%) and setting objectives and providing feedback (4.7%). There was no evidence that use of identifying similarities and differences, summarizing and note taking, reinforcing effort and providing recognition, cooperative learning, setting objectives and providing feedback, and generating and testing hypothesis instructional strategies changed from the initial to the second observation.

Table 31

Summary of Chi-Square Statistics for Instructional Strategy Use During Observation Two

Instructional Strategy	Chi-square χ^2	*df*	Asymp. Sig	
Identifying similarities and differences (*N* = 97)	3.085[a]	1	.079	
Summarizing and note taking (*N* = 97)	.402[a]	1	.526	
Reinforcing effort and providing recognition (*N* = 97)	1.050[a]	1	.306	
Homework and practice (*N* = 97)	3.923[a]	1	.048	*
Nonlinguistic representations (*N* = 97)	30.464[a]	1	.000	*
Cooperative learning (*N* = 97)	.710[a]	1	.400	
Setting objectives and providing feedback (*N* = 97)	3.903[a]	1	.048	*
Generating and testing hypothesis (*N* = 97)	2.347[a]	1	.126	
Cues, questions, and advance organizers (*N* = 97)	5.047[a]	1	.025	*

Note. * $p < .05$.

Second to third observation. Using the chi-square goodness-of-fit test and building from observation two data in Table 29, the null hypothesis stated there would be no change in instructional strategy use from the second to the third observation. The expected proportion of classrooms using the instructional strategy was computed. The expected proportion of classrooms using identifying similarities and differences (P_{SD})

was .103; summarizing and note taking (P_{SN}) was .392; reinforcing effort and providing recognition (PER) was .485; homework and practice (P_{HP}) was .515; nonlinguistic representations (P_{NR}) was .536; cooperative learning (P_{CL}) was .124; setting objectives and providing feedback (P_{OF}) was .010; generating and testing hypothesis (P_{GT}) was .010; and cues, questions, and advance organizers (P_{CQA}) was .237. The observed and expected quantities for each instructional strategy used during observation three are displayed in Table 32.

Table 32

Instructional Strategy Use During Observation Three

Instructional Strategy	Observed *n*	Expected *n*	Residual
Identifying similarities and differences			
Yes	8	10	-2.0
No	89	87	2.0
Summarizing and note taking			
Yes	40	38	2.0
No	57	59	-2.0
Reinforcing effort and providing recognition			
Yes	34	47	-13.0
No	63	50	13.0
Homework and practice			
Yes	65	50	15.0
No	32	47	-15.0
Nonlinguistic representations			
Yes	49	52	-3.0
No	48	45	3.0
Cooperative learning			
Yes	4	12	-8.0
No	93	85	8.0
Setting objectives and providing feedback			
Yes	1	1	.0
No	96	96	.0
Generating and testing hypothesis			
Yes	2	1	1.0
No	95	96	-1.0
Cues, questions, and advance organizers			
Yes	9	23	-14.0
No	88	74	14.0

A summary of the calculated chi-square test statistics for each instructional strategy used during observation three appears in Table 33. Changes in four instructional strategies were statistically significant. The use of the instructional strategy homework and practice increased 15.5%. Conversely, the use of three instructional strategies decreased: reinforcing effort and providing recognition (13.4%); cooperative learning (8.3%); and cues, questions, and advance organizers (14.4%) from the second to the third observation. There was no evidence that use of identifying similarities and differences, summarizing and note taking, instructional strategy nonlinguistic representations, setting objectives and providing feedback, and generating and testing hypothesis instructional strategies changed from the second to the third observation.

Table 33

Summary of Chi-Square Statistics for Instructional Strategy Use During Observation Three

Instructional Strategy	Chi-square χ^2	*df*	Asymp. Sig	
Identifying similarities and differences (*N* = 97)	.446[a]	1	.504	
Summarizing and note taking (*N* = 97)	.173[a]	1	.677	
Reinforcing effort and providing recognition (*N* = 97)	6.976[a]	1	.008	*
Homework and practice (*N* = 97)	9.287[a]	1	.002	*
Nonlinguistic representations (*N* = 97)	.373[a]	1	.541	
Cooperative learning (*N* = 97)	6.086[a]	1	.014	*
Setting objectives and providing feedback (*N* = 97)	.000[a]	1	1.000	
Generating and testing hypothesis (*N* = 97)	1.010[a]	1	.315	
Cues, questions, and advance organizers (*N* = 97)	11.170[a]	1	.001	*

Note. * $p < .05$.

Instructional strategy use changed over the course of the initiative but those changes were not consistent as the initiative progressed. A summary of instructional strategy use during observations appears in Table 29. Changes occurred from observation one to observation two. Nonlinguistic representations increased 25.2%, cues, questions and advanced organizers increased 7.8%, using homework and practice decreased 9.9%, and setting objectives and providing feedback decreased 4.7%. However, the changes in instructional strategy use from observation two to observation three showed changes that were the opposite of the changes in the first observed interval. Homework and practice increased 15.5%; reinforcing effort and providing recognition decreased 13.4%; cooperative learning decreased 8.3%; and cues, questions, and advanced organizers decreased 14.4%.

Research Question 2

Research question one focused on observed instructional practices as a result of the district-wide technology initiative involving Promethean boards. Research question two, "What changes do teachers report to their instructional practice as a result of a district-wide technology initiative involving Promethean boards?" and its subsequent questions, "If no changes are reported, what reasons are given?" and "Are these changes consistent with observed instructional practices?" focused on how teachers' reported use of the Promethean board manifested itself in instructional practices. Teacher interviews were used to gather data on reported changes to their instructional practices.

Ten teachers were interviewed. These teachers were purposely selected from the 97 teachers observed during the initiative rollout. Each teacher represented one of the middle schools that were part of the initiative (11 schools) with the exception of school 04, as no teacher from that school accepted the invitation to be interviewed. Teacher interviews lasted between 20 and 50 minutes and centered on how they used the Promethean board in their classroom.

The interview was guided by questions that prompted teachers to reflect on ways in which they taught before the installation of the Promethean board and after it. Additional prompts were used to gain insight into how their instruction had changed and what instructional benefits they believed the Promethean board had on their classroom practice. The final group of questions used to guide the interviews was related to research question three and are discussed later.

Instructional Practices

Data from walk-throughs and observations revealed that change occurred in teacher instructional activity organization and instructional strategy use over the course of the initiative, but data analysis did not reveal a clear pattern of change in instructional practices. The predominant instructional activity organization during all observed instances over the course of the initiative remained teacher-led whole group instruction. The findings regarding instructional activity organization and instructional strategy use support those reported by Rakes et al. (2006) and Kennewell et al. (2008) that many teachers use technology to support their current teaching practices.

During observation three, 4 of the interviewed teachers demonstrated advanced technology skills, and 6 of these teachers demonstrated intermediate skills. All 10 teachers demonstrated skills that were on the more advanced side of the technology skill continuum. Prompted by research that suggests that exemplary technology-using educators reside on the constructivist side of the instructional continuum (Becker & Ravitz, 1999; Glover et al., 2007; Kennewell & Beauchamp, 2007; Kennewell et al., 2008), the researcher analyzed the results of teacher interviews to determine if descriptions of their instructional practices were more traditional (as the quantitative data suggests) or more student-centered, indicating constructivist practices.

Two themes emerged from these interviews. The first emerged when teachers were asked, “How is the Promethean board used in your classroom and how has it changed the way you teach?” Teachers from three teachers (Schools 03, 08, and 11) commented that there had been no change in their instructional practices. The second theme emerged when all teachers described changes in instruction that centered on using at least one of four of the Promethean board’s functionalities: Teachers reported the use of multimedia, the ability to capture and save work, formative assessment, and interactivity. Two of these, multimedia and capture and save work, support more traditional instructional practices, although they do show a movement to engaging multiple learning styles. The other two, formative assessment and interactivity, could indicate a movement toward more constructivist practices.

No change. Teachers who reported no change in their instructional practices did not equate a change in technology used with a change in instructional practices. Instead, they commented on how they have fit the technology associated with the Promethean board into their current instructional practices. Their responses supported the findings in Rakes et al. (2006) and Kennewell et al. (2008). Instructionally, School 08’s teacher saw no change, stating, “I think it has enriched it, I don’t think it’s changing it, because I still do all of the activities I normally do.” School 03’s teacher did not see a difference between this and the other presentation tools that she had used in the past, stating, “It hasn’t changed that much because I always used at least the PowerPoint or some sort of technology so if using the boards makes them more interactive it's gonna help." Only one teacher (School 11) mentioned how it is used with student-centered activities in her classroom. She used collaborative groups and commented about how the board supports the group work as a source of guidance, not instruction, "I don't think that has changed except that they can have their directions up there when they are at stations."

Nine teachers (Schools 02, 03, 05, 06, 07, 08, 09, 10, and 11) commented that they used PowerPoint prior to the Promethean board installation to deliver their content and described how that has transitioned over to the Promethean board. School 02's teacher described her use before and after, "I did PowerPoint for all of my note taking and I did color coding, green was always the color code for what they needed to write down" so after the board was installed, "I could take my PowerPoints and . . . convert them." School 11's teacher expressed similar use within her department, "Because all of our lessons were already on PowerPoint so it's very easy to transfer a lot of those images to the Promethean board." These reports supported the quantitative findings in Tables 4.9 and 4.10 that showed use of competing presentation technologies decreased over the course of the initiative.

Multimedia. The presence of a tool in the classroom that has the capability of displaying video and audio as well as granting access to the Internet on a large interactive screen provides a level of access to resources that was not present prior to the initiative. The classroom technology model prior to the installation of the Promethean board consisted of a mounted 36-inch TV, an overhead projector, and two computers. Teachers believed that the Promethean board and access to Safari Montage had changed the way in which they used and presented multimedia in their classroom. Most reported changes were tied to the presentation, the ease of use in accessing quality resources without using additional equipment, and the quality that multimedia has added to their instruction.

The majority of teachers responded that the ability to display visual resources has had a great impact on their instruction. School 02's teacher cited the ability to display and interact with digital maps as having a large impact on their instruction, stating,

> I had taken an overhead and made maps on tablecloths with magnets and arrows to make them interactive. Once I figured out how to do it on the board I threw away the magnets and tablecloths. It was wonderful for Geography. How did I teach the Civil War without this?

School 08's social studies teacher described a day in her class,

> I use the board every day . . . we use it to teach the kids how to highlight and pick out important information . . . I put up primary sources . . . we used it for video. When we talked about the Panama Canal there's a web cam setup at the canal so we could bring up the web cam with the Promethean board and it was in real time and they can see how the locks go down and how they come up.

When asked to describe how the Promethean board has changed her classroom, School 10's teacher responded, "It's definitely brought in multimedia. Being able to use video and music at the touch of a button has really made the transition between using these different technologies great." She later describes this change,

> I did some video but you had to kind of had to show whole videos or larger clips to or it really wasn't worth the time or effort to fiddle with all of the technology. I

> don't have to fiddle with the TV or VCR or the DVD player or go hunting for the different things. It's all just right there. It's definitely made it nicer.

She and others (Schools 02, 03, 05, 08, and 09) identified Safari Montage as their key video source when using their Promethean board. Safari Montage is a purchased on-demand video library containing educational videos with indexed segments that can be easily integrated with ActivStudio (Promethean's software). School 05's teacher spoke about the seamless integration with other content, "We do videos with Safari Montage which is awesome. I can flip between them and scroll down to the next page."

Many teachers pointed to the small clip size as an instructional reinforcement; as School 02's teacher stated, "Safari Montage allowed me to share 1-minute and 2-minute videos. Sometimes that was all I needed to give them a picture of what they need to see." School 09's teacher reinforced the importance of the ability to chunk instruction with her comment,

> I love that we can access Safari Montage easily. I had not used it as much because with the small screen it just didn't keep the kids engaged like the large screen. If I choose a 5-minute segment on that [a topic] I don't feel like I'm being inefficient.

These comments support the endorsement of interviewed teachers for the importance of the multimedia functionality of the Promethean boards to impact classroom instruction. However, these teacher examples point to use of multimedia in the classroom to support teacher-led activities and not student-centered activities. Thus, although exemplifying the impact of the Promethean boards on classroom instruction, they support other findings that the technology was incorporated into existing instructional practices.

Safari Montage use. Since many teachers commented on their increased use of Safari Montage, I returned to the data set and analyzed whether the observation data supported their assertions. Safari Montage was purchased by Liberty District and made available to all teachers starting in the fall of 2007. It was identified on the instrument used during observations as “use of video with Safari Montage” written in the comments section of the form. Based on teacher comments during interviews, it was hypothesized that teacher observed use of Safari Montage would increase over the course of the initiative.

Observation data. Data from observations were analyzed using the chi-square goodness-of-fit test. With two categories in this case (k = 2), there was one degree of freedom (df = k-1 = 2-1 = 1). The χ^2 critical value with df = 1 and α = .05, was χ^2 = 3.84. Findings were considered statistically significant if the calculated χ^2 exceeded the χ^2 critical value. In these cases the null hypothesis was rejected.

Initial to second observation. Using the chi-square goodness-of-fit test and observation one data contained in Table 34 as the baseline, the null hypothesis predicted there would be no change in the proportion of teachers using Safari Montage from the initial to the second walk-through. The expected proportion of teachers using Safari Montage (PSM) was .023 during observation two. The observed and expected quantities of Safari Montage use during observation two are displayed in Table 35.

Table 34

Teacher Use of Safari Montage During Observations

Teacher use	Observation 1 (88 classes)		Observation 2 (97 classes)		Observation 3 (97 classes)	
Yes	2	2.3%	15	15.5%	10	10.3%
No	86	97.7%	82	84.5%	87	89.7%

Table 35

Teacher Use of Safari Montage During Observation Two

Teacher use	Observed *n*	Expected *n*	Residual
Yes	10	95	8.0
No	87	2.0	-8.0
Total	97		

The calculated chi-square test statistic for teacher Safari Montage use during observation two was χ^2 (1, N = 97) = 32.674, p = .000. The increase in teacher use of Safari Montage by 13.2% from the initial to the second observation was statistically significant.

Second to third observation. Using the chi-square goodness-of-fit test and observation two data contained in Table 34 as the baseline, the null hypothesis predicted there would be no change in the proportion of teachers using Safari Montage from the second to the third observation. The expected proportion of teachers using Safari Montage (P_{SM}) was .155 during observation three. The observed and expected quantities of Safari Montage use during observation three are displayed in Table 36.

Table 36

Teacher Use of Safari Montage During Observation Three

Teacher use	Observed N	Expected N	Residual
Yes	10	15.0	-5.0
No	87	82.0	5.0
Total	97		

The calculated chi-square test statistic for teacher Safari Montage use during observation three was χ^2 (1, N = 97) = 1.972, p = .000. There was no evidence that use of Safari Montage changed from the second to the third observation. These data supported the hypothesis that Safari Montage use (multimedia) would increased over the course of the initiative, particularly during the early part of the initiative.

Capture and save work. Teacher comments about capturing and saving work focused around the value this capability had for their students and the potential to impact their instruction. Several teachers (Schools 03, 05, 06, and 07) pointed to the ability to capture instruction and save their work for students in order to reproduce or reinforce concepts they covered during lecture. School 06's teacher shared an example,

> If we were brainstorming in a classroom I could save that as Block 2 and do the same for another class, and you can sometimes mesh them; I could write the three things down and on the next board when we were talking about something else and I said, 'What were those three things?', I could write them down again or go back to them.

School's 07's teacher shared how this ability had helped one of her students,

> I capture everything that I do every day in every one of my lessons. I have a very ill student. When she is absent, which is a lot, she would come to me and go over things with me and in school she is totally caught up. While they don't get my voice they get all the examples and my writing is up there and I am very conscious that I am going to save it so I don't skip any steps. If I say something that I think is important I make sure that I write it down. I want my notes to look like what their notes should be.

Although supportive of student learning, these examples, characterized by teacher descriptions of how "they" use the board to capture instruction, reinforce findings that the Promethean board primarily supported teacher-led instruction with minimal student interaction with the technology.

Formative assessment. Teachers' comments regarding formative assessments were tied to their use of the ActiVotes and how they were using the results of the assessments to better prepare their students for summative assessments. ActiVotes are Promethean's individual response systems (aka "clickers") that work within the ActivStudio software to support the development of assessments and instantly capture results. School 10's teacher mentioned using the ActiVotes as an effective formative assessment tool to check for understanding in their classroom, "We were able to use the ActiVotes for SOL [Standards of Learning] review and it definitely gave us an idea of who needed more help and where." And School 08's teacher pointed to its value in the review process, "I used to average a lot of retakes after a unit test. But now that I do the

ActiVote review I am down to maybe two maybe three retakes a unit. For some reason, it really works for them."

Many of the teachers (01, 03, 05, 08, 09, and 10) commented about their desire to have a classroom set of these devices even if they did not have much experience using them indicating their understanding of the technology's capabilities. These examples support the use of the Promethean technology to drive instruction that is more responsive to student needs. Although still used in the context of teacher-led instruction, the indications that changes are made to instruction, or assistance is targeted to student needs, reflected movement of some instructional practices in a direction that is more student-centered.

Interactivity. The name of the technology, "interactive whiteboard," implies that it is not a passive educational tool. Teachers pointed to this capability as having the most impact on their instruction. Some teachers (Schools 01, 05, and 07) thought that the boards had "shaken up some curriculum" in their schools. School 11's teacher commented that teachers "used to projecting it up on the overhead and lecturing become more focused on student-based learning." She continued by pointing out how it benefitted multiple learning styles, describing, "kids being able to manipulate (content). It's visual, it's auditory and they can move things around so it's kinesthetic and facilitates learning for all the different learning styles."

Although skill levels varied, teachers recognized the power of the ActivStudio software used with the Promethean board to deliver instruction that was more interactive. Many teachers (Schools 01, 02, 06, 09, and 11) spoke about the desire to master and integrate the interactive features into their instruction. School 06's teacher pointed to that as a goal, "That is something that I can't do yet, the layers and containers. There were a couple of times where I wish I had it because it would have made my life easier for a couple of different things." School 01's teacher strived to create more student engaged work, "I really wanted to focus on the greatness of the board and the interactivity of the board so I wanted every page to be interactive for the kids. They could drag and click and interact with the content."

Examples of this interactivity were provided by two social studies teachers. School 02's teacher shared two examples,

> I would make timelines and all of the events would be scrambled and they [students] had to drag them to the correct location. I also did this thing with Westward Expansion, there was this big painting done for the growth of the U.S. and I had it on the board and I taught myself how to do the magic eraser and get all things behind it and I had did it on the little TV, just the picture not the magic eraser. When it went up on the board it was not only "wow" for the kids and "wow" for me, the language arts teachers had walked by and they stepped in and went "wow."

School 01's teacher shared an activity she designed using containers,

> I did something with the containers so I would have three wars that were circles and facts about the wars and they had to drag facts about the three wars into the circles and I had a sound if they were correct.

These examples provided evidence that these teachers recognized the power of engaging students further in the instructional process and the need to increase student interaction by using the Promethean technology. This desire for teachers to move towards instruction that is more student-centered could indicate a change occurring within their practices that follows Guskey's Model of Teacher Change where changes in teachers' beliefs and attitudes are believed to occur after they see evidence of improvements in student learning resulting from changes in their instructional practices (2000). However, few instances of student use of the Promethean board were observed during observations.

Research Question 3

Teacher adoption of new technology is a complicated process, built on current and past technology experiences, social relationships, and environmental factors that influence and shape instructional decisions (Bandura, 1977; 1986; Compeau et al., 1999; Davis, 1989; Davis et al., 1989; Horton et al., 2001; Karahanna et al., 1999; Leh & Grafton, 2008; Lewis et al., 2003; Rogers, 2003; Windschitl & Sahl, 2002; Venkatesh et al., 2003). Research question three, "What do teachers report as having impacts on their adoption of new technology?" focused on what teachers' responses to survey and interview questions revealed about the influences on their adoption of the Promethean board. To answer research question three, questions were included on the protocol (Appendix D) used to interview the 10 teachers invited to complete interviews for phase one of the study and a teacher survey sent electronically to the 97 teachers who participated in the classroom observations.

An initial question prompted teachers to reflect on ways in which they learn new technologies. Additional prompts were used to gain insight into their beliefs about their technology abilities and the roles professional development, school-based leadership, and their peers had in their adoption of the Promethean board technology. Results were initially categorized using the UTAUT constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. Further categorization was based on the expanded conceptual framework from chapter two that expanded the four core constructs to include additional contributing categories to technology adoption.

Performance Expectancy

Performance expectancy is the strongest predictor of behavioral intention in UTAUT and is based on the constructs of perceived usefulness, extrinsic motivation, job-fit, relative advantage, and outcome expectations from contributing models. Indirectly included in this construct and effort expectancy is attitude toward using technology (Venkatesh et al., 2003). This construct was a gauge of what participants believed about adopting a technology and its impact on their job performance. Therefore, data was captured that reflected teachers' beliefs about the extent that the Promethean boards enhanced their instructional practices.

Perceived usefulness. Perceived usefulness (PU) reflected the extent that a participant believed that using a technology enhanced his or her job performance (Davis, 1989). For this study, it centered on how the teachers believed the Promethean board enhanced their instruction. Data gathered to answer this question came from the online teacher survey and teacher interviews.

Teacher survey. The data set for the teacher survey consisted of responses from 72 of the 97 teachers (74.2% response rate) observed over the course of the initiative rollout. These teachers completed a 15-question online survey at the end of the observation period. Teachers were asked to respond to the statement, "The Promethean Board Has Positively Impacted the Way I Teach", by selecting from one of the possible responses: strongly disagree, disagree, neither agree nor disagree, agree, or strongly agree. Table 37 displays the responses to this question. The majority of teachers (86.1%) who responded to the survey agreed (36.1%) or strongly agreed (50.0%) that the Promethean board had positively impacted the way they teach.

Table 37

Survey: The Promethean Board Has Positively Impacted the Way I Teach

Teacher responses	Frequency	Percentage
Strongly disagree	1	1.4%
Disagree	1	1.4%
Neither agree nor disagree	7	9.7%
Agree	26	36.1%
Strongly Agree	36	50.0%
No answer	1	1.4%
Total	72	

Teacher interviews. Teacher interview data that described changes in instructional practices also reflected teachers' beliefs and attitudes towards the Promethean board's perceived usefulness. Cited positive changes in instructional practices were a reflection of the teachers' views of the tool's instructional benefit for student learning and, thus, a positive change in the quality of their instruction. Teachers pointed to ways in which the Promethean board made their instructional delivery more dynamic by allowing them to incorporate more multimedia and better engage their students in the learning process.

School 02's teacher commented about the positive changes the Promethean board had on her practices. She reflected on her past practice using tablecloths and magnets to create maps and how the Promethean board improved her teaching of Geography.

> I threw away the magnets, I threw away the tablecloths and how wonderful to be able to not only put the notes the same way I did before . . . secondly to have a map that I could manipulate on the same board or have a series of them. So if I wanted to leave something or add something I could.

Her comments were mirrored by multiple teachers (Schools 01, 03, 05, 07, 08, 09, 10, and 11) when they reflected on how the use of interactivity and multimedia had made their instruction more efficient and effective. School 10's teacher detailed the ability to incorporate more multimedia into her instruction and the ease with which the Promethean board made this happen.

> It's definitely brought in multimedia, being able to use video and music at the touch of a button has really made the transition between using the technology and having a flip chart of some sort combined with the sound, it's great. Teacher Tube has a lot of different videos and the kids love seeing them and it's nice to be able to say, "Ok I can touch this button and it's going to pop up." I don't have to fiddle with the TV or VCR or the DVD player or go hunting for the different things. It's all just right there. It's definitely made it nicer and my job easier.

School 08's teacher provided multiple examples of the positive impact the Promethean board has had on facilitating her daily instruction.

> I use it every day! I usually do it to cover our agenda of the day. I use that tickertape thing all the time to, like, one side, [I've] given directions and they're working independently, I'll have up there to show what they're supposed to be doing. I use it to show videos from Safari Montage and I use it for NPR [National Public Radio] all the time. We play a video clip and then we do the headlines and then I just hand grab on the flip chart whatever the headlines are and then we debate from that. I also use it as a review. I'll make a flipchart where the kids would drag things and get feedback. And I do my ActiVote test review on there. I have it on all the time every day for lots of things.

Teacher perception of impact on student learning. Windschitl and Sahl (2002) found that several teachers who experimented with ICT technologies in their classrooms saw positive student changes and changed their instructional practices to incorporate a more constructivist approach. The infusion of a new technology into a classroom impacts all stakeholders. Teachers can be trained to incorporate the technology into their instruction but, ultimately, their real adoption will come when they see an impact on their students (Guskey, 2000).

Survey data: Student engagement. One question on the teacher survey focused on capturing teachers' beliefs about whether the board increased student engagement. Teachers were asked to respond to the statement, "The Promethean board increases student engagement with my content", by selecting from one of the possible responses:

strongly disagree, disagree, neither agree nor disagree, agree, or strongly agree. Table 38 displays the responses to the question. A majority of teachers (90.3%) agreed (55.6%) or strongly agreed (34.7%) that the board increases student engagement with their content.

Table 38

Survey: The Promethean Board Increases Student Engagement With My Content

Teacher responses	Frequency	Percentage
Strongly disagree	1	1.4%
Disagree	3	4.2%
Neither agree nor disagree	2	2.8%
Agree	40	55.6%
Strongly Agree	25	34.7%
No answer	1	1.4%
Total	72	

Survey data: Student achievement. A second survey question associated with impact on student learning asked teachers to respond to the statement, "The Promethean board has positively impacted my students' academic performance", by selecting from one of the possible responses: strongly disagree, disagree, neither agree nor disagree, agree, or strongly agree. Table 39 displays the responses to the question. A majority of teachers (63.9%) agreed (55.6%) or strongly agreed (34.7%) that use of the Promethean board increased student academic performance.

Table 39

Survey: The Promethean Board Has Positively Impacted My Students' Academic Performance

Teacher responses	Frequency	Percentage
Strongly disagree	2	2.8%
Disagree	3	4.2%
Neither agree nor disagree	18	25.0%
Agree	28	38.9%
Strongly Agree	21	29.2%
Total	72	

Teacher interviews. Teacher survey responses provided a snapshot of their beliefs regarding the Promethean board's impact on their students. However, teacher interviews provided specific classroom examples that supported or conflicted with the survey data. In addition to providing specific evidence about the impact of the Promethean board on student learning, the interviews offered glimpses into teachers' instructional practices and their instructional efficacy. Teacher responses often pointed to how the "novelty" of the technology increased student engagement. They spoke of how students wanted to get in front of the room and work with the technology even if it was to complete activities that they would have done in the past on the chalkboard or overhead projector. These examples of students working at the board were not, however, considered student engagement with the content. Examples directly associated with increased student engagement and achievement resulting from Promethean board use were only presented by three teachers (Schools 01, 02, and 05).

Student engagement. Most teachers provided examples of students working at the board and their willingness to participate in activities, even if it was just to do "review questions." School 01's teacher commented that she knew her SOL (Standards of Learning) review flipchart was awesome because, "I had every hand up and every kid jumping out of their seat to answer." And School 07's teacher believed that students "pay a little bit more attention because I think they are waiting for me to mess up." Several teachers (Schools 01, 02, 03, 08, 09, 10, and 11) included examples of how the use of multimedia "keeps their attention" and was "superior to overheads." Although these examples supported increased student engagement, that engagement was the result of using the technology and not the result of changes to instructional practices meant to increase engagement with the content.

Change in instructional practices to increase student engagement with the content required more than getting students up at the Promethean board to write the answer to a question. School 02's teacher hinted at a change in instructional practices when she spoke about how her attitude towards the Promethean board changed from the beginning when she was initially resistant to its use. "I'm the kind of person that once I figured out that it was much better for my students and I could teach more efficiently I didn't take my own words to heart." Instances of instructional change to increase student engagement reflected a teacher's understanding of the diversity of students within her classroom and their learning needs. School 01's teacher exemplified this when she shared how she created questions that addressed multiple learning levels with some that were "ridiculously easy and then some levels that were more difficult so that everyone had a chance to be successful." She would specifically call on students based on the level of the question and the student's ability to ensure that the student would experience success. Although these examples demonstrate that a few teachers were beginning to see the power of the Promethean boards to support student engagement, the view was not commonly held by all teachers.

Student achievement. The majority of teachers (63.9%) responded in the survey that they agreed or strongly agreed that the Promethean board positively impacted student achievement. However, when interviewed, teachers were more reserved in their responses. Many teachers (Schools 01, 02, 03, 05, 07, 08, 09, and 11) indicated that although they believed some students were benefiting, they were hesitant to identify the Promethean board as the primary reason for academic achievement. Comments by two teachers (Schools 07 and 09) highlighted that schools incorporated multiple strategies to improve student achievement, resulting in difficulty assessing whether increased student achievement was the result of any one of them. "We did a lot of stuff outside of Promethean [to improve achievement]." "Many factors go into student achievement . . . when you look at how much the presentation of the material helps . . . I don't know what percentage it increased scores."

Despite this general hesitancy, two teachers believed that flipcharts they created had an impact on some individual students' academic achievement. School 01's teacher created a SOL review flipchart for her students and commented about the review process,

> I think we actually went through it twice in my academic classes and I had only one student not pass and I had three quarters of my students receive an advanced . . . . I was so surprised and the kids who had failed and failed greatly throughout

> the year were getting like 515 [out of 600] and it was all my special education students.

School 05's teacher shared two stories showing how activities on the Promethean board helped students who were consistently low achievers.

> I mentor kids who were pretty low and one of the guys that I mentored, because of our review of the SOLs he got on a benchmark test and scored a 90%. Another was a girl, who was probably borderline low IQ. I would have her review the quizlet that I created on the board and she would do the matching flash cards on the board and she would do it for like 5 or 10 minutes and then she would ace the quiz, so I think it helped her do better.

These stories reflect the importance of good instructional design over mastery of the technology. These teachers spoke specifically about the instruction they created, the strategies they used, and the ties to their content. In these cases, the technology supported good instructional design. School 06's teacher summed this process up nicely referring to progress in academic achievement: "I think the strategies you develop are not just the board; it is how you use the board."

Summary of performance expectancy. Analysis of qualitative and quantitative data related to performance expectancy revealed teachers' beliefs about the Promethean board and its impact on their job performance. Teacher survey responses revealed that the majority (86.1%) believed that the Promethean board positively impacted the way they teach. Interview data provided supportive evidence for this. Teachers referred to the ease with which the Promethean board allowed them to incorporate multimedia content into their instruction and build more dynamic instruction.

Teacher survey responses revealed that the majority (90.3%) agreed or strongly agreed that the board increased student engagement. Interview data provided examples of how the Promethean board increased student engagement. Teachers indicated this increased engagement was a reflection of the technology being a “novelty” to students, prompting their desire to play with it. However, higher levels of student engagement occurred as a result of teachers changing their instructional practices to take advantage of the capabilities of the technology. They pointed to the Promethean board’s ability to display multiple levels of content which allowed them to address multiple levels of learners. They believed these capabilities allowed them to design instruction that engaged students in ways where all learning levels experienced success.

Teacher survey responses revealed that the majority (63.9%) agreed or strongly agreed that the board positively impacted students’ academic achievement. However, when interviewed, teachers were more reserved in their responses. They were hesitant to give the Promethean board sole credit for increasing student achievement, stating there are multiple strategies and practices implemented at the school level that target student achievement. Two teachers provided examples where they believed that the use of the Promethean board increased their students’ achievement, although these examples included evidence that this success could also be contributed to good instructional design.

Effort Expectancy

Venkatesh et al. (2003) believed the amount of effort associated with using a technology was based on the constructs of perceived ease of use, complexity, and ease of use. Additionally, they believed that self-efficacy and anxiety had no direct effect on technology adoption above and beyond effort expectancy. Therefore, in my analysis of teacher interview data, references to self-efficacy and anxiety by teachers were considered contributing factors to teachers' beliefs about the degree of ease associated with learning and using the Promethean board technology. Additional factors influencing technology self-efficacy beliefs are teachers' prior experiences with and knowledge of technology (Haldane & Somekh, 2005; Lewis et al., 2003; Venkatesh et al., 2003). Therefore, teachers' demonstrated technology levels prior to and throughout the initiative were analyzed to determine whether there were any changes as the initiative proceeded.

Teacher self-efficacy beliefs. Bandura (1977) described teachers with high self-efficacy as those who believed they would perform well and approached difficult tasks as something to be mastered rather than avoided. The online survey captured the responses of 72 of the 97 teachers observed during the initiative regarding their confidence using the hardware and software associated with the Promethean board. The interview data from the 10 teachers representing 10 of the 11 middle schools were analyzed for examples that captured how they went about learning the technology associated with the Promethean board and responses that reflected beliefs tied to technology self-efficacy. Additional analysis looked at responses that referenced prior experiences and self-perceptions as predictions of successful technology adoption.

Survey data. Although not a complete measure of teacher self-efficacy, confidence is a reflection of the strength of teachers' beliefs in their capabilities. Questions were asked in the online survey that captured teachers' levels of confidence about using the new technology introduced as part of this initiative and were separated into confidence using the hardware and confidence using the software. The hardware included the Promethean board and the pen and projector that were installed along with it, and the software included ActivStudio.

Teachers were asked to respond to the statement, "I feel confident using the technology associated with the Promethean board (i.e. pen, projector, etc. . . .)" by selecting from one of the possible responses; strongly disagree, disagree, neither agree nor disagree, agree, or strongly agree. Table 40 displays the responses to the question. The majority of teachers (94.9%) who responded to the survey agreed (48.6%) or strongly agreed (45.8%) that they felt confident in using the hardware associated with the Promethean board.

Table 40

Survey: I Feel Confident Using the Technology Associated With the Promethean Board (i.e. Pen, Projector, Etc. . . .)

Teacher responses	Frequency	Percentage
Strongly disagree	2	2.8%
Disagree	0	0.0%
Neither agree nor disagree	1	1.4%
Agree	35	48.6%
Strongly agree	33	45.8%
No answer	1	1.4%
Total	72	

The software installed with the Promethean board was called ActivStudio. Use of the Promethean board did not require use of ActivStudio. Rather, the software provided the mechanism for making content more interactive when using the board. Teachers were asked to respond to the statement, "I feel confident using ActivStudio (Promethean's software) to design instruction" by selecting from one of the possible responses: strongly disagree, disagree, neither agree nor disagree, agree, or strongly agree. Table 41 displays the responses to the question. The majority of teachers (76.4%) who responded to the survey agreed (51.4%) or strongly agreed (25.0%) they felt confident in using the software associated with the Promethean board to design instruction as compared to 94.9% of the teachers who felt confident using the hardware. The hardware associated with the Promethean board is fairly easy to master. However, the software has a steeper learning curve and was the focus of much of the professional development during the initiative.

Table 41

Survey: I Feel Confident Using ActivStudio (Promethean's Software) to Design Instruction

Teacher responses	Frequency	Percentage
Strongly disagree	3	4.2%
Disagree	5	6.9%
Neither agree nor disagree	9	12.5%
Agree	37	51.4%
Strongly agree	18	25.0%
Total	72	

Teacher interviews. Teacher's self-efficacy beliefs were revealed in discussions about their past and their attitudes towards the Promethean board in general. All 10 teachers interviewed expressed high self-efficacy beliefs using technology, including 1 teacher who was judged a novice by the school's principal and TRT. Two teachers (Schools 07 and 01) pointed to their prior education as a basis for their high self-efficacy, "I am an engineer by trade so I embrace that . . ." and "I'm a graphics major so design and technology come naturally to me." One teacher (School 11) pointed to her experiences growing up, "I grew up using a lot of technology so I am very comfortable." Comments by many (Schools 01, 03, 07, 09, 10, and 11) expressed fearlessness when it came to learning new technology. Examples of this fearlessness include comments by School 01's teacher, "If it doesn't do what you want, it's okay, it's not going to mess up," School 09's teacher, "I sort of trial and error and do it on my own," and School 03's teacher, "Technology does not intimidate me."

Teachers who express high self-efficacy are motivated to master the technology, often using means outside of the organization (Haldane & Somekh, 2005). These teachers researched their challenge and identified opportunities to achieve mastery. Four of the interviewed teachers (Schools 01, 03, 05, and 09) sought additional professional development opportunities or challenged themselves to learn the content independently. School 03's teacher attended an out-of-town training at her own expense. "When I knew they [the boards] were coming, another teacher and I went up to Boston last summer to attend training." School 09's teacher located online professional development sessions prior to their advertisement within the district, "I took the online basic training and then my principal paid for me to take the advanced training before the county started offering it." School 05's teacher spoke about making learning this technology her personal initiative,

> When I have something to learn I go above and beyond. Before the boards came I found out I could have the software at home. I downloaded all of those resource packs and started playing with the software at home.

School 01's teacher's comments about her training mirrored this self-directed learning approach, "Most of my skills came from trial and error and from doing it on my own."

The high confidence ratings (hardware 94.9%, software 76.4%) that teachers reported on the survey were mirrored in teachers' interview responses that spoke to their self-efficacy beliefs. They pointed to high levels of confidence in their abilities to learn a new technology based on past experiences and professional training, and provided multiple examples where they took the initiative to learn about the technology outside of district-provided resources.

Prior experiences with technology. A teacher's prior technology experiences shape their attitudes and beliefs about learning new technology and technology's role and value in their instruction (Haldane & Somekh, 2005; Lewis et al., 2003; Venkatesh et al., 2003). This, in turn, influences their behavior when it comes to adoption and their self-efficacy beliefs. If prior experiences with technology have been positive, teachers will likely embrace new technology as it is introduced. Teachers with positive technology experiences are more likely to overlook the little nuances that might frustrate others and focus instead on discovering solutions to them (Haldane & Somekh, 2005). Conversely, if prior experiences with new technology have been negative, teachers are more likely to focus on the negative issues they encounter, blaming problems on the technology even if fault lies elsewhere. Teacher frustration with even small problems can grow quickly and result in minimal classroom adoption.

The desire to embrace new technology and become an early adopter is a reflection of a teacher's self-efficacy beliefs and result, in part, in their mastery of existing technology. When a technology initiative is rolled out, it is assumed that teachers who are currently more advanced users will be the fastest to adopt and the first to use the tool at a more advanced level. Rogers refers to these as the early adopters (2003).

Teacher interviews. Among the 10 teachers who were interviewed, 4 were initially identified as advanced users (Schools 01, 03, 06, and 10), 5 were initially identified as intermediate users (Schools 02, 05, 07, 08, and 11), and 1 (School 09) was initially identified as a novice user by their school's principal and TRT. When asked to self-identify their technology level during the interview, 3 of these teachers (Schools 01, 07, and 10) placed themselves at the advanced level, 2 (Schools 03 and 09) placed themselves at the high intermediate–beginning advanced level, and the remaining 5 (Schools 02, 05, 06, 08, and 11) placed themselves at the intermediate level. Table 42 lists teachers' technology skill levels as identified by principals and TRTs as well as their self-reported levels during the interview.

Table 42

Teacher Technology Levels in Multiple Measures

Teacher technology levels	Principal and technology resource teacher (TRT) identification	Self-reported in interview
Teacher school 01	Advanced	Advanced
Teacher school 02	Intermediate	Intermediate
Teacher school 03	Advanced	High-Intermediate
Teacher school 05	Intermediate	Intermediate
Teacher school 06	Advanced	Intermediate
Teacher school 07	Intermediate	Advanced
Teacher school 08	Intermediate	Intermediate
Teacher school 09	Novice	High-Intermediate
Teacher school 10	Advanced	Advanced
Teacher school 11	Intermediate	Intermediate

Note. No teacher from School 04 participated.

Teacher interview responses revealed that although teachers reported confidence in their technology skill levels and identified themselves as having many of the skills characteristic of an advanced user—such as using containers, effective understanding of layers, and using the ActiVotes—they hesitated to include themselves in the advanced category because they felt there was much they did not know. Comments: School 01's teacher, "I don't know all of the functions"; School 03's teacher, "There is a lot more there that I want to do"; School 05's teacher, "I don't know what else is there, I'm not there yet"; School 06's teacher, "I don't know what more the software can do"; and School 02's teacher, "As soon as you figure something out you learn you can do more with it," reflect a self-awareness of their own skills and the depiction of their impression of an advanced user as an individual who knows all of the functions of the software and possesses the skills to use them.

Interestingly, a few teachers referred to their peers' beliefs about their technology expertise when assessing their own technology levels. For example, School 07's teacher considered the fact that her peers send her work to format as a reflection of her technology skill level being above theirs. She stated, "Things get sent to me and then I format them." School 01's teacher referred to the status of the title that her principal gave her when it came to her skills with the Promethean board. She commented, "My principal calls me the Promethean Queen."

Teacher technology levels summary. The majority (9 out of 10) of the teachers interviewed were initially ranked on the higher end of the technology skill continuum by their school's principal and TRT. Although this composition limited the voice of the novice teacher in the findings, the speed and level at which intermediate and advanced level teachers learned and demonstrated intermediate and advanced technology skills supports Rogers' (2003) ideas regarding early adopters: Teachers who were initially more advanced users were fast to adopt and use the tool at a more advanced level.

Perceived ease of use. Perceived ease-of-use (PEOU) reflects the amount of work that end users think it will take to learn the new technology (Davis, 1989). Part of this construct is a reflection of teachers' beliefs and attitudes regarding new technology and part is a reflection of the nature of the technology. Some technologies are more difficult to learn than others. The interview data from the 10 teachers representing each middle school (except School 04) were analyzed for examples that captured how difficult or easy the teachers felt the Promethean board technology was to learn.

Teacher interviews. ActivStudio and the advanced formatting features of the software presented challenges to many of the teachers. Comments from teachers revealed a large commitment of time and effort to learn the new technology, reflecting lower levels of perceived ease of use (i.e. the technology took a lot of work to learn). References to the steep learning curve were present in multiple teacher responses. School's 01 and 05 teachers shared examples of extended development time, "I remember spending 3 or 4 hours on one flipchart because you want to do something and you can't figure out how," and "I think the time that it takes to make flipcharts . . . I love technology so I don't mind spending in 4 hours at night trying to figure out how to move the box."

Four teachers (Schools 02, 03, 09, and 10) shared comparisons of this software to Microsoft Office, a software they are accustomed to using: "It's not as intuitive as PowerPoint or Word"; "It took a long time to create something, much longer than making PowerPoints"; "Not having the same abilities that you have in PowerPoint to be able to incorporate animation and sound has definitely been frustrating for me."

Learning a new technology takes time and the interviewed teachers recognized that commitment. However, their comments reflected a much higher learning curve than they anticipated. Extended development time and frustration trying to duplicate actions they could do in other software titles reflected a low perceived ease-of-use.

Summary of effort expectancy. Analysis of qualitative and quantitative data related to performance expectancy revealed teachers' beliefs about how much effort it would take to learn to use the Promethean board. Teacher survey responses revealed they felt confident in using the Promethean hardware (94.9%) and software (76.4%). Data revealed that all of the interviewed teachers held high technology self-efficacy beliefs. They pointed to prior professional experiences with technology, fearlessness when it comes to working with technology, and confidence in their technology knowledge and abilities. Observational, survey, and interview data supported their confidence in their abilities. Teachers who started the initiative rated as intermediate and advanced technology users by their principal and TRT demonstrated these levels of technology use with the Promethean board by observation two.

The interval of time it took for teachers to obtain skills using the Promethean boards that were equivalent to their skill levels with other technology tools appears to be a reflection of the Promethean board's low perceived ease of use (i.e. the technology is difficult to learn). Interviewed teachers pointed to the extended development time and frustration trying to duplicate actions they could do in other software titles as examples of the high learning curve associated with the Promethean board.

Facilitating Conditions

Facilitating conditions in UTAUT relate to how well the participant believes the organizational and technical infrastructure supported the technology initiative. These are based on the constructs of perceived behavioral control, facilitating conditions, and compatibility from contributing models (Venkatesh et al., 2003). Data captured from the online teacher survey and teacher interviews were analyzed to determine how facilitating conditions influenced teacher adoption of the Promethean board. Focus was placed on data describing the environment and professional development.

Environment. Central to the success of a technology initiative is putting equipment in place that operates at optimal levels and minimizing disruption to the instructional process by addressing any hardware/software issues quickly. In Haldane and Somekh (2005), the central role the functionality of the interactive whiteboard had in the classroom came from its prominent position in the classroom, and any failure to use it was fairly conspicuous. Functionality was also tied to the reliability of the technology. Organizations need to ensure that technology associated with any initiative is functional and reliable. Teachers who have to deal with a piece of unreliable technology develop negative attitudes toward the technology (Davis et al., 1989).

Teacher interviews. Ten teachers were interviewed about the functionality of the Promethean board and impacts that the board had in their classrooms. Placing the Promethean board in the front of the classroom sent a clear message to teachers regarding expectation of use. As School 07's teacher stated, "You know . . . they put it in my room in the front and they put it over my chalkboard so really I didn't have much of an option." Two teachers (Schools 02 and 09) responded positively to having the large screen in the front of their room versus the TVs that were installed prior to the initiative. One teacher commented, "With the small screen . . . it just didn't keep the kids engaged; the larger screen is much better." Another stated, "The videos and everything are so much more effective on this board than on the TV."

Only School 09's teacher had hardware problems with her board,

> I think I told you I had two bulbs go out in the first week. It was okay; the odds of me getting two bulbs that were bad was low. The third one didn't have any

> glitches. We thought after the second one, clearly something was causing the bulbs to break.

This experience did not deter her from using the board, but she did recommend having replacement bulbs on hand at the schools to minimize the impact to instructional time and having backup projectors available in case of hardware failure.

Most teachers (01, 02, 03, 04, 05, 06, 07, 08, 10, and 11) responded there was nothing negative about having the boards present in their classrooms. The only personal or shared issue raised by teachers (Schools 01, 02, and 07) was a classroom management concern. Teachers had to put their backs to students when working at the board and worried this would have a negative impact on classroom dynamics. However, two teachers discounted this:

> I was concerned that because I used an overhead that I faced the class and when you're using the promethean you're not facing the class, you turn your back to the class when you write on it and I thought that would be a problem but it was not a problem. Because you don't turn your back much or for very long and I found that because stuff was already up there I walked around lot more and then when I was using the overhead I was a little attached to the overhead. That's probably a benefit for the kids.

and

> Some teachers feel like they don't like having their back to the students, you know, they like their overhead projector. I hate the overhead projector and that

light is blinding and it's horrible and it's all hot, but I mean I guess that's sort of a complement. I don't miss the overhead at all.

Professional development. Professional development is an important component in building teacher technology skills and expanding their knowledge base. Leh and Grafton (2008) and Haldane and Somekh (2005) cited its importance in any initiative. Teachers optimally select professional development opportunities that best meet their learning needs. However, many do not know what they do not know. Becker's (1994) analysis of survey responses found that exemplary technology using teachers had access to more formal professional development opportunities.

Teacher survey. The teacher online survey captured how many hours of Promethean board professional development teachers attended. Individual schools were required to offer at least two hours of professional development to their staff, and the county offered two additional online professional development opportunities through Promethean. One opportunity was the 6-hour Promethean Level I course which covered the core tools and functionality of ActivStudio, and the other was the 11-hour Promethean Advanced level course which covered higher use of the tools and required teachers to create and submit an instructional flipchart.

Teachers were asked to identify the total number of hours of school-based professional development they attended. This does not reflect the total number of school-based professional development hours that were offered, and it does not identify if these sessions were mandatory. Table 43 displays the results of the survey data showing the number of school-based professional development hours attended. The majority (94.4%)

of teachers who responded to the online survey (N = 72, 74.6% response rate) attended at least two hours of school-based professional development.

Table 43

Survey: Teacher Hours of Professional Development

Hours of school-based professional development attended	Number of teachers	Percentage
Zero hours	1	1.4%
One hour	3	4.2%
Two hours	12	16.7%
Three hours	24	33.3%
Over three hours	32	44.4%
Total	72	

Teachers were asked to identify whether they completed the 6-hour Promethean Level I course and the 11-hour Promethean Advanced course. Table 44 displays the results of the survey data showing the number of teachers that attended each course. The majority (61.1%) of teachers who responded to the survey completed the 6-hour Level I Promethean course. However, only 12.5% of these teachers completed the 11-hour Advanced level course.

Table 44

Survey: Teacher Participation in Online Promethean Courses

Course title	Yes		No	
Promethean Level I	44	61.1%	28	38.9%
Promethean Advanced	9	12.5%	63	87.5%

Teacher interviews. Analysis of teacher interview data focusing on professional development and teacher preferred learning styles revealed several themes in interview responses: the value of professional development they received, their preferred learning styles, and the follow-up or next level of professional development.

Value. The school-based professional development consisted of face-to-face sessions where teachers were presented with technology "how to's" using the tools within ActivStudio. Because teachers do not have much free time, they have high expectations for any activity that deprives them of time. Negative responses implied that their expectations were not met by some of the opportunities provided. School 01's teacher raised concerns that her TRT did not have adequate knowledge or experience with the software to deliver the training.

> He doesn't relate well to the teachers and obviously he was newly trained. He would try to do something and it wouldn't work and he would be like, "um well I'll show you how to do that at another time." You know he couldn't take the time to master it.

One teacher commented that she found the training to be useful in providing a "basic knowledge." However, many commented these sessions did not meet their needs. Several teachers (Schools 01, 03, 05, and 09) felt that the level was below them. "I didn't think that it was a useful time because I had already done the summer and [online course] through Promethean"; "I thought ours was very minimal and not at all that useful"; and "I don't remember anything beyond a basic, I probably only needed 15 minutes of instruction and then I learned the rest by myself." The challenge of training a technologically diverse staff was summarized by School 09's teacher in her response, "Often when you do a staff or school-wide professional development you teach to the lowest common denominator and my skills are a little bit above that." Several teachers (Schools 05, 07, 10) stated that the online course they took from Promethean provided just as much information. It is important to note that there were no novice level teachers included in the interview sample. Therefore, their voice is absent from the responses about whether required professional development met the novice teachers' needs.

Format: School-based. The format of school-based professional development consisted of face-to-face sessions where teachers were required to attend at least two hours of training. Many of these were offered in two 90-minute sessions conducted during teacher planning time. These were small group, instructor-led sessions. Most teachers commented that these sessions did not fit their learning styles, which were more self-directed and independent. School 01's teacher commented about her preference for technology training, "Introduce me to the technology and say, 'here it is' and let me play with it and give me time to do it." Two other teachers also reported their styles to be more kinesthetic. School 05's teacher stated, "You have to do it yourself and play with it," and School 11's teacher stated that she preferred "practicing it on my own, I'm a kinesthetic learner and so I have to do it to learn it."

School 03's and 06's teachers described similar independent learning styles but still felt the need to have an expert nearby. School 03's teacher commented, "I'm more of a do-it-yourself kind of person, so I would just like to be given time to design stuff… but if I need help I can go to somebody." School 06's teacher stated, "I like to sit and play with it myself but I also like to have somebody there to answer my questions at the same time."

Format: Online. The Promethean online courses consisted of small chunked video lessons followed by short multiple choice assessments. The Advanced course included the requirement that teachers submit an instructional flipchart. Many teachers (01, 05, 07, 08, 09, and 10) reported that they completed the online Level I Promethean course. The online courses allowed teachers to access video content on demand that contained quick tutorials on the multiple tools in ActivStudio. School 07's teacher commented about the ability to watch videos demonstrating the skills, "The videos are good in the very beginning with just the basics." School 09's teacher expressed similar views about the videos, "The online training . . . was probably very helpful. I like to do the things online to see how you do certain things."

Format: Follow-up and the next level. When teachers leave a professional development session, they have the content learned fresh in their mind but often do not get to use it right away. Many find that they have lost some of their knowledge when it comes time to implement. Follow-up is often ignored until the next scheduled session. Understanding not all professional development needs to occur in a "classroom-like" setting, one teacher commented about the value she found in an alternative method her TRT used to ensure teacher success using the Promethean board. School 02's teacher stated,

> The TRT did a great job, I think he must have appeared in everyone's room in every block almost. At least it seemed like he was constantly stopping in and

> asking, which was nice because if something had happened earlier that class or "wait a minute, this happened, what did this" and he would take 10 seconds to tell the class "wait a minute" and go back and he could explain it to me. Or I made myself a note. He made himself very available to answer any questions.

Many teachers expressed a desire for the next level of professional development to better meet their learning styles. School 06's teacher suggested the need for the time and opportunity to work with an expert present when she commented, "I need more assistance. Like if I say I want to make a chart that does this I need people to sit down with me and walk me through this a little bit more." School 01's teacher stated that many sessions contained few examples that addressed her particular content area. This sentiment was echoed by others when they expressed a similar desire to restrict the sessions to their content peers. For instance, School 02's teacher stated, "I would like all sixth grade teachers in a classroom making flipcharts that we could do with someone who really knew what they were doing." School 01's teacher's shared this vision when she stated,

> What would be wonderful at the beginning of the year is if we had divided up and somebody could take the Geography unit and making sure that if you took all of the 6th grade teachers . . . and divided them up by unit and also divided them up by Promethean skills.

Summary of facilitating conditions. Analysis of qualitative and quantitative data related to facilitating conditions revealed teachers' beliefs about how the organizational and technical infrastructure supported use of the Promethean board.

Teacher interview data revealed that environmental conditions were supportive of use of the Promethean board. Only one teacher identified initial difficulties with board functionality but these were resolved quickly. Teachers commented about the board's placement in the front of the classroom over existing chalk and dry erase boards. They interpreted this placement as a message about the board being a primary instructional tool in their classrooms and that they were expected to use it. Teachers did not identify any negative impacts on their classrooms from the installation of the Promethean board. In fact, teachers' initial concerns about classroom management issues when their backs were to the class were found by some to be nonexistent.

Professional development was a primary focus in the initiative rollout. Schools were required to provide at least two hours of training for teachers at the basic level. Teacher survey data (N = 72) revealed that 94.4% of teachers completed at least two hours of professional development in their schools. In addition to those professional development sessions offered in the schools, teachers took advantage of online training purchased by Liberty District and provided by Promethean. Teachers reported participating in the Promethean Level I course (61.1%) and the Promethean Advanced course (12.5%). Teacher interview data revealed that teachers appreciated the amount of training provided for them but many felt that the training was too basic or designed for the lowest level of user. They also felt it was too scripted and did not allow them adequate time to practice on their own with an expert present. Many pointed to this format as a desire for follow-up professional development along with sessions that are restricted to their content area and grade-level peers.

Social Influence

Social influence is the extent that a participant perceives that his or her peers believe that he or she should use the new technology (Venkatesh et al., 2003). It is derived from the constructs of subjective norm, social factors, and image from contributing models. Expectations about use/adoption are important in measuring the success of an initiative. The power of institutional culture is clearly reflected in its staff when clear expectations about desired behaviors and practices are presented and embedded in all aspects of the culture (Bandura, 1986; Venkatesh et al., 2003; Windschitl & Sahl, 2002). The power of this institutional influence is reflected when individuals conform to the expectations of others and can be an effective tool motivating the more resistant learner (Karahanna et al., 1999). Data from teacher interviews were analyzed to capture the impact social influences had on teachers' adoption of the Promethean board.

Actions and performances of their peers. One of the most influential forces on a teacher's instructional practices is his or her peers. Aiken (1980) pointed to peers as an important influence in shaping attitudes if those peers are considered significant to the individual. Becker's (1994) research found that exemplary technology using teachers often worked in environments where their peers were equally exemplary in their technology use, suggesting the presence of a social network of computer-using teachers.

Peer experts. During interviews, teachers were asked if there were others in their schools besides the TRT who they could go to for technology assistance. Many identified other teachers who exhibited advanced technology skills. They believed these skills were often self-developed. School 08's teacher identified a social studies teacher who is, “definitely self-taught and he’s a technology guru type guy,” and School 01’s teacher referred to a peer who along with herself are called the “Promethean Queens” by their principal.

Although they did not identify themselves as experts, a few teachers (Schools 01, 02, 06, and 07) included examples where teachers had approached them to assist with technology problems. This suggested that these teachers might be considered peer experts by others. School 06’s teacher commented that what she knew was shared between schools,

> I was explaining to somebody what I was able to do with a board and she went home and told her husband who teaches at another school. So I get this email, “Can you tell me how to do this?”

School 07’s teacher pointed out that, “Things get sent to me and then I format them.” School 02’s teacher reflected on how she helped other teachers, stating, “When I sat down with people who were creating something I’d say, ‘did you know you could do this’ and then showed them how to duplicate pages and bring over images.”

Professional learning communities (PLCs). Leveraging the peer group to encourage the unmotivated or underskilled is an alternative professional development strategy for developing technology skills and knowledge. Haldane and Somekh (2005) reported such influence as learning communities emerged. These communities allowed new teachers to learn through observation and collaboration with more experienced teachers.

During interviews, several teachers shared the value professional learning communities played in their learning and how they facilitated sharing and collaboration. School 11's teacher spoke about how she went to her PLC for assistance: "If I didn't understand something, the math department had the Smart Boards for a lot longer so I felt comfortable asking some of my colleagues for help." Schools 07's and 02's teachers spoke about their PLC allowing them to share the instructional and developmental load. These teachers shared, "The [PLC] helps a lot so the three of us share everything, we develop a flipchart together and everything," and "It enables us to share stuff much more readily and every now and then you try something new and if it doesn't work you immediately can tell them, 'Don't do this just save that slide or let's change this.'"

Summary of social influence. Analysis of qualitative data related to social influence revealed teachers' beliefs about the influence their peers had on their adoption of the Promethean board. Teacher interview data revealed that peer groups were important support structures when struggling with technology issues. Many teachers pointed to other teachers they reached out to for technology support beyond their school's TRT. Additionally, a few teachers described themselves as those peer experts that others come to for support—although they did not identify themselves as experts.

Professional learning communities were reported by many teachers as a collaborative and supportive network that has helped them master the Promethean board. These networks allowed them to collaborate on instruction and share development demands with each other since creating flipcharts was often time consuming.

Additional Findings

In addition to the themes identified in the analysis of the interviews related to research questions two and three, an additional theme emerged. This theme centered on teachers' interpretation of the intent of the initiative. Analysis of teacher responses to the interview question, "What were the expectations for using the interactive whiteboard in your school?" revealed minimal expectations. Two teachers (Schools 05 and 07) did not identify any communicated expectations from their school leadership. However, the board installation in the front of the classroom and its mounting over existing chalk or dry erase boards sent a message to School 07's teacher: "They put it in my room in the front and they put it over my chalkboard so I didn't have much of an option." Several teachers (Schools 01, 02, 07, 08, 09, and 11) mirrored this when they stated their belief that the initiative was intended to replace existing technology in their classroom in order to force use of the Promethean boards. School 09's teacher stated this interpretation: "They're coming and the overhead projectors will be taken away so you'd better learn how to use them." School 08's teacher reinforced this perspective, stating, "We would be using them from the day they arrived no matter what and that they would take away our overheads from us no matter what."

Most teachers (Schools 01, 02, 03, 06, 07, 08, 09, 10, and 11) reported that expectations of use were communicated to them by their school's TRT, but expectations reflected a lack of specificity of demonstrated skill or instructional use. "We would use them at least for a portion of the class every single day" (School 11). "At the beginning they didn't care how you used it, they just wanted some use" (School 06). The majority of teachers (Schools 01, 02, 03, 06, 08, 09, 10, and 11) felt the TRT's message was the expectation of their principal. As mentioned by School 01's teacher, "We were told by our TRT that the higher-ups wanted us to use them pretty much as often as possible and on a daily basis." However, only one teacher (School 11) commented that her principal expected to walk into her classroom and "see a student with a pen [ActivPen] in their hand working at the board."

Summary of Phase One Results

Phase one focused on capturing data that represented teachers' beliefs, attitudes and practices using the Promethean board. Data were analyzed to answer three research questions and seven hypotheses. Phase one results are summarized by research question and hypothesis, data source(s), and results in Table 45.

The Promethean board initiative changed teachers' observed instructional practices. The greatest increases in use of the Promethean board came during the early part of the initiative with growth slowing as the initiative proceeded. Over the course of the initiative, teachers progressively spent a higher percentage of instructional time using the Promethean boards in their classrooms. However, this growth was not mirrored in all schools. The increase in use of the Promethean board resulted in a decrease in use of competing presentation technologies and slight decreases in the use of other technologies. Although there were changes in teacher activity organization and instructional strategy use over the course of the initiative, no clear patterns of use emerged that suggested a change in teachers' instructional beliefs and attitudes.

Teachers reported many factors that influenced their adoption of the Promethean board. Many of these factors reflected the UTAUT framework and were tied to performance expectancy, effort expectancy, facilitating conditions, and social influence. A factor related to communication was raised by many teachers and centered on communication of the intent of the initiative and expectations for use at the classroom level. Teachers' comments about inconsistencies in messages from administration and from TRTs concerning the intent of the initiative warranted further study and prompted the researcher to expand the scope of this study to include additional stakeholders.

Table 45

Summary of Results of Phase One

Research questions/hypotheses	Data	Results
1. Are there changes in teachers' observed instructional practices from the beginning to the end of the semester when Promethean board initiative is rolled out, and if so what are they?		There were changes to teachers' observed instructional practices from the beginning to the end of the Promethean board initiative rollout.
H1. As the initiative proceeded, use of the Promethean board by teachers would increase.	Walk-throughs	Walk-through data supported this hypothesis. Growth occurred in the earlier part of the initiative with continued growth slowing as the initiative proceeded. However, school-level use was not uniformly presented at the same levels when compared to initiative-wide use.
	Observations	Observation data supported this hypothesis. However, growth occurred in the earlier part of the initiative with continued growth slowing as the initiative proceeded. School-level data showed similar trends with the exception of School 01 which showed a decrease in teacher use as the initiative proceeded.
H2. As the initiative proceeded, overall use of competing presentation tools would decrease.	Walk-through	Analysis was not included due to questions of data validity raised in phase two.

(continued)

Table 45 (continued)

Research questions/hypotheses	Data	Results
	Observations	Analysis was not included due to questions of data validity raised in phase two.
H3. As the initiative proceeded, overall use of other technology tools would remain constant.	Walk-through	Analysis was not included due to questions of data validity raised in phase two.
	Observations	Analysis not included due to questions of data validity raised in phase two.
H4. As the initiative proceeded, a higher percentage of teacher time would be spent using the Promethean board.	Observations	Observation data supported this hypothesis. A higher percentage of teacher time was spent using the Promethean board as the initiative proceeded.

(continued)

Table 45 (continued)

Research questions/hypotheses	Data	Results
H5. Teacher instructional activity organization would not change as a result of the initiative.	Walk-throughs and observations	Overall, walk-through and observation data did not support the hypothesis that teacher instructional activity organization would not change as a result of the initiative. Teacher-led whole group instruction decreased initially and then increased to pre-initiative levels in walk-throughs and observations. Student-led whole group instruction decreased over the course of the initiative in walk-throughs and observations. Small group activities decreased over the course of the initiative during walk-throughs but increased from the initial (21.6%) to the third (50.5%) observation. And independent activity increased initially and then decreased to pre-initiative levels in walk-throughs but consistently decreased in observations.

(continued)

Table 45 (continued)

Research questions/hypotheses	Data	Results
H6. Teacher instructional strategy use would not change as a result of the initiative.	Observations	Overall, observation data did not support the hypothesis that teacher instructional strategy use would not change as a result of the initiative since use of multiple strategies were observed to change as the initiative proceeded. Homework and practice, setting objectives, and providing feedback decreased from the first to second observation and nonlinguistic representations and cues, questions, and advance organizers increased. Reinforcing effort and providing recognition; cooperative learning; and cues, questions, and advance organizers decreased from the second to third observation and homework and practice increased.

(continued)

Table 45 (continued)

Research questions/hypotheses	Data	Results
2. What changes do teachers report in their instructional practices as a result of a district-wide technology initiative involving Promethean boards? a. If no changes are reported, what reasons are given? b. Are these changes consistent with observed instructional practices?	Teacher interviews and observations	Several teachers commented that the Promethean board had not changed their instructional practices, only enhanced them. Those who did respond about changes identified the ability to incorporate multimedia and video, the ability to capture and save instruction, the ability to design and incorporate more formative assessment, and the ability to design more interactive instruction. Observational data supported that teachers increased their use of Safari Montage, a video on demand server in the schools over the course of the initiative, with greatest increase of use occurring earlier in the initiative.
H7. Teacher use of Safari Montage would increase over the course of the initiative.	Observations	Observation data supported this hypothesis. Safari Montage use increased over the course of the initiative, with increases occurring during the first part of the initiative.
3. What do teachers report as having impacts on their adoption of new technology?	Interviews and teacher surveys	Interview and teacher survey data revealed multiple themes when teachers reported about impacts on their adoption of Promethean boards: perceived usefulness, student engagement and achievement, perceived ease of use, self-efficacy, teacher technology levels, functionality, professional development, peers, and Professional Learning Communities (PLCs).

Chapter four summarized the qualitative and quantitative data analysis representing phase one data captured during the walk-throughs, observations, survey responses, and teacher interviews that occurred during the Promethean board rollout in the spring and summer 2009 semesters. Once these data were analyzed, a need arose for further data collection and an expansion of the scope to include additional stakeholders. That expansion and its justification are outlined in chapter five.

5. METHODS FOR PHASE TWO

Chapter four presented the results of the analysis of phase one data collected during the initiative's rollout in the spring and summer 2009 semesters. Data from that phase was collected and analyzed to answer research questions one, two, and three and focused on teachers' beliefs, attitudes, and practices. Inherent in those responses was an additional theme that prompted an expansion of the study to include a phase two. Chapter five presents the conclusions from the analysis of phase one and outlines the methods that drove the capture of data and methods for analysis to address emerging phase two questions.

Conclusions From Phase One

Findings from the phase one investigation of the implementation of the Promethean board initiative support the following conclusions.

Overall, there was an increase in teacher use of the Promethean board as the initiative proceeded, with the greatest increase coming during the first part of the initiative. Along with increased use came an increase in the percentage of time that teachers used the Promethean board during their instructional time. Initiative-wide measures of teacher use were not equal in all schools, with a few standing out on the high and low end of use.

The Promethean board initiative did not result in changes in teachers' instructional practices. Instead, the Promethean board was used as a tool to support current instructional practices. This was supported by teachers' reports in interviews about how the Promethean board changed their instructional practices. They described the largest changes in their instruction resulting from an increased use of multimedia (specifically video), formative assessments, and increased student interactivity with their content. However, many of these changes reflected changes resulting from the Promethean board's functionality and were not a reflection of changes in pedagogy.

Teachers' observed instructional practices changed over the course of the initiative, but no clear patterns emerged. Instructional activity organization changed with teacher-led whole group instruction decreasing initially and then increasing to preinitiative levels as observed in walk-throughs and observations. Student-led whole group instruction decreased over the course of the initiative. Small group activities decreased over the course of the initiative as observed in school-wide walk-throughs but increased from the initial (21.6%) to the third (50.5%) observation (during more sustained observations). Independent activity increased initially and then decreased to pre-initiative levels in walk-throughs but consistently decreased in observations.

Teachers' observed instructional strategy use demonstrated similar changes without a pattern developing. Homework and practice, setting objectives and providing feedback decreased from the first to second observation and nonlinguistic representations and cues, questions, and advance organizers increased. Reinforcing effort and providing recognition; cooperative learning; and cues, questions, and advance organizers decreased from the second to third observation and homework and practice increased.

The factors that interviewed teachers reported as influences on their adoption of the new technology were tied to facilitating conditions and social influence. Teachers reported that the nature of the technology fit well with their current instructional practices. They reported that interactions with their peers were important when learning and using the Promethean board technology, and teachers reported using varied professional development opportunities, some inside and some outside of the organization, to obtain their skills with the Promethean board. Some teachers added that the professional development at the school level did not meet the needs of all learning styles. Additionally, the placement of the Promethean board in the front and center of the classroom sent a clear, unspoken message about expectations that the Promethean boards were to be used.

Interviewed and surveyed teachers felt the Promethean board increased student engagement. The nature of the technology provided additional opportunities for students to work with their course content. They felt this increased student engagement and their ability to design more interactive content improved student learning, but were hesitant to quantify the impact on student achievement.

Discussion

Phase one's analysis produced results that described in depth what occurred at the school level as a result of the initiative. With substantial adoption of the Promethean board by teachers and an increased incorporation of multimedia and formative assessment in instruction, it appears that the initiative had an impact in middle school classrooms. However, understanding that the initiative originated at the highest levels of the organization, it was important to understand whether what manifested at the school level as documented in chapter four met the expectations of the initiative's leaders. Central to framing this phase were the generic and sometimes contradictory responses from teachers when asked, "What were the expectations for using the interactive whiteboard in your school?" Therefore, further data needed to be collected regarding how the initiative was conceived, disseminated, and implemented throughout all levels of the organization.

Data representing teacher use of the Promethean board revealed that Promethean board adoption did not occur uniformly in all schools. Although this case study's focus was on a district-wide Promethean board initiative, the embedded design also placed importance on understanding how the initiative manifested itself at the school level and why some schools had higher adoption rates than others. Teacher comments about influences on their adoption of the Promethean board demonstrated that technology adoption did not occur in isolation and was the result of multiple influences around and above them. Therefore, it was important to gather and examine additional school-level and organizational data to help explain these differences. Thus, two additional research questions—ultimately the study's questions four and five—were posed to frame phase two of this study.

4. What did school leaders report as their role in a technology initiative and what actions did they take to support it?

5. What do different stakeholders of a technology initiative report as its intent? Are their interpretations consistent with the district's intent? If not, what are the inconsistencies?

Design

Phase two's focus on the determination of the initiative's intent required a review of the Liberty District School Board's meeting notes and interviews conducted with the initiative's key decision makers including the Director of Instructional Technology and the Supervisor of Technology Resource Teachers (TRTs). Selected middle school principals and technology resource teachers were interviewed to examine how the initiative was communicated and interpreted at the school level and further disseminated to school-level staff. By capturing these data, depictions were made of administrative expectations for the initiative and how it would manifest in the classroom. Examination of the communication process and views of the stakeholders at these levels provided evidence reflecting how this vision was communicated from administration to individual schools and their teachers. Phase two methods are outlined below.

Participants/Data

School Board Minutes

Any initiative has a start and a funding source. In order to place Promethean boards in every middle school classroom, a budget item had to be created and that budget had to be approved by the district's school board. In order to gather data about the history of the initiative and how it was presented to the board, minutes from board meetings preceding the initiative were reviewed as well as archives of the meetings, documentation of any opinions of the members, and any presentation made to the Curriculum and Instruction School Board Committee.

Instructional Technology Administrator Interviews

This technology initiative was budgeted through Instructional Services. This department purchases and supports all instructional technology and professional development for the school district. It was important to capture how this office presented and viewed the impact on instruction that this initiative had. The Director of Instructional Services and the Technology Resource Teacher Supervisor responded to the emailed request for an interview (Appendix H). They were interviewed during the summer and fall semesters of 2010 regarding the district's Promethean board initiative at the middle school level. These individuals were selected due to their intimate knowledge of the initiative and its implementation. Instructional Services had presented and budgeted for the installation of the Promethean boards, and technology resource teachers were the primary professional developers on using the Promethean boards in their schools. An informed consent was obtained (Appendix I).

Director of Instructional Services biography. The Director of Instructional Services had served in this position since 2000. Prior to holding this position, he served as an elementary principal for many years in the Liberty District. The Director of Instructional Services provides leadership and coordination in developing programs for the Office of Instructional Services. Program supervision and responsibilities include Audio Visual Services, Administration of Federal Programs (No Child Left Behind), Head Start, Instructional Technology, Library/Media Services, and Staff Development.

Supervisor of Technology Resource Teacher biography. The Supervisor of Technology Resource Teachers had served in this position since 2002. Prior to holding this position, she served as an elementary TRT in the Liberty District for several years and as a high school English teacher. The Supervisor of Technology Resource Teachers is responsible for supporting 75 TRTs and their 100 technology assistants. She oversees the instructional technology review process and works with the technology steering committee in planning a vision for the future. She supports instructional technology integration by working with professional development programs for TRTs and administrators in leadership areas in technology.

Middle School Principal Interviews

Leadership at the school level provides the conduit for implementation of initiatives from administration. Results from phase one analysis revealed that the initiative did not manifest itself similarly in each school. Therefore, it was important to interview school principals about their understanding of the intent of the initiative and how it manifested itself in their schools. After a preliminary analysis of technology use using the walk-through data, two principals were purposely selected to represent schools that were on each end of the implementation continuum. This provided a snapshot of the initiative in schools where there was high and low adoption rates. An email invitation (Appendix H) was sent to one middle school principal whose walk-through data showed the highest use of the Promethean boards and one principal whose walk-through data showed the least use of the Promethean board. If either of them did not agree to be interviewed, an email invitation was sent to the next principal with the most or least usage.

This sampling strategy resulted in two middle school principals who agreed to be interviewed regarding their experiences with the Promethean board initiative. These principals were interviewed during the summer of 2010. These principals held intimate knowledge of how the initiative manifested itself in their schools due to their daily interaction with faculty and staff and their instructional and administrative leadership roles in the schools. Having one that was at the high end of the usage scale (School 02) and one at the low end of the usage scale (School 01) gave a more dichotomous view of how the initiative was implemented at the school level. An informed consent was obtained (Appendix I).

School 01 principal biography. School 01's principal had been at the school for 3 years. Prior to becoming a principal, he served as an assistant principal at a high school for 8 years. Before joining Liberty District he worked at a neighboring district in an alternative school approximately 15 years ago. That school was small, which resulted in faculty having additional responsibilities. His additional duties were to set up computers and identify software for student use. He equated those experiences to that of a TRT although on a much smaller and less complicated scale.

School 02 principal biography. As of this writing School 02's principal was a principal at a high school. She was the principal at middle school 02 during the Promethean board initiative and served in that role for 4 years. Prior to becoming a principal, she was an assistant principal at the same high school where she is now serving as the principal. She did not share much about her experiences prior to being an administrator but did emphasize that she saw herself as an instructional leader and not a manager.

Technology Resource Teacher Interviews

Technology professional development within each school is a primary responsibility of the technology resource teacher (TRT). Since teacher training on the Promethean board and its instructional application was the responsibility of the school's TRT, it was important to examine their understanding of the initiative and how they interpreted and planned for its implementation. After principals were selected, effort was made to also extend invitations to the TRTs at the schools of the selected principals to gain a twofold representation of the initiative at particular schools. An email invitation (Appendix H) was sent out to the middle school TRTs whose principals had already agreed to be interviewed (Schools 01 and 02). One agreed (School 02) and one did not (School 01). Therefore, an additional invitation was sent to the TRT at School 03. This invitation was accepted.

This sampling strategy resulted in two middle school TRTs who agreed to be interviewed regarding their experiences with the Promethean board initiative. These TRTs were interviewed over the summer and fall semesters of 2010. These TRTs held intimate knowledge about how the initiative manifested itself in their schools due to their role as the primary professional developer for the initiative and their daily interactions with their faculty and staff. Having one that was at the high end of the usage scale (School 02) and one at the low end of the usage scale (School 03) provided a dichotomous view of how the initiative was implemented at the school level. An informed consent was obtained (Appendix I).

School 02 Technology Resource Teacher biography. School 02's TRT started out in the district as a special education teacher certified in K-12 and later obtained his master's in Education, majoring in instructional technology. He had worked as a high school TRT for approximately four years before leaving to go to the middle school level at School 02. His change of schools was prompted by an assistant principal's promotion to school principal at School 02 and his desire to work with her.

School 03 Technology Resource Teacher biography. School 03's TRT started in the district as a keyboarding teacher. She became a TRT approximately 11 years ago and has been at the same school her entire career. She initially worked with Apple computers and then the district changed to a Windows platform, requiring her to learn all new software and hardware. She has worked with two different principals in her experiences at School 03 and has seen the school go from a medium-sized middle school with three grade levels to a very large school with only two grade levels. She was looking forward to the school's transition back to a medium-sized middle school in the upcoming school year, as a result of a new school opening in the district.

School-Based Professional Development Plans for Promethean Board

Since each school was required by the Instructional Services Department to plan and deliver professional development for their staff as part of the initiative, it was valuable to examine the formal professional development plans submitted by school principals and TRTs. These plans identified multiple levels of professional development and strategies that were to be used to reach all members of their faculty. The school-based professional development plans for the Promethean board initiative were collected by the Supervisor of Technology Resource Teachers prior the rollout of the Promethean boards in each school. These 11 plans were based on a supplied template (Appendix J) and were completed by all of the middle school TRTs in conjunction with their principals. These plans summarized the Promethean board professional development planned for faculty and staff during the course of the rollout semester. Plans were reviewed and approved by the Supervisor of Technology Resource Teachers.

Instruments

Interview Protocols

The interview protocols were designed by the researcher. The instructional technology administrator interview protocol (Appendix K) captured the expectations of instructional technology administrators regarding the Promethean board initiative and its anticipated impact on instruction. The middle school principals interview protocol (Appendix L) captured how the initiative was communicated to the principals, how they conveyed the vision of the initiative to their staff, and what model use of the Promethean board looked like in their schools. The technology resource teacher interview protocol (Appendix M) captured how the initiative was communicated to the TRTs, how they conveyed the vision of the initiative to their staff, what their training priorities were, and what model use of the Promethean board looked like in their schools. Questions in all protocols focused on initiating discussions that identified how the initiative started, the anticipated instructional value the Promethean boards added to the classroom, and what model use in the classroom looked like. The questions served to initiate and guide the interview; additional questions were posed to illicit clarification or expand the scope of the discussion.

School-Based Professional Development Plans for Promethean Board

The school-based professional development plan template (Appendix J) was developed to inform and guide the professional development plans created and delivered by TRTs at each middle school. The template was created and distributed by the Supervisor of Technology Resource Teachers to the TRTs and included expectations about Promethean board use, required training components, and suggestions to be included in each school's professional development plan. The final plan for each middle school represented a combination of the expectations conveyed with the plan and each TRT's knowledge of their faculty's professional development needs.

Data Collection

The phase two data set was collected after I left my role as Staff Development Trainer with the Liberty District. This data collection and its processes occurred under the supervision of the Department of Instructional Services and its leadership. The data collection and the processes for phase two occurred with the approval of Human Subjects Review Board at George Mason University and the Liberty District's Research Department and Assistant Superintendent for Instruction. Requests for interviews, interview protocols, and informed consents were approved as part of this process.

Interview Data Collection

A request for an interview (Appendix H) was sent by the researcher to the administrators, middle school principals, and technology resource teachers during the summer of 2010. An informed consent was obtained prior to the interviews. Upon receiving the informed consent, an interview was scheduled and conducted at locations convenient to the participants. The interviews were guided by the appropriate interview protocols (Appendices K, L, and M) with audio captured using a LiveScribe pen and notebook. Interviews lasted between 20 and 60 minutes.

School-Based Professional Development Plans for Promethean Board Data Collection

TRTs electronically submitted school-based professional development plans designed in consultation with their principal to the Supervisor of Technology Resource Teachers prior to the Promethean board installation at their schools. These plans were designed using the template provided to them by the supervisor (Appendix J) one month prior to the scheduled Promethean board installation. TRTs submitted the completed plan to the supervisor prior to the installation of the Promethean board at their schools. Copies of the plans were provided to the researcher by the Supervisor of Technology Resource Teachers.

Data Analysis

Qualitative Data

The qualitative data provided an in-depth exploration (Creswell, 2008) of the Promethean board initiative and its impact on all stakeholders. Qualitative analysis procedures emphasize the view of the participant and interpret the subject of study from his or her perspective. This process is inductive in that themes emerged during the process of coding and organizing data. Procedures for qualitative analysis for phase two were conducted in the same manner as documented in chapter three's section "Methods for Phase One."

Document analysis was conducted on the school level professional development plans. Consistencies in content and format were examined and customizations were analyzed in regard to stakeholders' needs and school characteristics. Included in the analysis where the purpose of the document, how schools used it, and how it contributed to the rollout of the Promethean board initiative.

Limitations

My role as a Staff Development Trainer within the Instructional Services Department placed me in an optimal position to capture the data for phase one of the study. At the time of phase two, I was no longer employed by Liberty District. However, recognizing my previous position within the district might have implications on the validity of the data, I took the following actions when collecting and analyzing it.

Instructional technology administrators. The Supervisor of Technology Resource Teachers was my direct supervisor when I was employed with Liberty District and the Director of Instructional Services was her direct supervisor. Being a subordinate, there were no concerns that my former role had any undue influence on their responses. On the contrary, my close relationship with these individuals and involvement in the rollout served as a validation of their responses with my own observations. However, I cannot ignore the possibility that this relationship may have colored my interpretation of the results in a manner that could have been more favorable toward the district.

Middle school principals. My role in Liberty District did not involve much interaction with school leadership. Therefore, my experiences with the two middle school principals consisted only of interactions that occurred during phase one and had been minimal. Since principals are seen within Liberty District as the instructional leaders within their building, they could "color" their responses to provide a more positive picture of instructional practices within their building. Comparing their comments with data from the walk-throughs, observations, and teacher interviews served to equalize these effects. Interviews with the principals occurred during the summer of 2010 at the times and locations of their choosing.

Technology resource teachers. My role in Liberty District had been considered the equivalent of a technology resource teacher. Therefore, these individuals were my peers. However, my geographic work location at the administrative building did impart the impression that my position was more administrative. My past relationships with both of these TRTs were professional and routinely involved conversations about challenges and successes with their staff and administration. Based on these relationships and my observations, I believe their responses to my questions where honest and forthcoming. However, I cannot negate that since the TRTs were the individuals held most responsible for the Promethean board professional development in their schools, they may have colored their responses to provide a more positive picture of instructional practices within their building. Comparing their comments with data from the walk-throughs, observations, and principal and teacher interviews served to equalize these effects.

Chapter five presented the conclusions from the analysis of phase one and outlined the methods for phase two. A description of the phase two subjects and data included brief biographies of those interviewed. The “Methods” section described the instruments used, including the interview protocols and professional development plan template, the processes for data capture, and the procedures for qualitative data analysis. The chapter concluded with a discussion of the limitations. Chapter six will present the analysis results of phase two of this study.

6. RESULTS OF PHASE TWO

Chapter five outlined the processes and procedures that guided the capture and analysis of data for phase two of the study. These data were used to answer research questions four and five and focused on what actions school leaders took to support the initiative and how the initiative was interpreted at different levels. The results are presented below.

Research Question 4

The Instructional Services Department is responsible for the implementation of any technology initiative in Liberty District. Therefore, the vision and planning in this department drives any implementation. Their responsibilities center on identifying and adopting new instructional technologies and securing funding for their purchase. Budget items for technology support are standard. However, the commitment to funding this new initiative required approval from the school board and ultimately funding of the budget from the district's Board of Supervisors. Once approved, multiple stakeholders had to be leveraged to ensure successful adoption. Research question four, "What did school leaders report as their role in a technology initiative and what actions did they take to support it?" examined these stakeholder actions.

School Board Documents

The Director of Instructional Services placed the purchase of the Promethean boards and supporting services in the FY 2009 Appropriated Budgets (District Website, 2009). To meet School Board Goal 05, Growth and Resources Parity, the budget item included $1,035,735 for the "expansion of the mounted short-throw LCD projector with interactive smart-board installation project to include every regular size classroom in all middle schools" (District Website, 2009, p. 179) and to meet School Board Goal 1, Student Achievement, Technology Resources committed to providing "professional development through Technology Resource Teacher activities and VITAL in visual literacy to support learning with interactive whiteboards" (p. 202). VITAL is Virginia's Initiative for Technology and Administrative Leadership.

The public school board agenda and minutes were not available to reflect the votes from the April 2008 school board meeting when installation of the Promethean boards at the middle school level was approved. Board Docs, which is the online repository for school board documents, was not used prior to September 2008. Contact with the Clerk of the Board revealed that minutes and agendas from meetings prior to that are no longer publically available. Looking to other sources of public information regarding board actions, the Internet was explored. There were nine individuals who served on the school board, and two of these members regularly blogged about issues in front of them. Their blogs dated April 8, 2008 reflected their feelings regarding the interactive whiteboards and the resulting vote from the prior school board meeting. School board member 01's response reflected his support of the initiative,

> During the FY09 Operating Budget Reconciliation Meeting, there were several attempts to reduce or eliminate the implementation of the Promethean Interactive Whiteboard. I'm happy to say the majority of the initiatives failed and a majority of the boards will be installed in the middle and elementary schools next year. Having actually observed teachers using the boards is what sold me on them. Our students' instruction will benefit from these boards. (Liberty District School Board member 01, 2008)

School board member 02's response reflected a conflict between his beliefs and those of his constituents.

> I think having interactive white boards in Middle Schools is a good idea that does not have the support of the community. Because they do not have the community's support, I voted against them. The other members of the School Board feel that the whiteboards do have community support, and voted for them. (Liberty District School Board member 02, 2008)

Prior to the installation on November 11, 2008, the Supervisor of Technology Resource Teachers arranged for a demonstration of the interactive whiteboards and their capabilities to the School Board's Curriculum and Instruction Committee (Liberty District School Board, 2008). This presentation was documented in the minutes. However, no copy or reference to covered content was included. Beyond the budget items, two blog entries by school board members, and the minutes of the Curriculum and Instruction Committee, no other public documents were located that showed school board support or lack thereof for the initiative beyond its inclusion in the FY09 budget.

Concern about the lack of community support for the boards pointed out in school board member 02's blog was raised by the Technology Resource Teacher Supervisor. Comments during her interview illuminated her beliefs about the need for public support beyond the school organization and identified the Board of Supervisors as individuals who could have done more to sway public opinion. Her reflection on the power of the few identified a core group of stakeholders who perhaps were not adequately engaged in the process.

> I was very surprised at the push back from some of the community. The Board of Supervisors for example and others who give lip service to what 21st Century Skills are about yet by the same token saying the boards were not necessary . . . I was really surprised that we had not educated the constituents about that. I don't think our parents for the most part feel that way but there are enough influential people who did and that surprised me.

Instructional Technology Leadership

The initiation of this initiative occurred in the Department of Instructional Services. The responsibility for its implementation rested here. Rolling out a technology initiative requires the determination of goals and establishment of processes and procedures at all levels. This leadership felt confident supporting this initiative, having completed a similar initiative at the high school level the year prior. Both the Director of Instructional Services and the Supervisor of Technology Resource Teacher pointed to the district's established "infrastructure for supporting new technology initiatives." Missing from their responses were explanations of formal processes for establishing and communicating the instructional goals of the initiative and ensuring their implementation. It was implied that the established infrastructure would manage all components of the initiative.

This infrastructure, according to the Supervisor of TRTs, focused on "hitting three legs of the stool." The first leg was the professional development of TRTs who would then "professionally develop their faculty and staff." The second leg was the professional development of administrators, using the "VITAL program to get principals on board . . . and show them what it should look like when implemented in the classroom." The third leg was providing additional professional development, "district-wide for anyone who wanted additional face-to-face or online professional development."

The Director of Instructional Services and Supervisor of TRTs required "principals and TRTs to develop a rollout plan for their schools and professional development had to be part of that plan." Coverage of awareness, basic, and advanced technology skill levels was mandated with required components contained in the sessions addressing each level (Appendix J). This plan was submitted to the Supervisor of TRTs for review. Expectations for Promethean board use were prominently located within the template. For example, the first item stated,

> It is expected that ALL teachers will use the ActivBoard every day for instruction. Every teacher is expected to turn the board on in the morning and bring up a webpage, graphic, or appropriate flipchart with a visual that is germane to the instruction that day. These along with other ActivStudio tools like *Tickertape*

(could display learning goals) or *Sticky Pad* (could display homework assignment) support the use of visuals to begin the day. (Appendix J)

The Director of Instructional Services acknowledged in his interview that there are challenges when implementing a district-wide initiative since each school's culture is unique. He anticipated disparate implementation within the schools. He based his predictions on knowledge of the characteristics and skills of the schools' leadership, technology resource teachers, and known characteristics of the faculty. "We could tell which schools have implemented the boards well. Depending on the Principal and the TRT you could almost predict up front who would do well and who would not." Although he acknowledged pockets of poor adoption, no actions were mentioned to address them.

Principals

Principals represent the highest level of school leadership. Interviewing principals allowed examining their leadership styles and beliefs and how they influence teacher instructional practices. There were two middle school principals interviewed. One represented School 02, which appeared at the higher end of the continuum of Promethean board use during walk-through three, and one represented School 01, which appeared at the lower end of the continuum of Promethean board use during walk-through three.

VITAL was identified by the district's technology administrators as the key leg in the district's infrastructure for training principals. Described by the technology resource teacher supervisor, these sessions were meant to "show them [principals] what it should look like when implemented in the classroom." This focus implied that expectations of classroom use were presented and communicated through this venue. School 02's principal attended a VITAL Promethean board session and reported that she learned about the Promethean board's capabilities in her session. School 01's principal did not mention attending any VITAL sessions. Unlike teacher Promethean board training, VITAL sessions were not mandatory.

Both principals described their role in the school as an instructional leader with a focus on student learning. School 02's principal pointed to her responsibility to "monitor and supervise the instructional mission . . . and be able to assess what the population needs and determine what actions are required." Each felt that the Promethean board made instruction more engaging for students. School 02's principal saw evidence that, "the nature of the resources with the board allows teachers to create multiple levels of instruction at the same time." And School 01's principal saw multiple instances where teachers' use of multimedia engaged students to the level where even his entrance into the room did not distract them from the instruction.

Being an instructional leader, principals should also model instructional technology integration. Both principals spoke about their past experiences with technology as measures of their own technology skill levels. They each expressed high technology self-efficacy beliefs and contributed these in part to their past experiences with technology and their fearlessness when using new technologies. School 01's principal pointed to a job position "similar to that of a TRT about 15 years ago," and School 02's principal pointed to her ability to "figure out and run with technology."

These reasons were similar to the responses provided by interviewed teachers who also expressed high technology self-efficacy beliefs during phase one. Both principals strived to be models for their teachers by using the Promethean board during the initial stage of the rollout.

VITAL workshops focused on showing best practices to principals. Missing from these workshops was a focus on skill development. Neither principal identified where they obtained their skills using the Promethean board but both spoke about using the board at the basic level with their staff. School 01's principal used to keep an ActivPen with him and "walk around and I would do things with the board to encourage use." He shared an opportunity where he entered a classroom and participated in the instruction,

> The teacher had a word problem on the board and she was breaking down the word problem with the kids. I found an opportunity to teach something so I went back and I said, "Can I share something?" and I took the highlighter [a tool on the Promethean board] and highlighted it. It's nothing that I'm doing dramatic, it's just small simple things.

School 02's principal encouraged use by engaging in collaborative activities with the teachers utilizing the Promethean board, "I use it as a background with the help of teachers. So in other words if we're doing presentations and those kinds of things I usually have the teacher involved using the board." Initially committed to active use, both principals admitted to not using the Promethean board as much as the initiative progressed. Pointing to increased teacher adoption levels, School 01's principal admitted, "I walked around with a pen for about a year . . . now I find I don't need to."

In preparing their staff for Promethean board use, both principals acknowledged working with their TRTs to create the professional development plans for their schools. Each felt they knew their staff well enough to predict those who would be, according to School 01's principal, "early adopters" and those who would be the "naysayers." Differences between these two principals arose in how they dealt with the multiple levels of users.

School 02's principal spoke about the strength of the professional development plan that she and the school's TRT developed.

> I sat down with my TRT scoping out a training plan. What I appreciated most about how we did it was that it was multitiered. Here was the plan for the person who can pick up technology quickly. Here's a secondary plan for the person who can pick it up not as quickly as the first group, but then here's the second layer for them. And in some cases even a third layer. This was a one-on-one with the TRT and teacher.

School 01's principal described this planning process at his school.

> There was a plan with the TRT to develop and submit their plans on how they were going to train the teachers with the technology. My TRT developed a plan and he shared it with me. We made some decisions about how much time, how much practice time, and how much teaching time we were going to dedicate to the training.

He pointed to the technology assistants (TAs) as an integral part of the plan in order to support his staff.

> We were going to make sure he [the TRT] was available and that he was training the TAs. How he was going to involve the technology assistants so that they were accessible . . . . It was very clear to me that they had to have early knowledge and be able to understand the skills. Given that the TRT's time is limited he can't be in every classroom. They needed to understand the tool just as well as the teachers.

School 02's principal expressed high expectations for her staff in using technology. She pointed to multiple past experiences where she piloted new technologies in her schools with the expectation that her teachers would also embrace its use. Even with these high expectations, School 02's principal anticipated diversity in her staff's adoption of the Promethean boards and anticipated inconsistencies in implementation. She and her school's TRT took a proactive approach and identified teachers who would be more resistant to this technology. They met individually with them prior to the board installation to, "talk about what we know about them as instructors and [we] appealed to that." Her approach focused on spinning the attitudes of her staff and ensuring a more positive message, "getting the people we know will be the hardest on board so that they're not the people in the room who are disgruntled." This approach also included more individualized attention by the school's TRT when designing professional development.

Leveraging existing structures, both schools planned to take advantage of the professional learning communities (PLCs) in place in their schools and used them to encourage sharing and collaboration between their staff. School 01's PLCs were organized around content area and grade level. The principal shared a collaborative success story that occurred with seventh grade math. Those teachers worked with the middle school math resource teacher to "create an entire SOL [Standards of Learning] review packet with the flipcharts and mapped out the curriculum as a team." However, the principal did not consistently see the level of sharing and collaboration he had hoped for. He presented multiple examples of staff members who teach the same subject yet demonstrated varying proficiency levels using the Promethean board. In areas where he saw more diversity in instruction, he identified a leadership challenge. "My job is how to get them to see this in a nonthreatening way and get them to adopt and collaborate more." Actions taken during and shortly after the initiative rollout to address these inconsistencies were not mentioned. However, he acknowledged that his staff was not yet at levels that he would like. He described technology use with his staff that did not meet his expectations.

> [There is] the person who uses the board and is not actually having kids interact with the technology. They're using it and they're doing some good things but it's not the full-fledged type of student engagement and involvement that we'd like to see more of.

School 02's principal and TRT also focused on using the PLC structure in their school to deliver professional development. The PLC model had just been implemented in that school in the fall so teachers did not have many experiences with it. The principal felt,

> The Promethean board brought them together around a central issue. They would have to work together as a team. It was the first thing that they had to do together so they immediately saw the value of it [the PLC] to divide and conquer.

Looking toward the upcoming school year and recognizing that his teachers are not yet where he would like them to be, School 01's principal described an initiative that he and his leadership team were implementing for the upcoming school year (2010-2011) that he believed would leverage the PLC structures and improve technology integration.

> My expectations next year are that there's going to be a lesson plan turned in per quarter to the deans or they can show the deans that overall collaboration is taking place. They can talk about the instruction and about how to use technology in the classroom

Technology Resource Teachers

Technology resource teachers (TRTs) are the instructional technology leaders in their respective schools. Successful management and implementation of all school-based technology falls within their job responsibilities. For the Promethean board initiative, the TRTs were expected to design and deliver at least two hours of professional development on this technology for their staff. There were two TRTs interviewed. One represented School 02 that appeared at the higher end of the continuum of Promethean board use during walk-through three, and one represented School 03 that appeared at the lower end of the continuum of Promethean board use during walk-through three.

TRTs' responses revealed several themes that paralleled their teachers' responses regarding adoption of the Promethean board technology. Similar to teachers, they spoke about levels of self-efficacy and comfort with the technology, professional development, school leadership, environmental factors, and the influence of peers. These themes not only shaped their own adoption of the Promethean board, they were embedded in how they rolled this technology out with their staff.

Self-efficacy is a representation of how TRTs viewed their individual capability to learn a new technology and be successful at it, and how this influenced the professional development (instruction) that they, in turn, rolled out to their staff. A key challenge for both TRTs was the short six-week time frame between their training and the rollout of this technology to their staff. This short notice affected each of them differently. Their comments reflected on their confidence at meeting this deadline. School 03's TRT felt the short time frame did not provide enough time to adequately prepare her staff. She repeatedly mentioned feeling short on time when preparing for this rollout. This pressure was reflected in one of her first comments,

> We got this all at once. It was sooner than expected because we didn't think we were gonna get them all and then all the sudden we were told "it's coming" and we had maybe six weeks' worth of notice. So I was running around like crazy trying to get everybody on board and the rooms set up.

In contrast, School 02's TRTs response to this challenge was more positive. He expressed confidence rolling this initiative out based on the training he received and the support and resources he received from high school TRTs who had done a similar rollout the year prior.

The middle school TRTs obtained much of their knowledge on the Promethean board from vendor-purchased training and shared resources from high school TRTs who facilitated this same initiative at their level the year prior. Liberty District purchased 3 days of train-the-trainer sessions for the middle school TRTs which took place approximately six weeks prior to the initiative. Additionally, high school TRTs shared their experiences and resources from the prior year's Promethean board rollout at the high school level.

Both middle school TRTs spoke about leveraging these existing materials in designing their training. School 02's TRT stated, "The nice part was there were some high school TRTs that had already created a lot of the training materials so I took from this and from that and pieced my training together." School 03's TRT stated, "I had to learn to download well from Promethean Planet and I had everything that everybody had given me from last year."

The train-the-trainer model for professional development is premised on the assumption that those who attend the training will turn around and deliver that training to others, becoming the experts with that technology tool. The middle school TRTs had mixed feelings about their level of confidence resulting from the training. School 02's TRT felt, "very confident, the fact that we had three days of training made me very confident when delivering my training." However, School 03's TRT did not express the same level of confidence, "I didn't have a lot of time to play with it myself . . . saying and doing it and making up your own are two different things."

TRTs were the primary professional developers for this initiative; their competence levels with the technology and quality of instruction had an impact on teacher adoption levels. Comments by teachers during interviews conducted during phase one reflected teachers' views of their TRTs and the quality of support they received from them during the initiative. Schools 01 and 03 were on the lower end of the spectrum of teacher Promethean board use with 22.6% and 42.5% of teachers using the Promethean board during walk-through three. School 02, with 67.2%, was on the higher end of the spectrum during this walk-through. The observed level of competence (or lack thereof) of an instructional leader was something noted by participants. A teacher at School 01 reflected on her TRT's competence level during training with the comment,

> He would try to do something and it wouldn't work and he would be like, "um, well I'll show you how to do that another time." You know, he couldn't take the time to master that.

In contrast, a teacher at School 02 spoke about her TRT's ability to explain things in a way she could understand, "He would take 10 seconds to tell the class, 'wait a minute,' and go back and he could explain it to me. He made himself very available to answer any questions."

Planning and delivering the professional development at each school was a manifestation of the school's physical structure and culture and the TRT's perception of the timeline given between TRT training and expected implementation. Minimal expectations were communicated in the professional development plan template, and it was understood that the TRT would design sessions in agreement with his or her principal that best met the needs of their faculty and staff.

School 02. School 02's TRT spoke about how he worked with his principal to plan the sessions and had excellent support from his two technology assistants: "We all worked together as a team and having those to help me . . . we were all doing the same thing to get to the end product." In addition to the face-to-face sessions which were laid out in the school's' professional development plan, this TRT, faced with a quick turnaround between training and rollout, created introductory videos that, "allowed us to provide teachers with basic knowledge" while the installation was occurring. This freed him to deal with the logistics of the installation.

Recognizing the role of other instructional leaders and their influence in his school, he and his principal targeted, "some teachers that would be much more resistant to accepting this technology" but were instructional leaders. Leveraging the influence of one "clan leader," they provided her with a mobile board in her classroom prior to the installation. "I got her on board and she started to see the value of it all and all of the sixth grade teachers just fell in line because she saw value in the board."

To further push this new technology, his school chose to remove competing equipment from the classrooms.

> We flat out just took away the overheads and we sat in the lab and said, "We will show you how to scan until your heart's content so that you can put that stuff [existing handouts/documents] up on the Promethean board."

He continued to monitor their progress informally by "walking around the entire school just looking into the classrooms to see what teachers were actually doing there. I would make informal notes to myself about getting back to teachers." This practice was valued by his teachers and was pointed out by School 02's teacher,

> I think he must have appeared in everyone's room in every block, at least it seemed like he was constantly stopping in and asking, which was nice because if something had happened earlier that class, he would explain it to me.

School 03. School 03's TRT faced many challenges rolling out the initiative. Initial challenges were tied to the school environment and difficulty locating rooms in which she could conduct training during the school day. "We had no lab space because all of our labs were tied up with the keyboarding classes and PE [Physical Education] classes teaching health." This resulted in training occurring in "after-school sessions and at lunchtime."

School 03's TRT did not include in any of her responses how she worked with her principal to develop her plan, although she did comment that her plan was approved by her principal. Analysis of the school's professional development plan revealed that the school included activities involving the principal as part of the rollout. These activities included creating a weekly teacher bulletin with updates on installations and hot links to Promethean Planet and other information websites, distributing certificates to teachers who earned points during basic training, and encouraging teachers to register to take the online Level II Promethean ActivStudio course.

After the initial rollout, the TRT leveraged the PLCs that were in place in her building, "Trying to do it by departments as much as possible . . . all sixth grade science teachers would meet at the same time . . . so by grade level and department times we could do a little bit more." Challenges arose trying to reach all of the math and special education teachers because, "They didn't have common planning time and part of their planning was to work with resource classes."

Additional challenges were presented with faculty attitudes and behaviors,

> Everyone in the building was angry because it was set up right in the middle of their chalkboard in the middle of the year. They had no idea how to use it, and they were forced to use it. There were a lot of angry people and a lot of resentment, so they didn't do it.

Her summation of teacher responses was similar in tone to her responses when describing the initiative. These descriptions were negative when referring to the initial rollout. However, her tone changed when she spoke about how her staff were using the Promethean board a year post-installation,

> The math people were all on board with it. The math teachers did a preschool session with at-risk kids and everybody in the sixth grade math department worked two mornings a week and they found online games to use with it.

The principal at this school was not interviewed. However, the TRT made an observation about staffing changes made by the principal at the end of the implementation year, "When we had to cut staff this year, the people who were the most uncooperative [with the Promethean board] are not here this year. And I'm probably the only one that noticed that."

Professional Development Plans

The principal and TRT were required to collaborate on the development of the school's professional development plan and submit it to the Supervisor of Technology Resource Teachers. The goal of the template was to provide a model of expected sessions and their proposed skill levels. Contained within the plan were required sessions that addressed awareness, basic, and advanced technology skills. Inclusion of these requirements reinforced to schools expectations regarding Promethean board professional development. Table 46 contains a list of the different levels along with the required and suggested activities to be contained in each.

Table 46

Components of School Promethean Board Professional Development Plans

Level	Required	Suggested
Awareness	A 20-minute introduction by Technology Resource Teacher (TRT) to ActivBoard/ActivStudio in faculty or department meeting include a demo of one or more flipcharts.	Set up a game where teachers engage in a task (e.g. create flipchart and submit to TRT) for award.
	Encourage teachers to join PrometheanPlanetManuals and QuickStart Guides should be shared.	Create a PrometheanWorld awareness game with prizes to award.
Basic	At the secondary level, teachers should be **trained as much as possible by curriculum area**. Special Ed teachers should attend the trainings for the curriculum areas that they support.	Encourage teachers to take free online basic course before school's basic training occurs.
	Minimum of **2-hour, preferably 3-hour** training at basic level; this can be offered during school day or after-school; schools can use staff development allotment for substitutes (Note: no Monday or Friday trainings).	Encourage teachers' sharing flipcharts with accompanying hands-on activities for students.
	Sample flipchart lessons should show a variety of design strategies: show one that requires lower level thinking skill and then one that requires higher level thinking skills; include any accompanying hands-on activities for students.	Saturate regular training opportunities—department meetings, Tech Tuesdays, etc. with flipchart examples.

(continued)

Table 47 (continued)

Level	Required	Suggested
	Topics should be determined by you (you know your staff) but at a minimum: Board/Projector Basics and Basic Troubleshooting Introduction to ActivStudio's basic tools, File Management, and Use of ActivPen. How to Convert PowerPoint and/or Smart Notebook Files STRESS the use of multimedia (images, audio, video, simulations) with the board; that is the heart of the power of the board. You do not want to see teachers using text only. Assessment should include open-ended questions asking for areas in which teachers want to learn more.	Feature a 10-minute best practice flip chart at every faculty or department meeting.
Advanced	Follow-up with teachers before end of SY2009 to ascertain their needs. There are options as to how this could be accomplished: workshop (face-to-face or online), study groups, Q&A session in faculty meetings, newsletters, etc. Follow-up needs to be documented in your plan and should address teachers' areas of concern and curiosity. As a group and working with Curriculum and Instruction supervisors, TRTs will look at advanced offerings for the Summer 2009.	Develop a repository for your staff's flipcharts. Email best practice weekly flipchart to faculty. Start a flipchart blog.

All but one of the 11 schools submitted the completed template (Appendix J) addressing each required level of professional development. School 01 only submitted a schedule for training. Details for each session included the teachers/groups to be trained, details about what would be covered, who would conduct the session, and an estimated date and time. Present in all of the completed plans were the TRT's responsibility to design and deliver the majority of the training. At six schools (01, 04, 05, 06, 07, and 09), the TRTs were the only individuals identified in the professional development plans holding any responsibility for professional development. The other five schools (02, 03, 08, 10, and 11) shared these responsibilities with additional staff members. All five of those schools identified technology assistants as sharing responsibility in the rollout. Two schools (03 and 08) included the middle school math resource teacher housed at their schools as an individual responsible for a portion of the sessions, and schools 02 and 03 included their principals and other leadership (deans, department chairs, librarians, counselors, and librarians) as individuals responsible for components of the rollout.

The professional development options offered to teachers to obtain basic skill levels centered around two delivery methods: face-to-face sessions with the TRT and the free online basic Promethean course from Promethean Learning. All schools included delivery of sessions in a face-to-face environment, and seven schools (02, 03, 04, 08, 09, 10, and 11) included the online basic Promethean course as an option. Three schools (02, 07, and 08) included TRT-created videos as options for staff, and School 08 included the use of videos on www.atomiclearning.com.

The outline of basic training sessions created by schools often mentioned only technology skills to be covered. Common skills covered were: the dashboard, the toolbox creating flipcharts, text and objects, the resource library, converting PowerPoints and Smart Notebook, and accessing Promethean Planet. Only two schools (09 and 10) included instructional applications as part of their basic training. School 09 included a demonstration of Marzano's strategy for Cues and Questions (Marzano et al., 2001). School 10 included showing teachers how to create a Bell Ringer Flipchart. A Bell Ringer or warm-up is the instructional practice of posting a question or two from the prior day's instruction to assess whether students had mastered the content.

All schools minimized the use of substitutes to cover teachers' attendance at training by leveraging teacher planning time and after-school sessions. Training was chunked into multiple sessions that lasted from 45 minutes to 1 hour. Six schools (02, 03, 06, 07, 10, and 11) leveraged the meeting times of professional learning communities (PLCs) within their school to address specific content or grade-level needs.

The professional development options offered to teachers to obtain advanced skill levels were face-to-face sessions in most schools (02, 03, 04, 05, 06, 07, 08, 09, and 10). However, additional less formal options that focused on sharing resources and knowledge were more abundant than at the basic level. These options included resources on the school website or server (Schools 02 and 03), faculty meetings (Schools 03 and 05), Q&A sessions (School 08), online training (Schools 03, 04, and 05), and study groups and newsletters (School 11).

Research Question 5

Maintaining a consistent message and intent is important when rolling out any initiative (Lewis et al., 2003; Rogers, 2003). It ensures that the goals established by key decision makers are shared with those tasked with its actual use. Research question five, "What do different stakeholders of a technology initiative report as its intent?" and its subquestions, "Are their interpretations consistent with the district's intent? If not what are the inconsistencies?" examines the consistency of the initiative's intent.

School Board Documents

Support within school board documents regarding the intent of the initiative appears in the FY 2009 Appropriated Budgets (District Website, 2009). To meet School Board Goal 05, Growth and Resources Parity, the budget item included $1,035,735 for the "expansion of the mounted short-throw LCD projector with interactive smart-board installation project to include every regular size classroom in all middle schools" (District Website, 2009, p. 179) and to meet School Board Goal 1, Student Achievement, Technology Resources committed to providing "professional development through Technology Resource Teacher activities and VITAL in visual literacy to support learning with interactive whiteboards" (p. 202).

Instructional Technology Leadership

Liberty District's county's Technology Plan drives the 5-year technology vision for the district. Target 4 states that the county establishes multiple trials of a variety of technology solutions moving closer to the goal of one-to-one computing. In the county's *Technology Plan 2008 Status* report, "The committee determined that deploying one interactive whiteboard in every classroom (hence turning one single-user computer into a classroom computer) was truly the first step to ubiquitous computing" (District Website, 2008, p. 19). This report was formulated by the Department of Instructional Resources, and therefore served as a reflection of the beliefs within the department related to the goals established for Promethean board use.

The Director of Instructional Services pointed to financial restrictions when determining the Promethean boards fit with the district's goal of ubiquitous computing. In his interview he said he considered the price per board and how that compared to a one-to-one initiative and, this served as justification for placing the boards in the classroom before putting a device in the hands of every student.

> I'm not sure the timeline but it's going to be in there [one-to-one computing] and we're going to recommend that we make that move. I think we are beginning to work that now, already I see us making that move. I see too many possibilities in the price point. I always said the price point is going to have to get between 3 and $400 per device [for laptops] and that's within striking distance. I see it coming but until then we have the interactive boards.

Highlighting the strengths of the technology and its ability to support existing technology purchases, the Director of Instructional Services pointed to Promethean boards as a way to "infuse technology into the classrooms" and to leverage already-purchased "online databases like Safari Montage video. The only way we could truly deliver that and get it into the classroom was through this initiative." This supported the *Technology Plan 2008 Status* report that reported this technology would turn a single-user computer into a classroom computer. Mirroring this vision, the Supervisor of TRTs described her vision of technology use in the classroom.

> This technology [the Promethean board] is the first step to ubiquitous computing. It allowed, through this large interactive board, to bring the computer to the whole class. Once we move to providing every student with a device and all the digital resources as opposed to textbook resources the teacher has to be prepared for teaching with that. The board is the first step to that.

Asked how they see the board being used in a classroom, the Director of Instructional Services described the ability to integrate multiple formats into presentations.

> You can integrate more than just printed text. You can infuse content into it. A good example of that is the purchase of digital maps; before when we purchased maps they were expensive and they're outdated almost from the time we got them. Now maps cost $.75 a student and they are up to date.

He also spoke about the ability of teachers to share instruction, stating, "Anything that you put on the board you can hold onto and save for students when they are out," and the ability of teachers to use multimedia to enable "learning to take place in different ways." These reasons—the increased use of multimedia and the ability to capture and share work— mirrored teachers' comments made during their interviews in phase one when asked about the how the Promethean board technology changed instruction.

Instructionally, the Director stated that change would not occur until two other initiatives, CLARITY, an online curriculum management system and VISION, an online learning management system, were fully implemented. Once that occurs, he anticipated a change in "How teachers teach and how students learn because everything will be there for them online and teachers will be able to access materials quickly, providing one-stop shopping." He believed that increasing access to quality resources would leverage "the power of the board along with other changes that we will see in instruction and technology over the next 5 years." These comments identified the need for quality resources to support instruction but implied that access to quality resources would result in changes to instruction.

The Supervisor of TRT's vision of Promethean board use focused around its power to be "the whole classroom portal into all of the digital resources, whether it be microscopes or GIS or electronic resources." However, she admitted that the initiative was not quite there yet. "I think we've moved through stage one, which was getting teachers to use the boards." Reflecting on the predominance of teacher-centered instruction during the walk-throughs, she commented, "The goal is to have teachers using them in ways that support inquiry-based learning, constructivist activities, and social groupings for learning." This goal was not included as part of the initiative. It originated from the supervisor's knowledge about good instruction. Recognizing that instructional change does not result from the adoption of new technology, she hypothesized, "I think that [change] is going to come as teachers become more sophisticated in the use of the board and we continue to push professional development in those areas of instruction. We're not there yet."

The instructional technology leadership expressed a unified vision regarding expectations of Promethean board use by teachers. They both believed in its value in bringing multimedia resources to the classroom and recognized that exemplary implementation would not happen instantly, instead occurring over time. Both centered their responses on the use of the technology, refraining from comments on appropriate instructional use except to point out that they were not there yet.

The goals listed in the school board documents addressing visual literacy were mentioned as content for the principals' VITAL training but were not mentioned as components in TRT or district-wide professional development, nor were they included as requirements to be included in school-based professional development plans. However, the professional development plan template included multiple suggestions on how to incorporate visuals into presentations, reflecting this as a best practice. The omission of an instructional goal in documentation and professional development and the resulting focus on Promethean technology skills tied to Promethean board use impacted how this initiative was interpreted as it rolled out in schools. A focus was placed on technology use with little emphasis on instructional practices.

Principals

The principal is the senior leader in each school; his or her expectations can drive teacher actions (Greaves et al., 2010; Lai & Chen, 2011; Moos et al., 2008). Both interviewed principals (Schools 01 and 02) expressed their vision of how the Promethean boards should be used in their schools' classrooms and that vision was similar to the

Instructional Technology Administrators'—with a focus on the use of multimedia resources and a desire for increased student engagement.

School 01's principal felt a kinship to his staff when it came to learning about this technology. "As a principal, we really were not different than the teachers. We didn't get early training, and we didn't have early access." His vision for the first year was that teachers would use the "Promethean technology the right way." When talking about his vision, he described the instructional benefits that the Promethean board technology brought to the classroom.

> The sound, the visuals using color, and the opportunities for kids to get up and share and interact [with the content] are a benefit. It also brings a sense of organization to the teaching that I think is, for me, it's not something that I would have really predicted . . . . Now everything is in one place and it moves in a little more of a sequence. Teachers have to think a little bit more about "what am I going to do next" and then execute it.

Describing student use and engagement, he shared what he had observed in his classrooms.

> It's a nice change because kids are throwing their hands up to give their best shot at it. And it's not even so much sometimes the problem on the board or the activity on the board [referring to the context of the engagement]. It's just the excitement about the technology and wanting to hold the little pen and be in charge.

His description of the right way to use the Promethean board centered on the Promethean board's use as a presentation tool where multimedia resources were regularly incorporated into instructional delivery. He did not describe how he communicated this vision to his staff, but did provide examples of what he considered exemplary use of the technology. For example, his description of its use in a social studies classroom follows.

> I was watching a great history teacher doing WWII. She was studying WWII and she had found a website where you could be a WWII bomber. You are flying and listening to all the radio transactions as you're flying over your target. You were looking for targets assessing what's going on around you and it put the kids right there. It was a great example of where the kids were really interacting with the whiteboard and the pen, that they were participating, and I looked in and those kids were engaged. That was an example where I snuck in. Even when I walked in and shut the door the kids remained focused, and they were watching it. It was so experiential; it was a terrific activity.

Sharing School 01's principal's comments about student engagement, School 02's principal pointed to student use as an ultimate goal and an instructional changing opportunity.

> For students it is by the virtue of the board that you make whatever you're teaching relevant to them. Because they are engaged with it and because it is their comfort zone they enjoy every part of it. They enjoy how it makes them feel like the instructional leader in their classroom. At times, depending on how it's being used, I think that it also brings our veteran teachers kind of into an even playing

> field with kids where they can have conversations about the technology that they would not have had before . . . . I loved it when we first put them in and walking in a classroom and having a kid show the teacher how to use it. That just completely changed the dynamics of their relationships and in a good way.

School 02's principal felt that her vision for the Promethean board use was "in line with what the district put out there." She saw it "becoming the primary focus for instruction any time when previously you would have used a PowerPoint or overhead." Her expectation to teachers was, "To use it every block; whether it is used for a couple of minutes or a whole block it was up to them." She relied on peer interaction in the PLCs to facilitate adoption since this model encouraged regular instructional discussions, and she saw that as an effective way to bring more reluctant users on board.

She shared an example of exemplary use by describing the board's use in a special needs classroom where the teacher, in the past, had not been a big adopter of technology.

> One thing that comes to mind is we had a self-contained history class. I think it was Civics with low-functioning kids. Some of them had been identified for the MMR [Mild Moderate Retarded] program and some were little higher. That is an environment where it would be real easy for the teacher to ignore the board. The teacher in that room had embraced it and as a result her kids did. There was no question in my mind that those kids were more engaged with that than they've ever been. Because of the nature of the resources in the board the lesson plan had multiple levels of the same lesson going on at the same time. So the low-end kid

> in the room could literally go up with hand-over-hand assistance with a staff member [and] do a kind of drop and drag motion with the information. The higher level kid could highlight something at the same time. That I think was astounding, to watch them be that engaged with the material, and I've been in self-contained classrooms for years and years and I don't think I've ever seen kids that engaged.

Reflecting on the diverse composition of her staff, consistent adoption was a concern for her. She specifically pointed to the steep learning curve and time involved as an obstacle.

> I think that probably the time investment or the perceived time investment was a big obstacle for teachers. I think a lot of teachers just flat out only used it as a projector because they had convinced themselves that there was no way that they could give the time to learn it.

As a possible solution to this demand on teachers' time, she felt the PLCs allowed teachers to share the load placed on them.

> They can divide and conquer where "you do this and you do that and we'll put it together at the table and share comments at the end." They also didn't each spend 10 hours developing. That was huge for us because of the timing.

This principal did point to an initial obstacle in the initiative which was the district's decision to mount the boards in the front of the room. Although she acknowledged the impact on her staff—"The teachers were furious that they were putting them front and center"—she was still supportive of the district's message. "Obviously they were right to do it that way because otherwise they would have been tossed to the side." She pointed to this as a strategic and effective way to communicate expectations.

Technology Resource Teachers

Both TRTs interviewed commented that their vision of the boards included a focus on incorporating multimedia. Their actions during the rollout were guided by the professional development plan which centered on getting teacher skill levels to a functional (or higher) level by the end of the school year. Although both reported a high value on getting students engaged with the technology, neither made it a focus of their actions during the spring 2009 semester.

Buying into the adoption of a new technology goes beyond regurgitating the canned message from superiors. Reflecting high performance expectancy, School 02's TRT commented about his understanding of where the Promethean board technology fit into instruction. "In this initiative I saw a lot more educational value than in some others . . . . I personally saw the educational value for every single person in my building." Recognizing that instructional adoption of this tool would take time, he spoke about how he communicated his expectations to staff.

> I made my expectations clear as to what I was going to expect from them initially. Yes, they could use electronic handouts if that's what they were doing, that was fine. However, down the road one year from now if they were still at that point then I needed to work on their development and progress them to the next step.

He envisioned that “ultimately they should be used with the students as well.” His interpretation of a good presentation included, “getting students up to interact with the boards, and they should be engaging and interactive and there should be media.”

School 03’s TRT was not surprised with the low adoption rate in her school. Her description of the rollout was often negative in tone. Her teachers’ actions were as she expected.

> My staff did what I thought they were going to do with it. There wasn’t going to be a lot of use initially even though I tried and gave them all of the handouts and showed them how to download everything.

Although she focused on the acquisition of skills during the rollout, she described no vision of what optimal adoption would look like. Conversely, the only vision she shared was that of a lack of adoption. Her teachers did what she expected, suggesting that communications supported this. She described teacher use as lower level. “Most of them would play games with it but they didn’t do a lot to learn how to do anything with it until the next year.”

When asked about student engagement with the technology, she noted, “Kids really like it when they’re interactive with it, not necessarily with the voters. They like to be hands-on with it and that doesn’t happen a lot.” When explaining why she thought the student engagement was not happening, she pointed to teacher comfort levels with the technology.

> The teachers are still uncomfortable with it. It’s funny when the teachers run into me and ask, “Why isn’t this working?’ and the kids would say, “Well have you

> tried so-and-so?" So the kids are seeing other teachers using it and they have a lot of knowledge and they help a lot of the uncomfortable teachers. The teachers are more afraid of it than the kids.

Professional Development Plans

Contained in the template for the Promethean professional development plan for schools was the statement:

> It is expected that ALL teachers will use the ActivBoard [Promethean board] every day for instruction. Every teacher is expected to turn the board on in the morning and bring up a webpage, graphic, or appropriate flipchart with a visual that is germane to the instruction that day. (Appendix J)

Placing this message in the professional development template ensured this message was communicated to school principals and technology resource teachers who used the template to plan their school's Promethean board professional development. How they furthered that message was school dependent. No documentation was made in any of the 11 schools' professional development plans about extending the message or expectations.

Summary of Phase Two Results

Findings from the phase two investigation of the consequences of implementation of the Promethean board initiative support the following conclusions.

The two goals for the Promethean board initiative were set at the district level in formal documents. Goal one, the instructional goal, was not well communicated to all stakeholders and was not observed at the classroom level. Goal two, expectation of use, was well-communicated by principals and TRTs, as well as the implied message inherent in the placement of the Promethean boards front and center in classrooms. The use of the Promethean boards was observed at the classroom level.

The established infrastructures (VITAL, technology resource teachers, and PLCs) worked well to support the second goal of the initiative, use of the Promethean board. VITAL and technology resource teachers served as channels for communication and professional development. Professional learning communities served as a channel for professional development and collaboration.

School-based professional development was planned using a template (with examples) distributed by the Department of Instructional Services. This plan was developed by each school's principal and TRT. When using this school-based professional development plan template, schools planned their professional development in a manner consistent with expectations set by the template. Interview data demonstrated that implementation of professional development was consistent with school-level plans specified in submitted plans and met expectations.

Technology resources teachers' beliefs, attitudes, and practices influenced classroom teachers' beliefs, attitudes, and practices towards the Promethean board initiative. TRTs who held high self-efficacy beliefs and demonstrated competence with the Promethean board technology encouraged and influenced their teachers to use the Promethean board. As a result, teachers in their schools demonstrated high instances of Promethean board use. TRTs who expressed lower self-efficacy beliefs or demonstrated low levels of competence with the Promethean board technology were not seen by their teachers as a reliable resource. Teachers at these schools often demonstrated lower instances of Promethean board use.

Chapter six summarized the qualitative data analysis representing phase two data that included school board documents, district technology administrator interviews, middle school principal interviews, technology resource teacher interviews, and professional development plans. Once these data were analyzed, conclusions from the phase two analysis were presented. A summary of phase one and two's conclusions, a discussion of the study results, and recommendations for future research are presented in chapter seven.

7. CONCLUSION

Summary

This study examined the impact that a district-wide technology initiative involving interactive whiteboards had on teachers' attitudes, beliefs, and practices and whether this impact was consistent with the overall goals of the initiative. Using the Unified Theory of Acceptance and Use of Technology (UTAUT) as its framework, this case study used a mixed methods design to examine a district-wide interactive whiteboard technology initiative in middle schools. This study occurred in two phases. Phase one occurred during the semesters when the initiative occurred and captured data that described how the initiative manifested itself in teachers' attitudes, beliefs, and instructional practices. This was followed 18 months later by phase two which captured data that examined the intent of the initiative and how this intent was interpreted by all stakeholders.

Five questions focused this study:

1. Are there changes in teachers' observed instructional practices from the beginning to the end of the semester when an interactive whiteboard initiative is rolled out, and if so what are they?
2. What changes do teachers report in their instructional practices as a result of a district-wide technology initiative involving interactive whiteboards?

a. If no changes are reported, what reasons are given?

b. Are these changes consistent with observed instructional practices?

3. What do teachers report as having impacts on their adoption of new technology?

4. What did school leaders report as their role in a technology initiative and what actions did they take to support it?

5. What do different stakeholders of a technology initiative report as its intent?

   c. Are their interpretations consistent with the district's intent? If not what are the inconsistencies?

Phase one data contained walk-through, observation, survey, and interview data as well as school-based professional development plans. Participants consisted of a total of 1,127 middle school classrooms in 11 schools observed during school walk-throughs over the course of the implementation semester. These represented 100% of the classrooms that had students present during the times when walk-throughs occurred and represented approximately 75% of the classrooms since 25% of teachers are in planning during any instructional block. There were 97 middle school teachers observed over three sessions during the implementation semester, and 10 middle school teachers interviewed at the end of the conclusion of the implementation semester. The walk-through and observations were conducted using instruments developed by the State Educational Technology Directors Association (SETDA) and modified for this study to capture technology use in the classroom. Teacher interviews were conducted using a researcher-developed interview protocol.

To answer research questions one, two, and three, walk-through, observational, and survey data were analyzed using chi-square goodness of fit to describe teacher practices during the initiative. Qualitative analysis of interview data from 10 teachers revealed evidence of teachers' attitudes and beliefs and how they influenced their instructional practices. The qualitative data sources were examined for common themes centered on performance expectancy, effort expectancy, social influence, and facilitating conditions.

Phase two data consisted of interviews with initiative stakeholders as well as existing documents related to the initiative including district budgets, district technology plans, school board meeting notes, blogs, and school-based professional development plans. Participants consisted of the Director of Instructional Services, the Technology Resource Teacher Supervisor, two middle school principals, and two middle school technology resource teachers. In order to answer research questions four and five, school board documents and communications were analyzed to capture stakeholder beliefs about the Promethean board, and interview data were analyzed qualitatively to capture stakeholders' beliefs about the intent of the initiative and what actions they took to support it. The qualitative data sources were examined for common themes centered on beliefs and actions. Document analysis was conducted on the school-based professional development plans.

Combining a quantitative and qualitative analysis of the data provided a more complete representation of how a district-wide technology initiative involving

Promethean boards manifested itself in the classroom, how its intent was interpreted by multiple stakeholders, and possible reasons why the initiative manifested the way it did. Findings from this research have provided the basis for recommendations to the administration at the district where the study took place. In addition, recommendations have been made for further research with the sample of schools and for additional studies of similar district-level initiatives.

Conclusions

The main goal of this research was to examine the impact that a district-wide technology initiative involving interactive whiteboards had on teachers' attitudes, beliefs, and practices and whether this impact was consistent with the overall goals of the initiative. Several factors were examined to determine the impact. The following conclusions regarding phase one, the examination of teachers' attitudes, beliefs, and practices, were supported by the data. Overall, there was an increase in teacher use of the Promethean board as the initiative proceeded, with the greatest increase coming during the first part of the initiative. In addition, the percentage of time that teachers used technology in the classroom increased as a result of the Promethean board initiative. These increases in use and length of time of use were consistent with the initiative's goal, use of the Promethean board. Initiative-wide measures of teacher use were not equal in all schools, with a few standing out on the high and low end of use. There was evidence that school level leadership (principals and TRTs) influenced the use of the Promethean board with strong leadership linked to schools where high use was observed. The Promethean board became the primary technology used in the classrooms, although it was not possible to determine the reasons for this given that some schools reported removing competing technologies as a strategy to force board use.

Instructional activity organization changed over the course of the initiative with teacher-led whole group instruction decreasing initially and then increasing to pre-initiative levels observed in walk-throughs and observations. Student-led whole group instruction decreased over the course of the initiative. Small group activities decreased over the course of the initiative as observed in school-wide walk-throughs but increased from the initial to the third more sustained observations. Independent activity increased initially and then decreased to pre-initiative levels in walk-throughs but consistently decreased in observations. Instructional strategy use likewise changed over the course of the initiative, but no clear patterns emerged. Homework and practice, setting objectives and providing feedback decreased from the first to second observation and nonlinguistic representations and cues, questions, and advance organizers increased. Reinforcing effort and providing recognition; cooperative learning; and cues, questions, and advance organizers decreased from the second to third observation and homework and practice increased. Teachers reported the largest changes in their instruction to be increased use of multimedia (specifically video), formative assessments, and increased student interactivity with content. The Promethean board initiative did not result in changes in teachers' instructional practices; instead, the Promethean board was used as a tool to support current instructional practices. No evidence was observed that might account for these patterns in instructional activity organization or instructional strategy use, but the changes are consistent with the literature that states teacher adoption of a new technology is more likely when use matches current instructional practices (e.g. Glover et al., 2007; Kennewell, et al., 2008; Miller et al., 2005).

The factors teachers reported as influential in their adoption of the new technology were the nature of the technology, interactions with their peers, and varied professional development opportunities. The placement of the Promethean board in the front and center of the classroom was also reported to be a clear, unspoken message about expectations that the Promethean boards were to be used. Teachers felt the Promethean board increased student engagement with their content and improved student learning but were hesitant to quantify the impact on student achievement. Teachers (at least initially) perceived the Promethean board to be an alternative presentation device meant to replace their overhead projectors. Professional development at the school level did not meet the needs of all learning styles.

The following conclusions regarding phase two, the intent of the initiative, were supported by the data. Instructional goals for Promethean board use were set at the district level in formal documents but these goals were not well-communicated at the classroom level. Expectations regarding use of the technology associated with the Promethean board were set at the district level in informal documents, and these expectations were manifested at the classroom level. Placement of the Promethean board front and center in classrooms over existing chalk or dry erase boards was perceived and understood as a clear message to teachers about expected use.

The established infrastructures worked well to support the technology portion of the initiative. These infrastructures were partially used to support the instructional components. When using the school-based professional development plan template (with examples), schools planned their professional development in a consistent manner that met expectations. Technology resource teachers' beliefs, attitudes, and practices influenced classroom teachers' beliefs, attitudes, and practices towards the Promethean board initiative. The initiative was positively impacted by the use of established infrastructures (VITAL, technology resource teachers, PLCs). These infrastructures served as channels for communication, professional development, and collaboration.

Discussion

The Innovation

One goal identified for this initiative was a technology goal. School Board Goal 05, Growth and Resources Parity, guided the equitable placement of Promethean boards in all middle school classrooms. This goal was implemented by district-level leaders and manifested in a focus on getting teachers to use the board on a daily basis as part of instruction. This goal was communicated explicitly through a mandate for skill-based professional development reflected in the professional development template originating from district administration. It was also tacitly communicated by the placement of Promethean board front and center in classrooms. Increased use of the board was supported by findings of this study, suggesting the success of the initiative in achieving this goal.

Although study findings demonstrate increased use of the Promethean board, it is not possible to link this use directly with endorsement by teachers of the innovation. Interview data suggests two factors that took decisions about the board's use out of the hands of teachers and instead created contexts that made the boards' use inevitable. First, interview data from one TRT and teachers at two schools revealed that competing presentation technology (overhead projectors) were removed, leaving the Promethean board as the only technology option. In that situation, teacher use of the Promethean board was a necessity for maintaining current classroom practices and removed teacher choice of presentation tool. Second, the decision at the district level to install all Promethean boards at the front of middle school classrooms over the top of existing chalk or dry erase boards sent a clear message that the Promethean board was to be used. Teachers were not involved in decisions about the boards' placement, but their placement at the front of classrooms made it difficult for teachers not to use them. Together, removal of competing technology and the placement of the board in the front of classrooms limited the study's ability to understand teacher choice about the board's use because they were given no input or option to not use it. Thus, possible teacher resistance could not be identified or examined.

A second goal for the initiative was embedded in School Board Goal 1, Student Achievement, and was not well-translated by district-level leadership beyond targeting teacher use. Results of the study did not identify changes in instructional activity organization or instructional strategy use. Teachers used the Promethean boards as their primary presentation tool during walk-throughs and observations, replacing the use of overhead projectors but rarely challenging the teacher-centered instructional approach. This lack of change in instructional practice reflects prior literature (Glover et al, 2007; Miller et al., 2005) that found interactive whiteboard use to be tied to the technology's functionality and not to pedagogical approaches. Teacher-led instructional activity organization was the dominant instructional activity structure documented throughout the walk-through and observational data. This is consistent with Kennewell et al.'s (2008) findings that the interactive whiteboard, by nature of its enhanced presentation functionality, led to more teacher-centered instruction.

Similar to findings related to instructional activity organization, instructional strategy use also showed no pattern of change over the course of the initiative. Results illustrated that some of the instructional strategies' use increased during the first part of the initiative but were reversed by decreases of the same strategies during the second part of the initiative. These findings are supportive of Rogers' (2003) concept of compatibility where adoption of technology is more likely when the technology fits with existing practice, and Rakes et al.'s (2006) findings that teachers tend to use technology to support their current traditional practices.

Although the second goal connecting installation of the Promethean board with student achievement was not achieved, the study did find a pocket of change that appeared when small group/cooperative activities increased from observation two to observation three, offering the possibility that instructional change might be tied to length of time and teacher experience with the board. Teachers spoke in their interviews about the desire to create more interactive and student-centered activities as their understanding of the technology's capabilities increased. This suggested that perhaps more time was needed before changes in instructional practices would occur. The short duration of phase one of this study during the first semester after the initial installation of the boards may have been too brief a period of time to observe instructional changes. Perhaps examining instructional activity organization and instructional strategy use at a later date might demonstrate realization of these expressed teacher desires over time.

Research in schools challenges the researcher with competing concerns. It is necessary for a researcher to make his or her presence in a school known to principals. In addition, it is common practice for principals to notify teachers of potential observations and the presence of nonschool staff in classrooms. Conversely, notification of walk-throughs and observations in advance of the researcher's visits to schools may well shape teachers' choices about the board's use and about instructional practices. Thus, the study's findings might have been influenced by the researcher's presence. The increased use of the Promethean boards may have reflected increased teachers' use of the board on those days when visits occurred. There was no way to verify that those use patterns were similar on days when no walk-throughs or observations were scheduled. However, the finding of minimal change in use from walk-through two to walk-through three suggests the possibility that use patterns reflect overall classroom practice and not changes in anticipation of the researcher's presence. In addition, findings of no patterns of change in instructional activity organization and instructional strategy use suggest that teachers did not alter their instructional practices in anticipation of the researcher's presence. This may have been the result of not knowing how to use the board in ways that supported instruction that differed from current practice, or as an indication that the researcher's presence did not influence teachers' choice of instruction activity organization or instructional strategy use on those days when the researcher was present.

Teachers' Beliefs, Attitudes, and Practices

This study used the UTAUT model (Venkatesh et al., 2003) as a guide to the examination of teachers' beliefs, attitudes, and practices. This model identified four constructs as appropriate domains of investigation. Two of the constructs (effort expectancy and performance expectancy) and their associated subconstructs (perceived ease of use, self-efficacy, and perceived usefulness) led to the study of teacher beliefs and attitudes impacting their adoption of the Promethean board. The remaining two constructs (facilitating conditions and social influence) supported consideration of contextual factors impacting teacher adoption of the Promethean board. Examination of the data revealed beliefs and attitudes about performance expectancy and effort expectancy were indicators of teacher Promethean board adoption and examination of facilitating conditions and social influence were useful in identifying factors that supported teacher adoption of the Promethean board.

Parrish (2010) stated that regardless of the intent of an initiative, ultimately the outcome is determined by the classroom teacher's commitment to the new technology. Several teachers reported that the Promethean board technology allowed them to improve their instructional practices. A few spoke about how they were excited about the capabilities of the Promethean board, and they had made it their goal to leverage these capabilities to design more student-centered activities. Specific examples highlighted the increased use of multimedia (specifically video), formative assessments, the ability to capture and save work, and increased student engagement with their content as positive improvements to student learning. These examples supported performance expectancy research that found beliefs about the technology's ability to support or improve job performance to be a strong predictor of technology adoption (Lai & Chen, 2011; Teo, 2009; Venkatesh et al., 2003).

Some of the responses about changes in instructional practices suggested a change (even if modest) in teachers' instructional beliefs. These results supported Bai and Ertmer's (2008) and Zhao and Frank's (2003) research indicating teachers' changes in beliefs occur before changes in practice. However, this change appears to be the result of the increased functionality provided by the Promethean board and not a pedagogical transformation. It is possible that these beliefs were always present, but teachers did not feel their implementation was supported with the prior technology in their environment. It is worthy of note that teacher interviews found no negative comments associated directly with the functionality or concept of including Promethean boards in their practice, even though the researcher asked about any concerns they might have about the Promethean board. However, during the 282 observations, 14 observations revealed no teacher use of the Promethean board. Eleven of these 14 observations were of teachers initially identified by principals and TRTs as novice technology users. It is not possible to determine if nonuse was related to the teachers' confidence with technology in general and the Promethean board specifically, to teacher decisions about instruction unique to those observations, or to teacher concerns with the Promethean boards. No follow-up data from these teachers was obtained for the purposes of the study. It might be that there were concerns about the boards that this study missed.

Cognizant of the need to support teacher learning as instrumental in facilitating teacher use of the Promethean board, district-level leaders recognized the high learning curve associated with use of the Promethean board and embedded requirements for a professional development component to the initiative. Although some teachers felt the professional development opportunities were helpful, others felt they did not meet their learning needs and expressed a low perception of ease of use and high effort expectancy. Conversely, teachers in general expressed high expectations for the impact of the boards on their performance, believing the Promethean board would improve their instruction.

Those who were most successful in adopting the Promethean boards demonstrated intermediate or advanced technology skills and stated that their own abilities contributed to their success with the Promethean board. Some teachers commented that their positive technology experiences in the past and their high technology self-efficacy beliefs shaped their approach to learning the Promethean board technology and implied a low effort expectancy (i.e. the technology would be easy to learn), supporting the findings of Lai and Chen (2011), Teo (2009), and Venkatesh et al. (2003).

Additional teacher comments reflected a high amount of development time and extended practice in order to master particular features of the Promethean board technology. These comments implied a low perceived ease of use even from those who were more confident users. Although teachers in general believed the Promethean board would be easy to use, their responses described the effort to learn the Promethean board technology as a personal challenge (low perceived ease of use) despite their high confidence for success (high self-efficacy) when faced with these difficult challenges.

These teachers' responses to the Promethean board are similar to descriptions of teachers with high self-efficacy by Bandura (2001), Compeau et al. (1999), and Teo (2009). These results imply that self-efficacy may have a stronger influence on teachers' willingness to adopt an innovation than perceived ease of use and perceptions of effort expectancy.

In addition to personal beliefs, teachers identified contextual factors that influenced their adoption of the Promethean boards as predicted by the UTAUT model (Venkatesh et al., 2003). Facilitating conditions identified by teachers included the placement of the board, removal of competing presentation technology, the professional development provided as part of the initiative, and professional learning communities. The functionality and placement of the Promethean board in the front of the classroom made it a centerpiece to teachers' instructional delivery, and teachers understood that lack of its use would be conspicuous. Teachers' recognition of the message communicated by the placement of the board is similar to Haldane and Somekh's (2005) finding that placement and functionality facilitated use of interactive whiteboards.

All interviewed teachers reported attending the required professional development workshops offered in their school as part of the initiative implementation strategy. Two schools incorporated instructional strategies in their professional development plans but separated these workshops from skill-based sessions. Across schools, the majority of workshops focused on basic skills acquisition and not instructional integration, a common practice with educational technology professional development (Glover et al., 2007; Holland, 2001; Leh & Grafton, 2008; Palak & Walls, 2009; Sandholtz & Reilly, 2004).

This focus on professional development led to successes in the board's usage goal but contributed to lack of success in achieving the second, instructional goal.

The outcome of these skill-based sessions was that teachers learned basic skills. Teachers with higher technology skill levels felt this professional development did little to address their individual learning needs. Many teachers pointed to a desire to attend professional development anchored in their curriculum—a best practice endorsed by Palak and Walls (2009). Additional professional development needs were reported by teachers and described various scenarios where the teacher could work independently with the technology yet have an expert available to assist with questions or difficulties. Some of the teachers believed the school's technology resource teacher served as an excellent resource, coming to them on a regular basis to check on their progress or making time available for collaboration. This "servant leader" behavior of the school technology resource teacher was identified as a best practice by Sugar and Holloman (2009) and supported Windschitl and Sahl's (2002) recommendations for regular interactions between teachers and those responsible for professional development. Other teachers described a lack of knowledge and support from their TRT, suggesting that professional development was uneven between schools.

Additional opportunities for collaboration were provided through professional learning communities that were part of the organizational structure in many of the schools. Principals and technology resource teachers used these embedded structures to deliver professional development during the rollout, taking advantage of times when several teachers had common planning times. One principal used the PLC structure to leverage the ability of a few influential individuals to motivate their peers to use the Promethean board technology, capitalizing on Gladwell's (2002) idea that a few well-selected individuals can influence the masses. Many teachers identified PLCs as support structures in learning the Promethean board technology. These regular interactions encouraged shared learning and allowed them to collaborate with their curriculum and grade-level peers, a practice supported by Ertmer et al. (2001) and Zhao and Frank (2003).

The four constructs (effort expectancy, performance expectancy, facilitating conditions, and social influence) supported the researcher's ability to identify and examine teachers' attitudes and beliefs. However, the model was insufficient to discriminate among and understand the attitudes of teachers of varied levels of adoption of the Promethean board. For some teachers, the adoption of the Promethean board technology occurred quickly as reflected in the increases in use during the first part of the initiative. The smaller increases observed as the initiative progressed suggest there were teachers who required additional time to adopt the Promethean board. Likewise, there was a small group of teachers who were never observed using the Promethean board.

Although the UTAUT model provides little guidance in understanding these varied adoption levels, Rogers' (2003) Diffusion of Innovations model provides a framework as he discriminated between innovators, early adopters, early majority, late majority, and laggards. This current study initially attempted to identify novice, intermediate, and advanced technology users by asking principals and TRTs for recommendations in each category. This strategy did not work as there was no way to establish validity to the recommendations and, in fact, teacher self-identification often conflicted with that of the principal and TRT. In addition, only one of those identified as novice agreed to be interviewed and observations and self-identification called into question the validity of the initial identification as novice. Therefore, the researcher was not able to examine the relationship between teacher technology level (novice, intermediate, and advanced) and teacher attitudes, beliefs, and practices. This resulted in many unanswered questions about the influence of teacher technology level and the level of adoption of the innovation. It may well be that substantial concerns with the Promethean board and with professional development were missed. It also might be that observed increases in use and small shifts in instructional practice might not apply to all teachers even though all teachers were given a Promethean board. There might well have been patterns within the aggregate data that could be accounted for by teacher technology level that were not identified by the study.

The UTAUT model provided some guidance for predicting adoption of innovations but did not provide a framework to predict levels of adoption. If all end users adopt a technology but use it at its most basic level, an initiative fails. Use of UTAUT and prior models captured data at or around the time of the initiative and focused on influences on end users' adoption. It would be beneficial to be able to identify and target prospective high-end users and low-end users prior to the rollout and implement and assess strategies that best meet their needs.

From the research perspective, it is important to better understand teachers' attitudes and beliefs as they differ across users. For example, teachers identified in the study as early adopters (Schools 01, 02, 03, 05, 08, and 10) included in their comments many characteristics descriptive of self-directed learners. They often took the initiative with or without the help of others, “in diagnosing their learning needs, formulating goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes” (Knowles, 1975, p. 18). Although components of performance expectancy and effort expectancy overlap with self-directed learners’ processes, the characteristics of self-directed learners and their actions are absent from UTAUT and prior models from which it was built.

The UTAUT model was helpful in examining existing teachers’ attitudes and beliefs. However, it offered no framework for identifying changes in attitudes and beliefs over the course of the implementation of the initiative or strategies to promote change in attitudes and beliefs. Data obtained in this study presented findings that describe the current state of attitudes and beliefs but not a process by which teachers might evolve in their attitudes and beliefs about the Promethean boards. A model that offers a framework for understanding and promoting the process by which change occurs in attitudes and beliefs would be particularly helpful in the design of professional development opportunities to advance the goals of the initiative. Data obtained from the teacher interviews identifies several teacher recommendations that might identify strategies to promote change and are consistent with recommendations in the literature. These include linking professional development to teachers’ curriculum and grade level (Sandholtz & Reilly, 2004), diversifying professional development consistent with teachers’ levels of adoption and technology skills (Ertmer et al., 2001; Zhao & Frank, 2003), and professional development that is embedded in teacher practice and teacher collaboration (Sugar & Holloman, 2009; Windschitl and Sahl, 2002).

Leadership and District-Level Communication

Recognizing the limitations of the UTAUT model to account for understanding the change process, Rogers' (2003) Diffusion of Innovations model suggested leveraging organizational channels and social structure to communicate about an innovation. Understanding communication is likely instrumental in facilitating the transition from goals to practice. The study findings suggest that institutional infrastructures were effective at communicating the first goal of this initiative, promoting use of the Promethean boards. However, these channels were not effectively used to communicate the second, instructional goal of this initiative, resulting in an absence of change in teacher instructional practices.

The lack of a shared vision by all stakeholders was the result of multiple breaks in the established communication channels, starting at the top. District administrators described instructional and technology goals for the Promethean board initiative in district documents that were used to justify and fund purchase of the boards. During interviews, they communicated expectations describing technology use, but instructional expectations were tied to use of existing multimedia technologies. As a component of the visual literacy instructional goal, the Director of Instructional Services and Supervisor of Technology Resource Teachers described the Promethean board technology as a way to leverage existing resources (Safari Montage, Brain Pop, online databases) as part of classroom instruction. This vision was communicated to some middle school principals who attended optional workshops as part of the VITAL program but not explicitly communicated to teachers.

Interpreting the instructional goal, School 02's principal noted in her interview that she saw this tool, "becoming the primary focus for instruction any time when previously you would have used a PowerPoint or overhead." Thus, this principal communicated only the first initiative goal, demonstrating that the message changed or was modified as it proceeded through established channels. The goal of incorporating multimedia resources was diluted and became a message that the Promethean boards were a replacement presentation tool. The principal's vision was ultimately the one that teachers at her school shared, and her vision was reflected in teachers' use of the Promethean board.

Communication of the vision from the district administrators to the technology resource teachers was framed by the TRTs' roles in the initiative as the professional developers for the Promethean board technology. Ultimately, they were responsible for teaching teachers the technology skills necessary to successfully use the Promethean board and its software. Using the school-level professional development template which emphasized skill development resulted in schools' Promethean board professional development being focused on use and not integration. Since the TRTs were the direct connection to teachers, it was this vision that was translated to the classroom level. The absence of emphasis on or even inclusion of the second, instructional goal in communications to the TRTs resulted in teachers focusing only on the initiative's technology goal.

The breakdown in communication surrounding the second, instructional goal resulted in teachers incorporating the Promethean board into existing practices as has resulted in other instances (e.g. Rakes et al., 2006). Promethean boards were used and, as a result, the first goal of the initiative was successful. However, inadequate communication of the second, instructional goal resulted in teacher responses such as, "I think it has enriched it [instruction], I don't think it's changing it, because I still do all of the activities I normally do." Thus, in the absence of communicated expectations, teachers simply added this tool to their instructional repertoire and continued current practices.

Leadership at the School Level

Leadership at the school level provides the conduit for implementation of initiatives from district-level administration. It is the point where policy is translated into practice. Responsibility for the implementation of the Promethean board initiative at the school level rested with the building principal and the technology resource teacher (TRT). Results of this study demonstrate the impact this leadership team (principal and TRT) have on the success or failure of an initiative. School 02 had a high number of teachers using the Promethean board during the third walk-through, placing the school on the higher end of the technology use continuum. Examining the manifestation of the rollout at this school provided some examples of best practices for planning and implementing a widespread technology initiative.

Professional development played a key role in the successful rollout at this school. The principal attended an optional VITAL session on the Promethean board and translated the vision and goals from that session into expected behaviors for her teachers. The school's TRT attended a 3-day train-the-trainer session and collaborated with high school TRTs who had already rolled out this training to obtain resources and understand issues that arose during the high school implementation. Together, the principal and TRT designed a comprehensive professional development plan (although focused only on the technology goal) that addressed multiple levels of learners. They extended formal workshop sessions by providing constant monitoring and support as teachers began using the Promethean board in their classrooms.

This school implemented several strategies that communicated expected use at their school and drove the changes desired. The first was the removal of competing technologies from teacher access, specifically the overhead projector. Recognizing that teachers would be upset about their loss of this ubiquitous tool in their classroom, the school offered resources to scan and integrate existing instructional materials into a format that could be utilized using the Promethean board. The second was targeting those users whom school leadership knew would be hesitant adopters prior to the initiative rollout. This resulted in a twofold success. The early attention to these users resulted in minimal push back from staff once the Promethean boards were installed. In addition, the support these teachers received resulted in their early adoption of the technology and turned them into some of the greatest advocates for its use with their peers. The third strategy was the utilization of the professional learning communities within the school to leverage Promethean board use and support teachers. Teachers used these shared planning times to collaborate on instruction and share development tasks to create instructional resources for the entire PLC. The principal and TRT used this existing infrastructure as a third arm to the push to implement Promethean board use in classrooms.

Conversely, School 01 had the lowest number of teachers using the Promethean board throughout the initiative's first semester. In fact, between observation two and three, teacher usage went down. This poor adoption could have been the result of many influences tied to individual characteristics, but is more likely the result of school-level leadership that failed to communicate expectations and support teachers as they sought to adopt the Promethean board. The principal did not have a clear vision of how the Promethean board should be used, perhaps because he did not attend any VITAL workshops on the Promethean board. In addition, the principal did not take an active role in promoting professional development. The principal at School 01 reported that he discussed the components of the professional development plan with his TRT, covering the length of time, days, and teachers to be included. However, the professional development plan submitted from School 01 contained only a schedule of training, not an outline of covered content. No evidence of what was planned at the school was provided to the Supervisor of Technology Resource Teachers and, thus, not to the researcher.

Although the TRT attended the 3-day train-the-trainer session, a teacher interviewed at the school reported she felt the TRT was not very comfortable with the technology. She pointed to instances where he would try to do something with the technology, and it would not work. When this happened, he commented that he would show them how to do that later but never followed up with them. Since he was the primary professional developer for the school, his mastery or lack thereof was a major influence on his staff's comfort level with the Promethean board.

The principal discussed the presence of PLCs in his school and how he envisioned they would encourage instructional collaboration and support teachers with the use of the Promethean board. Although he reported examples of good collaboration between curriculum teams, he also reported multiple examples of teachers who taught the same subject and grade level incorporating different instructional strategies and practices with little evidence of shared planning occurring.

Recommendations

From this study, recommendations can be made to help plan and implement district-wide technology initiatives. Its focus on patterns of use and teachers' attitudes, beliefs, and practices lead to the following recommendations for school divisions and practitioners and for further research.

School Divisions/Practitioners

For district-wide initiatives to be successful, it is necessary to formulate clear and articulated goals (Rogers, 2003). These goals should be explicit and available for distribution and referred to frequently as the initiative moves forward. District channels of communication must not only send directives but continually target goals. It is likewise important that these goals be accompanied by an action plan that stipulates short-term and long-term procedures and processes.

Leadership is essential to an initiative's success and thus explicit procedures and processes must be in place to support school leadership (Bolman & Deal, 2003; Osterman

& Kottkamp, 2004). Those responsible for leading the implementation of an initiative must be assisted in understanding the initiative's goals, be clearly informed and supportive of the initiative's goals, and be supported in their efforts to successfully guide the initiative. This takes sustained opportunities for professional development (Lawless & Pellegrino, 2007), clear and frequent communication (Rogers, 2003), systematic benchmarks and measurements to inform next steps, and active engagement with teachers as they work to directly impact classroom practice.

Because teachers are at the heart of an initiative, their adoption of the technology is central to an initiative's success. Attention must be given to teachers' attitudes and beliefs about perceived ease of use, perceived usefulness, and self-efficacy (Venkatesh et al., 2003). Teachers must be clearly briefed about the initiative and prepared for the installation—preferably before its installation. Teachers' voices should be included in the planning and placement of technology, and their concerns recognized openly.

Professional development should be linked to initiative goals (Ertmer et al., 2007; Glover et al., 2007; Holland, 2001). If there are multiple goals, each goal should be directly tied to professional development activities. In addition, professional development should be ongoing and various in its approaches. Efforts should leverage all communication channels (email, newsletter, superintendent/principal memos, face-to-face workshops, and online learning) and continue beyond the initial stage of the initiative's implementation.

Professional development should be designed to represent multiple tracks to address different learning styles, different levels of technology self-efficacy and skill, and different levels of professional responsibility. Likewise, it should embed professional development practices recognized in the literature as best practices, those linked to individual curriculum and grade level, situated in the context of teacher practice, and responsive to peer collaboration (Gonzales et al., 2002). Professional development should make use of existing social, communication, and organizational structures so that it is embedded in established practices as opposed to added on as yet another mandate.

Research

District-wide initiatives are designed to promote long-term change. It is, therefore, necessary to understand not only what happens at the time of an initiative's implementation but at additional points. This study should be repeated at the 1-, 2-, and 3-year points to determine if technology and/or instructional use have changed. Longitudinal data would be beneficial in determining if this technology required more time to learn before instructional changes occurred (Sandholtz & Reilly, 2004). This would further add to studies that suggest that teachers will change their instructional beliefs and practices toward a more constructivist approach with continued classroom technology use (Becker & Ravitz, 1999; Glover et al., 2007; Kennewell & Beauchamp, 2007; Kennewell et al., 2008). Longitudinal data would also corroborate or challenge principal and TRT interview responses that reported teacher usage increased the second and subsequent years of the initiative.

This study focused on a technology innovation. The first goal of the initiative—daily use of the Promethean boards—was supported by the study's findings. However, the second goal—student achievement and changes in instructional activity organization and instructional strategy use—were not supported by the study's findings. This study should be repeated with an increased focus on longitudinal changes in instructional patterns and student achievement. The UTAUT constructs (Venkatesh et al., 2003) examined in this study are tied to an end user's ability to adapt to change and innovation. Does change occur? How? If so, why? If not, why not? Do the UTAUT constructs serve to capture changes? What other constructs might better support understanding change and teachers' adoption of innovation?

This study examined a district-wide initiative focusing on multiple middle schools to capture a profile of use and attitudes and beliefs across schools. This study should be adapted and replicated at the school level to more clearly identify the impacts of school culture to include leadership, peer interactions, role of school organizational structures, social influence, student achievement, student attitudes and beliefs, and site-based professional development.

The UTAUT framework does not account for varied levels of adoption and technology skill. This research did not interview low-level technology users or those who resisted using the Promethean board. There is a great deal to be learned about the differences between users based on differences in technology skill, self-efficacy, and beliefs about instruction. Further research should be conducted to examine patterns of use and teachers' attitudes and beliefs among the varied levels of technology adopters. Such research would be central to informing professional development activities and preparing for the implementation of district initiatives.

Because this study focused on a technology innovation, further research should be conducted that compares the processes, influences, and outcomes associated with a nontechnology initiative. Such a comparison would identify the ways in which technology and nontechnology initiatives impact teachers similarly and differently. It would allow researchers to identify those characteristics that more broadly define innovation and those that are more specifically tied to the nature of a particular innovation.

This chapter summarized the conclusions made from phase one and phase two of this study as detailed in chapters four and six. Drawing on these and using the conceptual framework from the end of chapter two, the study's findings were discussed and compared to the reviewed literature. Additional recommendations were made regarding future research directions to better inform studies of district-wide initiatives.

Findings of this study examined patterns of use that emerged when a district-level Promethean board initiative was implemented, teachers' attitudes and beliefs related to the initiative, contextual influences on adoption of the innovation, and factors of social influence which impacted the initiative. The first goal established by the district for use of the Promethean board was generally met with some variations at the school and individual levels. However, the second goal directed at student achievement was poorly communicated and largely unmet. Patterns of use and teacher attitudes and beliefs were most strongly reflected in and influenced by four factors: professional development, school-based leadership, communication channels, and peer interactions. Together, these four factors were identified as the primary influences in the initiative's successes and limitations.

APPENDIX A. WALK-THROUGH PROTOCOL

Instructions: The Key below should be used with the Walk-Through Recording Sheet. In addition to taking descriptive notes on the Recording Sheet, also document whether any of the technologies below were used by writing the **Code** in the appropriate **Notes** box. When the walk-through has been completed and you are tabulating data, sum the number of classrooms in which each technology was used and record that sum in the last column of the table below.

Key for Walk-Through Recording Sheet – Technology Use

Code	Types of Hardware Used	Number of Classes
IWB	Interactive whiteboard	
PR	Computer + Projector	
OH	Overhead Projector	
OT	Other	

Code	Types of Software Used	Number of Classes
IWB	Interactive whiteboard software (ActivStudio/Smart Notebook)	
MS	Educational management software (e.g. for attendance, grades, lesson plans)	
DR	Drill and practice, ILS, or educational games	
WP	Word processing software	
DM	Data management (spreadsheets), graphing, or analysis software (e.g. EXCEL, SPSS, STATVIEW)	
DB	Database software (e.g. FileMaker Pro, Microsoft Access)	
PR	Presentation software (e.g. PowerPoint)	
EM	Email	
CO	Other communication tools (IM, discussion boards, video conferencing)	
DP	Desktop Publishing software	
PU	Web publishing software	
IN	Internet for research	
MR	Multimedia reference CDs for research (e.g. online encyclopedias)	

SM	Simulations/Modeling software
VI	Software for video, graphics, and sound editing or production
OT	Other

State Educational Technology Directors Association (modified)
Walk-Through Recording Sheet

Time	Room	Grade Level	Subject	Classroom	Org	Teacher Using?	Notes	Student Using?	Notes
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
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		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	
		6 7 8 C	La M Sc SS O			Y N		Y N	

Sub-Total Teachers Yes: ________________ Sub-Total Students Yes: ________________
Sub-Total Teachers No: ________________ Sub-Total Students No: ________________

APPENDIX B. OBSERVATION PROTOCOL

School: ____ Date: ____/____/____

Grade Level(s): ______________ Subject Area(s): _________________
Description of the unit that provides the context for the lesson:

Duration: Start Time: _________ a.m. / p.m. End Time: _________ a.m. / p.m.
Participants (numbers): Students ____ Teachers, Teachers' Aides, etc. ____

Technology Used by Teachers or Students (check all that apply) [C3-1]:

Equipment	Teacher	Student
Laptops:		
Desktop Computers		
Calculators		
Cameras (still or video		
TV/VCR		
Overhead Projector (Transparency)		
Other ______________		

Code	Types of Software Used	Teacher	Student
IWB	Interactive whiteboard software (ActivStudio/Smart Notebook)		
MS	Educational management software (e.g. for attendance, grades, lesson plans)		
DR	Drill and practice, ILS, or educational games		
WP	Word processing software		
DM	Data management (spreadsheets), graphing, or analysis software (e.g. EXCEL, SPSS, STATVIEW)		
DB	Database software (e.g. FileMaker Pro, Microsoft Access)		
PR	Presentation software (e.g. PowerPoint)		
EM	Email		
CO	Other communication tools (IM, discussion boards, video conferencing)		
DP	Desktop Publishing software		

PU	Web publishing software
IN	Internet for research
MR	Multimedia reference CDs for research (e.g. online encyclopedias)
SM	Simulations/Modeling software
VI	Software for video, graphics, and sound editing or production
OT	Other

Activity Organization

A01	Teacher-led whole class
A02	Student-led whole class
A03	Small group or pair cooperative
A04	Independent Activity

Teacher Activities

TA1	Presenting information
TA2	Leading student work
TA3	Supporting student work
TA4	Providing feedback for students
TA5	Evaluating progress

Student Focus

SF1	Whole class lead by instructor
SF2	Whole class interactive
SF3	Student or group presentation
SF4	Individual reading or work
SF5	Pair work
SF6	Interactive group work on a project

Technology use by teachers

TT0	No technology used
TT1	1-25% teacher time using technology
TT2	26-50% teacher time using technology
TT3	51-75% teacher time using technology
TT4	76-100% teacher time using technology

Technology use by students

TT0 No technology used
TT1 1-25% student time using technology
TT2 26-50% student time using technology
TT3 51-75% student time using technology
TT4 76-100% student time using technology

Teacher demonstrated technology skills

TC2 Teacher demonstrates novice technology skills
TC3 Teacher demonstrates moderate technology skills
TC4 Teacher demonstrates advanced technology skills

Research-Based Instructional Strategies used by Teachers (check all that apply)

Identifying Similarities and Differences

Summarizing and Note Taking

Reinforcing Effort and Providing Recognition

Homework and Practice

Nonlinguistic Representations

Cooperative Learning

Setting Objectives and Providing Feedback

Generating and Testing Hypothesis

Cues, Questions, and Advance Organizers

Setting:

_ Classroom _ Lab _Mobile Lab _ Library _ Other

Pattern of Access to Technology (check only one):

_ Teacher access only
_ One presentation station
_ 1 student per device
_ 2 students per device
_ 3-5 students per device
_ More than 5 students per device

Classroom Organization

TR	Traditional Rows (even 2 abreast)
SC	Small clusters of 3-5 student desks
Lab	Lab
F2F	Desks arranged so that students face each other
C	Desks in circles or semi-circles

Average Length of Time Using Technology (check only one) [C3-1]:

_ Less than 5 minutes
_ 5 - 10 minutes
_ 10 - 15 minutes
_ More than 15 minutes

Proportion of Students Using Technology (check only one) [C3-1]:

_ Fewer than 1 in 10 (1/10)
_ 1/10 or more; fewer than 1/4
_ 1/4 or more; fewer than 1/2
_ 1/2 or more; fewer than 3/4
_ 3/4 or more; fewer than 90%
_ 90% or more

Summary Description of Lesson and Major Activities [S1-1, C1-1, C1-2, C2-1]:

Notes:

APPENDIX C. INTERACTIVE WHITEBOARD TEACHER SURVEY

1. Gender

    a. Male
    b. Female

2. Age

    a. 20-25
    b. 26-30
    c. 31-35
    d. 36-40
    e. 41-45
    f. 46-50
    g. 51-55
    h. >55

3. Years teaching

    a. 0-2
    b. 3-5
    c. 5-10
    d. 11-15
    e. 16-20
    f. >20

4. Highest degree

    a. Bachelor's
    b. Master's (single)
    c. Master's (multiple)
    d. PhD/EDD

5. Hours of school-based Promethean board professional development that you have attended

    a. 0

b. 1
c. 2
d. 3
e. >3

6. Completion of Promethean Level I Online Course on Promethean Planet

   a. Yes
   b. No

7. Completion of Promethean Advanced Online Course on Promethean Planet

   a. Yes
   b. No

8. Percentage of class time that you use the Promethean board

   a. 0-25%
   b. 26-50%
   c. 51-75%
   d. 76-100%

9. Percentage of class time that students use the Promethean board

   a. 0-25%
   b. 26-50%
   c. 51-75%
   d. 76-100%

10. What do you think is your overall technology proficiency level?

   a. Novice
   b. Intermediate
   c. Advanced

11. The Promethean board has positively impacted the way I teach

   a. Strongly disagree
   b. Disagree
   c. Neither agree nor disagree
   d. Agree
   e. Strongly agree

12. I feel confident using the technology associated with the Promethean board (i.e. pen, projector)

    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly agree

13. I feel confident using ActivStudio (Promethean's software) to design instruction.

    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly agree

14. The Promethean board increases student engagement with my content

    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly agree

15. The Promethean board has positively impacted my students' academic performance.

    a. Strongly disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly agree

APPENDIX D. TEACHER INTERVIEW PROTOCOL

Thank you for agreeing to this interview.

1. What are the expectations for IWB use in your school?
    a. How are these expectations communicated
2. How do you use the board in your classroom?
    a. Has the board changed the way you teach?
    b. What do you think is the greatest instructional benefit of the IWB on your classroom practices?
    c. Has the board had any negative impact in your classroom?
3. How comfortable are you at using the Promethean Board and its software?
    a. How would you say your own comfort/discomfort with technology helped or challenged the use of the board in your classroom?
    b. To what extent did the professional development on the IWB help or hinder your use of the boards?
        i. What would you say is your preferred method for learning new technology?

ii. Are there other people or places you go to receive technology support?

c. What has been the biggest challenge for you?

d. When you reflect on your skills using technology how would you rate yourself: novice, intermediate, or advanced?

i. What characteristics would you say describe an advanced user?

e. Is there a particular lesson/technique that you have mastered that you are exceptionally proud of?

f. If you could design the next level of professional development for the IWB what would it look like?

4. If you were to describe the best ways for students to learn your content what would it look like in your classroom?

a. Can you describe what your classroom looked like before the board?

i. Teacher centered

ii. Student centered

iii. Collaborative

iv. Problem centered

b. How was instruction delivered?

c. Before the board what type of technology did you use in your classroom?

d. Before the board what type of technology did your students use in your classroom?

5. What impact has the Promethean Board had on your students?

    a. Do you think the board is improving their learning experience?

        i. How?

    b. How about student achievement? Do you have any examples?

    c. How often do you think students get to interact with the board?

    d. How do you think students learn to use the board?

6. What impact do you think the boards have had at your school?

    a. Can you provide an example?

    b. Do you think that they have changed the way teachers teach?

        i. If yes, is this for the better or worse?

APPENDIX E. PRINCIPAL LETTER TO STAFF FOR WALK-THROUGH

Dear staff:

In order to better understand the impact of Interactive Whiteboards in the classroom [Liberty District] Instructional Services is conducting a site visit process that will be used to capture data. The purpose of this process is not to evaluate individual schools, but to build a picture of how the boards are impacting teachers, students, and learning in our district.

In order to collect this data, Barb Gruber from Instructional Services is conducting an initial site visit on [Day, Date XX,] 2009 using observational checklists developed for the project. By repeating this process in future months, we hope to be able to gauge the impact of the boards and technology integration efforts around the county.

Our school has been selected for participation in this process and will be visited on [Day, Date XX,] 2009. With your permission, during that time, Barb will be observing for a few minutes in most classrooms in the building.

We would like to minimize any disruption to your classroom. Please continue with your normal schedule and routine; do not plan any special activities for the visit. In general, Barb will observe in classrooms very briefly, and will attempt to place as little a burden on your schedule as possible. If you have any questions about this visit or its purpose, please do not hesitate to contact [--- ---].

Thank you,

[PRINCIPAL NAME]

APPENDIX F. PRINCIPAL/RESEARCHER NOTICE TO STAFF FOR OBSERVATIONS

Dear Teachers,

In order to better understand the impact of Interactive Whiteboards in the classroom [Liberty District] Instructional Services is conducting a site visit process that will be used to capture data. The purpose of this process is not to evaluate individual schools, but to build a picture of how the boards are impacting teachers, students, and learning in our district.

In order to collect this data, I am conducting a site visit on [Day, Date XX,] 2009 using observational checklists developed for the project. I will be observing your classroom for approximately 20 minutes on the [XX]. By repeating this process in future months, we hope to be able to gauge the impact of the boards and technology integration efforts around the county.

I would like to minimize any disruption to your classroom. Please continue with your normal schedule and routine; do not plan any special activities for the visit. In general, I will observe in classrooms briefly, and will attempt to place as little a burden on your schedule as possible.

If you have any questions about this visit or its purpose, please do not hesitate to contact myself or [--- ---].

Thank you,

Barb

APPENDIX G. TEACHER INTERVIEW INVITATION

Good morning,

I want to thank you for allowing me to observe your classroom over the past semester. It has been an amazing learning experience for me and has allowed Instructional Services to capture some of the wonderful things going on in the schools.

While I have captured a lot of observational data on the use of the Promethean Boards I would also like to explore teacher perceptions and attitudes surrounding the boards. Your feelings and experiences with the board offer important insights into best practices when implementing major district technology initiatives and the professional development that goes with it.

I would love to do an interview with you over the next few weeks. This would be voluntary and I will happily meet your for coffee or lunch (my treat). If you would like to do this outside of school time or during planning I will work with your schedule. The interview would take approximately 45 minutes and will be recorded and later transcribed. Your identity will be coded and a copy of the transcript sent to you once it is transcribed.

If you are open to having this conversation please shoot me an email with a day, time, and location that would best serve you and I will try to accommodate. Thanks again for allowing me to enter your classroom all semester.

Regards,

Barb

APPENDIX H. INSTRUCTIONAL TECHNOLOGY ADMINISTRATOR, MIDDLE SCHOOL PRINCIPAL, TECHNOLOGY RESOURCE TEACHER INTERVIEW INVITATION

Good morning Mr./Mrs./Dr. XXXXX,

I am currently attending George Mason University where I am working on my Ph.D. in Education. My major is Instructional Technology with a minor in Education Policy. As part of my dissertation, I am conducting a case study analysis of a technology initiative, specifically the installation of Promethean interactive whiteboards in [Liberty District].

While I will have access to observational data on the initiative, I would also like to explore the perceptions concerning the initiative from those in leadership roles. Your feelings and experiences with the initiative offer important insights into best practices when implementing major district technology initiatives.

I would appreciate the opportunity to interview you over the next few weeks regarding your experiences. This would be voluntary, and I will happily meet you for coffee or lunch (my treat). If you would like to do this outside of school time, I will work with your schedule. The interview will take approximately 45 minutes and will be recorded and later transcribed. Your identity will be coded, and a copy of the transcript sent to you once it is transcribed.

If you consent to be interviewed, please reply to this email with a day, time, and location that would best serve you. Thank you for your time.

Regards,

Barbara Gruber

APPENDIX I. INFORMED CONSENT FORM

For the Study: A Case Study of a Middle School Interactive Whiteboard District-Wide Technology Initiative.

RESEARCH PROCEDURES

This research project is designed to provide an in-depth look at an interactive whiteboard district-wide technology initiative. If you agree, you will be asked to participate in one interview with the researcher, Barbara Gruber. Interviews should last between 45 minutes and an hour and will be audiotaped. Interviews will be scheduled at times and places convenient to you. A copy of the transcript of the interview will be sent to you once transcribed for your review and any additional comments.

RISKS

There are no foreseeable risks for participating in this research.

BENEFITS

There are no benefits to you for participating in this research other than to further research in implementing district-wide technology initiatives.

CONFIDENTIALITY

The data in this study will be kept confidential. Only the researcher will have access to the data collected. Your name will not be used on any documents or publications; you will only be referred to by your title at a large suburban school district on the East coast.

PARTICIPATION

Your participation is voluntary, and you may withdraw from the study at any time and for any reason. If you decide not to participate or if you withdraw from the study, there is no penalty. There are no costs to you or any other party.

CONTACT

This research is being conducted by Barbara Gruber, a Ph.D. student at George Mason University. You may contact her advisor, Dr. Priscilla Norton at (703)xxx-xxxx or by email at xxx@xxx.edu if you have any questions. You may also contact the George Mason University Office of Research Subject Protections at 703-993-4121 if you have questions or comments regarding your rights as a subject in the research.

This research has been reviewed according to George Mason University and [Liberty District] procedures governing your participation in this research.

CONSENT

I have read this form and agree to participate in this study.

____
Name

____________________________________ ________________________
Signature Date

APPENDIX J. TECHNOLOGY RESOURCE TEACHER PROMETHEAN PROFESSIONAL DEVELOPMENT PLAN FOR SCHOOLS SCHOOL YEAR 2008-2009

EXPECTATIONS FOR USE OF ACTIVEBOARD
It is expected that ALL teachers will use the ActivBoard every day for instruction. Every teacher is expected to turn the board on in the morning and bring up a webpage, graphic, or appropriate flipchart with a visual that is germane to the instruction that day. These along with other ActivStudio tools like *Tickertape* (could display learning goals) or *Sticky Pad* (could display homework assignment) support the use of visuals to begin the day.

ActivBoard required Training Elements

Please see the required components that must be a part of your school's training plan.

I. Awareness Level

Required

- A 20-minute introduction by TRT to ActivBoard/ActivStudio in faculty or department meeting:
    - Demo one or more flipcharts;
    - Encourage teachers to join PrometheanPlanet (ActivStudio templates, lessons, guides, world-wide user groups, blogs, etc.);
- Manuals and QuickStart Guides should be shared http://www.prometheanworld.com/us/server/show/nav.4955

Suggested

- Set up a game where teachers engage in a task (e.g. create flipchart and submit to TRT) for award;

- Create a PrometheanWorld awareness game with prizes to award.

II. Basic Level

Required

- At the secondary level, teachers should be **trained as much as possible by curriculum area**. Special Ed teachers should attend the trainings for the curriculum areas that they support.
- Minimum of **2-hour, preferably 3-hour** training at basic level; this can be offered during school day or after-school; schools can use staff development allotment for substitutes (Note: no Monday or Friday trainings);
- Sample flipchart lessons should show a variety of design strategies: show one that requires lower level thinking skill and then one that requires higher level thinking skills; include any accompanying hands-on activities for students;
- Topics should be determined by you (you know your staff) but at a minimum:
    - Board/Projector Basics and Basic Troubleshooting
    - Introduction to ActivStudio's basic tools, File Management, and Use of ActivPen
    - How to Convert PowerPoint and/or Smart Notebook Files
    - STRESS the use of multimedia (images, audio, video, simulations) with the board; that is the heart of the power of the board. You <u>do</u> <u>not</u> want to see teachers using text only.
- Assessment should include open-ended questions asking for areas in which teachers want to learn more

Suggested

- Encourage teachers to take free online basic course before school's basic training occurs;
- Encourage teachers' sharing flipcharts with accompanying hands-on activities for students;
- Saturate regular training opportunities—department meetings, Tech Tuesdays, etc. with flipchart examples;
- Feature a 10-minute best practice flip chart at every faculty or department meeting.

III. Advanced Level

Required

- Follow-up with teachers before end of SY 2009 to ascertain their needs. There are options as to how this could be accomplished: workshop (face-to-face or online), study groups, Q&A session in faculty meetings, newsletters, etc. Follow-up needs to be documented in your plan and should address teachers' areas of concern and curiosity. As a group and working with C&I supervisors, TRT's will look at advanced offerings for the Summer 2009.

Suggested

- Develop a repository for your staff's flipcharts;
- Email best practice weekly flipchart to faculty;
- Start a flipchart blog.

Promethean PD Plan
Directions: Add rows to tables as needed.

I. Awareness Level

Teacher Group(s)	Activities	Date/Time	Person Responsible

II. Basic Level

A. Hand Off of Pen and Remote (boards not installed so no hand off yet. Preparing teachers to be able to use the boards on the first day they received them).

Teacher Group(s)	Activities	Date/Time	Person Responsible

B. ActivStudio Basics

Teacher Group(s)	Activities	Date/Time	Person Responsible

III. Advanced Level (later in school year or summer 2009)

Teacher Group(s)	Activities	Date/Time	Person Responsible

Note: Don't forget that Promethean has online basic and advanced ActivStudio training. The basic is free and teachers can register for the advanced in MyLearningPlan. In addition, TRTs might want to think about designing their own face-to-face or online training to be offered across the district in Summer 2009.

APPENDIX K. INSTRUCTIONAL TECHNOLOGY ADMINISTRATOR INTERVIEW PROTOCOL

Thank you for taking the time to answer my questions regarding the IWB initiative

1. Can you give me some background about your position and role in [Liberty District]?
2. How did you learn about the IWB technology?
3. Can you give me a brief timeline describing how the boards came into the county and the start of this initiative?
    a. What strategies/practices did you use for this initiative that are different/similar to prior initiatives?
4. What about this technology made you feel that it belonged in every classroom?
5. Ultimately how do you see the IWBs being used in the classroom?

APPENDIX L. MIDDLE SCHOOL PRINCIPAL INTERVIEW PROTOCOL

Thank you for taking the time to answer my questions regarding the IWB initiative

1. Can you describe your background/experiences as a Middle School Principal and how you view your role in the school?
2. How comfortable would you say you are with technology?
    a. Do you adopt new technologies easily or do you rely on others to provide training for you?
3. How did you learn about the IWB technology?
4. What kind of planning did you and the school's TRT do regarding this initiative?
    a. How did you present this technology to your faculty?
5. Ultimately how do you see the IWBs being used in the classroom in your school?
    a. What do you think are some of the best advantages that this technology offers for your students? For your teachers?
    b. What are some of the obstacles that your teachers/students have encountered with its use?
6. How does your vision of IWB use compare to how the boards are being used in your classrooms? Are they consistent?

APPENDIX M. TECHNOLOGY RESOURCE TEACHER INTERVIEW PROTOCOL

Thank you for taking the time to answer my questions regarding the IWB initiative

1. Can you give me a little about your background and experience as a TRT?
2. Prior to the initiative what experience did you have with the IWBs?
    a. How is this technology different/similar to other new initiatives that you have been a part of?
3. When you created your school-based professional development plan did you work with your Principal?
4. How confident did you feel delivering training to your teachers on the IWB?
5. In addition to a more formal "workshop" type training what other things did you do to assist your teachers in this new technology adoption?
6. Were there teachers who did particularly well with the initiative and if so what do you think mitigated this? How about teachers who did not do particularly well?
7. Ultimately how do you see the IWBs being used in the classroom?
8. How does your vision of IWB use compare to how the boards are being used in your classrooms? Are they consistent?

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