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A Mixed Methods Case Study of the Levels of Interactive Whiteboard Use by K-12 Teachers

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A MIXED METHODS CASE STUDY

OF

THE LEVELS OF INTERACTIVE WHITEBOARD USE BY K-12 TEACHERS

by

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ABSTRACT

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The growing presence of educational technology in our nation's K-12 schools has had little effect on teacher practices to enhance student learning (Oncu, Delialioglu, & Brown, 2008). Sophisticated levels of educational technology use are believed to influence student learning (Hall, Loucks, Rutherford, & Newlove, 1975) yet research on effective levels of use is almost non-existent.

The Concerns Based Adoption Model (CBAM) assesses a teacher's level of educational technology use across eight stages, ranging from the lowest level of nonuse to the most sophisticated level where the teacher's technology implementation utilizes instructional strategies to support knowledge building, reflection, and goal setting. Prior studies indicate that higher CBAM levels are linked to enhanced pedagogical change and increased positive attitudes for teachers (Hutchison & Reinking, 2011; Lee, 2010), as well as more effective instructional strategies and collaborative classrooms (Hall et al., 1975; Somekh et al., 2007). Instructional settings incorporating these success elements also show equal conversation from both teachers and students (Beauchamp & Kennewell, 2010), the analysis of which can be facilitated with the Flanders Interaction Analysis Matrix (Flanders, 1961b).

Guided by the Concerns-Based Adoption Model and modified Flanders Interactive Analysis Categories, this study explored the use of Interactive Whiteboards in

one school district of 427 K-12 teachers. Approximately one-half the district's classroom teachers completed a three-part survey which collected demographic data, assessed attitudes toward Interactive Whiteboards, and determined a self-reported level of technology use in their classrooms. Results show that despite positive attitudes, the district's teachers use Interactive Whiteboards at a level that does not yet consider student achievement. Observations of 23 classroom teachers in the same district validated the survey findings.

Keywords: level of use, Concerns-Based Adoption Model, Interactive Whiteboards, educational technology, instructional strategies, teacher attitude, enhanced student learning, Flanders Interactive Analysis

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This dissertation is dedicated to the memory of my parents … who read aloud to me for countless hours … and instilled in me a deep love of books.

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Ernest Hemingway offered that, "It is good to have an end to journey toward; but it is the journey that matters, in the end." As I face the end of my doctoral journey, I reflect on those along the way who actually made this possible.

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CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

Introduction

The level of educational technology use can play a central role in meaningful student learning (Angeli & Valanides, 2009; Bradshaw, 2002; Hew & Brush, 2007). Introducing educational technology for the purpose of enhancing student achievement requires reflective thinking by teachers to facilitate and promote relevant knowledge construction (Jonassen, 1996; Morrison & Lowther, 2010). Unfortunately, educational technology practices remain centered on teacher-imposed knowledge with little focus on student learning (Cuban, Kirkpatrick, & Peck, 2001; Oncu, et al., 2008; Russell, Bebell, O'Dwyer, & O'Connor, 2003; Rutherford, 2004).

The Interactive Whiteboard is similar to earlier educational technologies that came with great promise and struggled to demonstrate clear support of improving student success (Richtel, 2011). A 2009 survey revealed that nearly one-third of all American classrooms were equipped with Interactive Whiteboards (Gray, Thomas, & Lewis, 2010); in other countries, such as Great Britain, Interactive Whiteboard presence was as high as 60% of all classrooms (Davis, 2007). School districts have been quick to invest heavily in the Interactive Whiteboard technology; one Arizona school district invested $33 million over a six year period (Richtel, 2011). Yet uptake in the classroom and teacher support has been slow, possibly fueled by professional development that has not kept pace with Interactive Whiteboard installation (DeSantis, 2012). Teachers most frequently acquire Interactive Whiteboard skills from their peers (Glover & Miller, 2001; Moss et al., 2007) and implement the Interactive Whiteboard as a tool supporting teaching as

opposed to learning (Smith, Higgins, Wall, & Miller, 2005). Instructional settings that demonstrate practices believed to elevate levels of educational technology use, however, have not yet shown long term, improved student learning (Higgins, 2010).

K-12 Interactive Whiteboard research remains weak and informal (Smith, et al., 2005). A recent search of the ERIC database showed 71 refereed K-12 Interactive Whiteboard studies in the past five years. During the same period, an independent search in the ERIC database for "computers" and the "Internet" showed three and five times the number of studies completed, respectively. Most studies related teacher experiences with classroom application of Interactive Whiteboards and less than a handful of studies addressed possible impact on student learning and behavior. None of the studies considered the Interactive Whiteboard Level of Use, which centers on teacher behaviors surrounding new technology adoption.

The focus of this study was to explore the level of Interactive Whiteboard use by K-12 classroom teachers in a single school district. Findings support the preparation and delivery of professional development that promotes interactive classrooms for the district while also informing the literature on implementation strategies and levels of use in authentic environments.

Literature Review

Innovations – newly devised ideas, practices or objects (Rogers, 1976) – have challenged the approval and adaptability of classroom teachers for decades. Educational technology, an innovation subset, is intended to facilitate learning (Januszewski & Molenda, 2008) yet few educational technologies have become instructional mainstays and many have struggled for teacher endorsement (Cuban, 1986). This educational

technology adoption trend has plagued a host of educational technologies over the last century.

Educational film was the first of many educational technologies with a tumultuous schoolhouse history. Early twentieth century teachers played no role in the decision to implement educational film, prompting doubt and apprehension toward this innovative tool. Although Edison predicted in 1913 that educational film would eliminate textbooks and transform the American school system (Saettler, 1990), this innovative aid to teaching with roots external to education never realized its full instructional potential (Reiser, 2001). An early 1930's prediction by Morgan suggested that radios would be "as common as the book and powerful in their effect on learning and teaching" (as cited in Reiser, 2001, p. 56), yet radio enjoyed only a decade of prominence in education. Instructional television of the 1950s and 1960s was another technology that garnered heavy public and private funding, but was subsequently labeled a "disappointment," "disaster," and "enormous failure" (Saettler, 1990). Similarly, Papert (1984) stated that "the computer is going to be a catalyst of very deep and radical change in the educational system" (p. 422). However, computers were yet another educational technology disappointment revealing low-level student uses consisting of drill-and-practice and word processing that could not be correlated to enhanced student performance (Cuban, 1986; Reiser, 2001; Saettler, 1990).

Time has demonstrated classroom teachers as gatekeepers of educational technology use (Armstrong et al., 2005; Cuban, 1986) and administrators as the process decision makers (Hall, 2010). Successful implementation of classroom innovations necessitates shared decision-making by both classroom teachers and administrators to

maximize effective use (Hall et al., 1999; Moss, et al., 2007). Further confusing the educational technology debate is the limited scholarly agreement on the role of educational technology.

Technological Debate

The technological debate refers to years of discussion on the use of technologies as a mere delivery media versus unique facilitator of learning. Discussion within the debate has moved from utilization and adoption to integration and implementation, yet literature has clouded the differentiation of these terms over time.

Utilization -- the selection, preparation, and use of media resources -- dominated twentieth century dialogue of technology use (Brown, Lewis, & Harcleroad, 1973; Dale, 1962). While some encouraged the transition from the mechanical presence of media to its effective instructional use, giving careful consideration to accommodating learner needs to achieve objectives in an interactive classroom setting (Heinich, Molenda, & Russell, 1985), others demonstrated that learner-centered instructional media utilization was rare (Cuban, 1986). Computer utilization in select middle school classrooms was observed to center on student shared use of computers for drill-and-practice software and games (Pruett, Morrison, Dietrich, & Smith, 1993). Yet just over a decade later, Stolle's (2008) national one-to-one laptop study of American teachers suggested that the problem of poor utilization continued and that "teachers are limited in their ability to envision beyond what they already know and do" (p. 65).

Rogers' (1958) innovation adoption studies attached great importance and value to the moment that an individual chooses to use an innovation. Refinements to this perspective offered that adoption "involves the multitude of activities, decisions, and

evaluations that encompass the broad effort to successfully integrate an innovation into the functional structure of a formal organization such as a school ..." (Hall, Wallace, & Dossett, 1973, p. 5). This viewpoint suggested that instructional innovation adoption went well beyond the moment of personal adoption to reflect "systemic reform" (Hall, Dirksen, & George, 2006). Still, it was offered that teachers maintained rather than changed their existing instructional practices when adopting educational technologies mandated by school administrations (Cuban, et al., 2001).

Educational technology integration is a difficult, time-consuming, and resource-intensive endeavor (Congress, 1995), which introduces the technology into regular classroom work (Honey & Moeller, 1990). A practice intended to encourage higher-order and critical thinking (Jonassen, Carr, & Yueh, 1998; Morrison & Lowther, 2010), technology integration demands that teachers harness technology capabilities while simultaneously expounding on their content and pedagogy expertise (Koehler & Mishra, 2009). Time has clarified a description of the ideal technology integration and the terminology describing the process. The term "integration" has been removed from current teacher technology standards and replaced by terminology that conveys the need for teachers to "design, implement, and assess learning experiences" that "facilitate and inspire student learning and creativity" ("International Society for Technology in Education," 2013).

Over time, the study of innovation use was more appropriately viewed as a process, as opposed to a single event with classroom teachers at center stage (Hall, et al., 1999; Hall, 2010). This process is portrayed as an implementation bridge where teacher-centric instructional practices transition to learner-focused instructional methods as progressively more sophisticated levels of technology use are attained (Hall, 2010). Teachers, critical to the success of the bridging effort, have unique needs which must be addressed for a change in practice to be fully realized (Hall, et al., 2006; Jones & Vincent, 2006). Peer modeling of educational technology use and professional development focused on design and delivery of technology-infused instruction are two crucial components for successful teacher technology implementation (Congress, 1995). Both are important to facilitate a change in practice that promotes learner-centered methods of more recent technologies such as the Interactive Whiteboard.

Interactive Whiteboard

The Interactive Whiteboard is a "board connected to a personal computer, capable of displaying a projected image which allows the user to control the personal computer by [either] touching the board or [using] the computer mouse" (Beauchamp, 2004, p. 328). When the Interactive Whiteboard system is not in use the board looks and functions like a traditional whiteboard that can be used with dry-erase markers.

A number of classroom-appropriate Interactive Whiteboard peripherals have emerged including digital scanners, digital microscopes, card readers, and digital cameras (Lee, 2010). Wands extend the reach of the digital pen for young learners and remote controls permit users to maintain system management from anywhere in the classroom ("Promethean Products," 2012). Interactive response systems in the form of clickers and

keyboard response pads provide not only whole-class participation, but afford the means for individual learner formative and summative assessments ("Promethean Products," 2012; "SMART response interactive response systems," 2012). The growing list of similar peripherals is limited only by the imagination.

Interactive Whiteboard users appreciate the easy access to stored instructional content as well as the ability to spontaneously create and store interactive text, images, sound, and video during instruction ("Creating classrooms for everyone: How interactive whiteboards support universal design for learning," 2009; Reedy, 2008; Smith, et al., 2005). The two primary manufacturers of Interactive Whiteboards, SMART Technologies and Promethean, offer extensive instructional resources on each of the manufacturer's support websites, limiting the need for time-consuming preparation of original content. The online resources are perceived to support a more engaging instructional setting (Edwards, Hartness, & Martin, 2002); however, improvement in learner performance has been neither long-lived nor measurable (Higgins, 2010).

While the boards provide opportunities for numerous types of interaction, research indicates that Interactive Whiteboard implementation fails to take advantage of these features to promote learning. During a two-term school district study, Reedy (2008) noted that robust Interactive Whiteboard features were ignored while PowerPoint delivery via Interactive Whiteboard systems was the norm. Observations of one classroom teacher thought to deliver technologically innovative instruction revealed only the repeated viewing of movie clips (Stolle, 2008).

Teacher Interactive Whiteboard practices point to an educational reform that focuses on individual teacher adoption of complex educational technologies to foster

student learning (Hall, et al., 2006). Supporting the needs of teachers during this reform is founded on understanding the current use of educational technologies. Yet an Interactive Whiteboard literature search in the ERIC database showed a limited number of empirical studies exploring Interactive Whiteboard use during the past five years. Studies centered on Interactive Whiteboard general operation and opinion. No studies considered the educational technology Level of Use. Table 1 summarizes the search results with each study categorized into one of eight topics based on the primary focus of the study.

Table 1

ERIC Interactive Whiteboard Refereed Studies

Topic	USA	Canada	Australia	Europe	Mexico	South Africa
General/Use/Opinion	9	0	12	17	0	1
Prof Development	6	1	7	3	1	0
Student Learning	3	0	0	3	0	0
Non-Academic	3	0	0	0	0	0
Student Behavior	2	0	0	0	0	0
Preservice Teacher	0	0	1	1	0	0
Teacher Attitudes	0	0	0	1	0	0
Level of Use	0	0	0	0	0	0

Betcher and Lee (2009) suggested that unlike the abandonment of other educational technologies, the Interactive Whiteboard may succeed in gaining classroom teacher endorsement given its likeness to current practices and technologies; a whole class device that embraces 21st century connectivity by blending aspects of the traditional blackboard, overhead projectors, and Internet accessibility. Like many other educational technologies, the challenge is facilitating its use to promote learning.

Concerns-Based Adoption Model

The Concerns-Based Adoption Model (CBAM) is a framework for understanding the manner in which a teacher implements an innovation (Hall, et al., 1975; Straub, 2009). CBAM is conceptually grounded in teacher concerns research (Hall, et al., 1973) and consists of three diagnostic instruments: Stages of Concern (SoC), Levels of Use (LoU), and Innovation Configuration (IC). The combined CBAM instruments offer a three-dimensional snapshot of a teacher's practices with respect to innovation change. The SoC addresses affective elements of change such as feelings and perceptions toward technology adoption, the LoU centers on behaviors and decisions during the technology adoption process and actual classroom use, and the IC contemplates how the innovation actually looks when used by the teacher (Hall, et al., 2006).

CBAM is both a framework and set of tools based on the understanding that in the classroom "presence of educational innovations does not guarantee their use" (Hall, et al., 1973, p. 1). Enhancing the likelihood of innovative use takes into account the individual adopter and the school itself, which are believed to offer focus on teacher concerns and behaviors throughout the change process.

CBAM is rooted in Adoption Theory (Straub, 2009), but it may be argued that there are major theoretical differences such that the tendencies of innovation adoption is their only similarity. CBAM is centered on the individual user; Adoption Theory is broader and often pertains to the population at large. CBAM focuses on the depth of an innovation's adoption; Adoption Theory focuses on the point in time of an innovation's adoption. Yet both may be observed to be part of a "universal micro-process of social change" (Rogers, 2004, p. 16).

The adoption and full implementation of an innovation is asserted to be a personal process resulting in varying levels of use among large populations (Hall, et al., 1975). Many population members may appreciate the success and experiences of early innovation adopters; however, it does little to encourage earlier adoption (Rogers, 2003; Ryan & Gross, 1943). Moreover, late adopter use may not rival early adopter practices until the point of near total population adoption – or diffusion – and early and late adopters may both demand personal experimentation to validate an innovation's purpose (Ryan & Gross, 1943). Once adopted, higher levels of more sophisticated use may take as long as five years to attain (Hooper & Rieber, 1995; Ryan & Gross, 1943).

This study was limited to the use of the framework's LoU concept in the interest of teacher innovation implementation behaviors.

CBAM-LoU. A teacher's innovation utilization is at the heart of CBAM-Levels of Use (CBAM-LoU), which defines teacher behavior in the classroom with respect to eight graduated levels of educational technology use. Use levels range from 0 indicating nonuse to VI where the teacher not only integrates successfully but also reflects on the use and sets goals for continued successful integration. Table 2 (on following page) elaborates on the levels of classroom teacher use of an innovation as defined by Hall, et al (1975).

Table 2

CBAM Levels of Innovation Use and Level Descriptions

	Level of Use		Description of innovation use
Nonusers	0	Nonuse	Teacher has little knowledge of innovation, does nothing with the innovation and makes no effort to learn about innovation
	I	Orientation	Teacher has taken steps to learn about an innovation and is considering the value it could add to user
	II	Preparation	Teacher is preparing for the initial use of the innovation
Users	III	Mechanical	Teacher meticulously plans for innovation implementation, focusing on personal needs; mastering tasks to use innovation
	IVA	Routine	Teacher has standardized use of innovation, but not yet ready to consider what the real implications of the innovation's are on students
	IVB	Refinement	Teacher begins to adjust the use of innovation in an effort to enhance student learning
	V	Integration	Teacher works with colleagues in the use of the innovation to gain broader influence on student learning
	VI	Renewal	Teacher reflects on the use of the innovation and considers the impact on students while examining new uses; establishes new goals for both self and system with respect to innovation use

Further categorical delineation of the eight Levels of Use isolate factors specific to each Level of Use (Hall & Loucks, 1977). These indicators include knowledge, acquiring information, sharing, assessing, planning, status reporting, and performing. Specific transition points between the Levels of Use can be identified based on user actions surrounding the use of the educational technology (Table 3).

Table 3

Transition Decision Points for Levels of Use

From Level of Use	To Level of Use	Decision Point	Definition
0 Nonuse	I Orientation	A	User begins to learn more about innovation
I Orientation	II Preparation	B	User sets time to begin using innovation
II Preparation	III Mechanical	C	User adjusts use of innovation to best fit needs
III Mechanical	IVA Routine	D-1	Innovation is part of user's routine
IVA Routine	IVB Refinement	D-2	User adjusts how innovation is used to enhance student experience
IVB Refinement	V Integration	E	Makes changes based on comparison/coordination of personal and peer use
V Integration	VI Renewal	F	Considers alternatives to the innovation

The initial Concerns-Based Adoption Model Level of Use (CBAM-LoU) measure consisted of a two-step assessment. The first step was the administration of a single question asking teachers to choose their level of technology use. The second step was a direct observation of the teacher to independently rate the LoU (Hall, et al., 1973). Subsequent writings of the authors, reflective of early diffusion study practices (Ryan & Gross, 1943), endorsed the use of a focused interview to determine innovation use. The

result was a branching interview that asked a series of questions with reference to specific decisions users make when moving between LoU (Hall & Loucks, 1977). The branching interview was developed using 1,381 taped teacher interviews and reported inter-rater reliabilities of three raters ranging from .87 to .96 on the overall LoU (Hall & Loucks, 1977). A correlation coefficient of .98 between levels of use for classroom observations and the branching interview provided validity evidence for the use of these measures to determine and compare LoUs.

The traditional CBAM-LoU observation and focused interview design have been used to classify teacher LoU during student-owned computer implementation (Newhouse, 2001) and to evaluate student learning subsequent to professional development (Adey, 1995). Use of the branching interview, however, was labor intensive and the single-question assessment for LoU soon dominated research given the increased presence of technology and need for greater understanding of innovation use across large populations. The instrument's single-item design did not permit the calculation of internal consistency measures, yet multiple administrations of the instrument in longitudinal studies provided test-retest reliability coefficients (Christensen, Knezek, & Overall, 2007; Mrazek & Orr, 2008; Swain, 2006). Given its ease of administration and minimal demand on researcher's time, the single-item survey has dominated CBAM-LoU research.

In addition to supporting research on the use of technology, the one-question CBAM-LoU instrument has been employed to assess teacher technology training needs (Velasquez-Bryant & Shonkwiler, 2004), and to differentiate professional development needs based on teacher experience (Christou, Eliophotou-Menon, & Philippou, 2004). The single item LoU assessment has also been used to assess learner gains during pre-

service teacher technology instruction with identical self-assessments conducted at the beginning and end of the semester (Christensen & Knezek, 2006; Mrazek & Orr, 2008; Swain, 2006). The single item LoU has also been successful investigating relationships between teacher level of technology use and student achievement as reflected on standardized achievement tests (Christensen, Griffin, & Knezek, 2001; George, Hall, & Uchiyama, 2000).

CBAM-LoU aligns higher levels of educational technology use with student-centered learning and although not measured by CBAM-LoU, higher levels of educational technology use have been shown to positively correlate to classroom constructivist practices that encourage shared classroom learning (Rakes, Fields, & Cox, 2006). Research is limited despite the potential impact of the level of educational technology use on student learning, (Means, 2010). Interactive Whiteboard specific research contends that attaining higher levels of educational technology use resulting in improved student achievement can only be achieved with instructional strategies embedded within a teacher's pedagogy (Somekh et al., 2007).

The Role of Instructional Strategies

The need for K-12 teacher professional development in the area of pedagogy, content, and technological integration is clear (Johnson, Ramanair, & Brine, 2010; Lee, 2010). Prepared instructional content does not generally provide teachers with specific guidelines for the purposeful use of technology (Pruett, et al., 1993) and despite the passage of time and the known need for technology integration skills, graduates of teacher programs continue to demonstrate poor preparation for their role in the 21st century classroom (Lei, 2009). Traditional technology courses fail to model or elaborate

on the many facets of technology use, which eliminate the opportunity for pre-service teachers to derive individualized instructional strategies (Jones & Vincent, 2006; Polly, Mims, Shepherd, & Inan, 2010; Vannatta & Beyerbach, 2000).

Effective instructional design prescriptions can be achieved by fusing human learning theory with situational appropriate instructional strategies (Ertmer & Newby, 1993). The call for pedagogical transformation surrounding the use of Interactive Whiteboards (Beauchamp, 2004; Betcher & Lee, 2009; McCormick & Scrimshaw, 2001) is suggested to begin with refinement of instructional strategies (Lee, 2010; Somekh, et al., 2007) to facilitate the technology's whole class learning environment.

Current research indicates that the instructional strategies used with the boards are driven by Interactive Whiteboard features that do little to improve learning and understanding (Moss, et al., 2007). Focus on the innovation should not detract from the critical role of facilitating "meaning making through both dialogic interaction with one another, and physical interaction with the board" (Armstrong, et al., 2005; Smith, et al., 2005, p. 99).

Trends in Interactive Whiteboard use indicate a socially-based pedagogy unique to their multi-modal design that benefit from a teacher's full grasp of Interactive Whiteboard capabilities (Lewin, Somekh, & Steadman, 2008), but consideration for more traditional and theoretically grounded instructional strategies are implied to be more effective in fully integrating the Interactive Whiteboard into the classroom setting. Wittrock's (1979) generative learning theory, focused on the selection of instructional activities in a learner-centered classroom, emphasized student need recognition by teachers. Grabowski (2004) stated that generative learning theory was easily introduced

into the classroom setting and described it as a "second cousin" to constructivism. Appropriate teacher-led, classroom discussion is just one of the theory's strategies believed to elicit meaning construction by learners, which may efficiently transfer to the implementation of Interactive Whiteboards.

Wittrock (1990) proposed that students should make predictions, make comparisons, explain relationships in diagrams or graphs, and be questioned about meaning. Kim, Grabowski, and Sharma (2004) advocated the use of reflective questioning techniques including guided questioning. Jonassen (1996) suggested overt modeling of thinking practices in conjunction with educational technology, and coaching as needed. And LeCornu and Peters (2005) suggested a classroom climate of sharing with a defined language to include question and discussion skills.

Many of these strategies rely on teacher spontaneity and willingness to participate directly in the learning process. Jonassen (1996) saw this modeling or coaching role rife with risk; yet transitioning the sage [teacher] from the front of the classroom to the center of learning with students has been deemed imperative (Grabowski, 2004; Mercer, Hennessy, & Warwick, 2010).

These pleas for instructional reform have gone unanswered and suggest contemplation of other influencing factors. One consideration is teacher attitudes, which have long been categorized as barriers to technology implementation (Ertmer, 1999).

Teacher Attitude

Attitudes are defined by Thurstone (1928) as "... inclinations and feelings, prejudice or bias, pre-conceived notions, ideas, fears, threats, and convictions about any specified topic" (p. 531). Measured attitudes may not necessarily predict a person's

actions (LaPiere, 1934; Thurstone, 1928); however, teacher attitudes perceived as barriers to implementation efforts are capable of being influenced by professional development (Ertmer, 1999; Lewin, et al., 2008; Somekh, et al., 2007).

Glover and Miller (2001) identified a range of teachers' attitudes related to Interactive Whiteboard use believed to hinder personal pedagogy change resulting in more interactive instructional settings. Positive teacher attitude was asserted to lead one school to comprehensive Interactive Whiteboard usage within three months (Lee, 2010). In another school, positive attitudes were claimed to have influenced early adoption tendencies of teachers asserting to have minimal technology literacy (Jones & Vincent, 2006, p. 6). These studies are supported by evidence that teachers' beliefs and attitudes toward technology's value are crucial to enhancing levels of integration (Hutchison & Reinking, 2011).

Student Interactive Whiteboard expectations and enthusiasm have purportedly changed teacher attitudes and resulted in deeper overall learning; although student frustration accompanies the lack of change in teacher instructional practices (Schmid, 2006). Students have clearly seen the affordance of the Interactive Whiteboard for a more interactive classroom environment. The technology has strong student appeal and when used is suggested to increase engagement (Beeland, 2002) and motivation (Higgins, 2010); however, the technology's novelty vanishes for older students when content commands a greater focus (Reedy, 2008).

Students have appropriately assessed teacher attitudes surrounding instructional change. Many teachers are dissuaded from using Interactive Whiteboards given increased instruction preparation time and refuse to substitute the technology for that

which can easily be done without (Beswick & Muir, 2011). It is this perception of increased instructional preparation time, which was shown to diminish the value of Interactive Whiteboards for student teachers (Kennewell & Morgan, 2003).

One may speculate that novice teachers adopt educational technology more willingly given a generational technology readiness. However, one small study revealed that poor attitudes toward Interactive Whiteboards were not related to age but centered on malfunctioning hardware, minimal professional development, and preparation time (Way et al., 2009). Earlier confidences of digital age learners holding the key to broader instructional technology integration have been disproved. Their recent arrival in pre-service settings has revealed that even they are ill-equipped to effectively integrate technology into instruction (Lei, 2009; Prensky, 2011), which may be predicated on their own classroom experiences (Congress, 1995). University level preparation remains entrenched in technology skill-building with little regard for instructional design-theory-practice relationship that would enhance the meaningful implementation of technology (Gomez, Sherin, Griesdorn, & Finn, 2008).

Purpose of Research

Statement of Problem

Interactive Whiteboards were guardedly welcomed into instructional settings given a long list of earlier educational technologies that failed to live up to high expectations (Richtel, 2011). As the presence of Interactive Whiteboards in K-12 education grows and financial obligations surrounding their maintenance escalate, school districts must assess their effectiveness and consider the manner in which they are being used in the classroom.

One rural, east coast school district shared their struggle to introduce more innovative educational technologies. Schools throughout the district have fought to meet state performance goals and most were performing well below the state's low average. District leaders have worked to equip instructional facilities with current technologies; the district reported a 2.5 student-to-instructional-computer ratio, a ratio that was slightly greater than the state average of 2.14. However, district leaders sought to better understand teacher use of educational technologies to support purchasing decisions and professional development.

The district purchased 198 Interactive Whiteboards for use across 12 schools in the two years preceding this study. They refrained from further widespread purchases given the cost of maintaining these and other educational technologies in the district's schools (District Director of Technology, Personal Communication, May 10, 2011). District leaders specifically questioned Interactive Whiteboard utilization due to the significant capital outlay required for widespread purchase. As a result, the district joined this study to provide insight into current Interactive Whiteboard use and to help guide the district's future professional development and technology procurements.

Purpose Statement and Research Questions

The purpose of this research was to explore how Interactive Whiteboards were used by K-12 classroom teachers in this rural, east coast school district as defined by the CBAM-LoU. Specifically, this study examined the relationships between Interactive Whiteboard Level of Use, teacher attitudes toward Interactive Whiteboard technologies, and instructional strategies.

Four research questions guided this study:

1. How were Interactive Whiteboards used in the K-12 classroom?
2. What was the Interactive Whiteboard Level of Use, as measured by the CBAM-LoU, in K-12 classrooms?
3. To what extent were teachers' attitudes related to the Level of Use, as measured by the CBAM-LoU model?
4. What was the relationship between instructional strategies and Interactive Whiteboard Levels of Use?

CHAPTER II

METHODS

Participants

All K-12 classroom teachers in the district were invited to participate in the study; approximately one-half of the district's 427 teachers voluntarily took part. The majority of participants were females (85.8%) in their 30s (29.8%) who had been teaching for 5-10 years (27.5%) and who possessed a bachelor's degree (56.5%). These demographics closely align with other districts in the state; however, other districts are staffed with approximately 10% more teachers with advanced degrees.

Participants conveyed ongoing efforts to expand their instructional technological capabilities by most completing three or more technology-focused college level courses (42.1%). In addition, the majority of participants indicated completion of professional development provided by the district that centered on basic operational features (90.2%) and instructional design training external to the district that included the preparation of lessons for Interactive Whiteboards (50.6%).

Design

This case study explored the use of Interactive Whiteboards in the K-12 classroom and was supported by both quantitative and qualitative methods. Methods included survey research with cross-sectional analysis, classroom dialogue analysis, and phenomologically-grounded classroom observations acknowledging emergent teacher practices using Interactive Whiteboards.

The study design triangulated teacher self-report instruments, classroom observations, and teacher lesson plans. Data sources included classroom observations of

23 teachers, a review of teacher lesson plans and an online survey open to 427 teachers consisting of (a) teacher demographics, (b) a classroom teacher attitude scale, and (c) a self-assessment of level of Interactive Whiteboard use.

Instruments

Teacher survey. A three-part teacher survey (Appendix A) was administered online at the beginning of the study that solicited teacher participants' demographic data, attitudes toward the use of Interactive Whiteboards, and self-reported use of Interactive Whiteboards. Full survey results are provided in Appendix B.

Demographic survey items. Nine teacher demographic items documented teacher participant gender, age, education, years in the teaching profession, previous non-academic professional experiences, grade(s)-level teaching responsibilities, teaching concentration area, formal coursework in classroom technologies, and specific Interactive Whiteboard training. All items were select-response with the exception of an optional short answer item to collect pre-instructional experience with educational technology.

Teacher attitude scale. An adapted Thurstone scale was constructed to measure teachers' attitudes toward Interactive Whiteboard use. This scale, an alternative to the CBAM-Stages of Concern (SoC) assessment, served to align the measurement of teacher participant attitudes with findings of the most recent Interactive Whiteboard research. This process began with the extraction of statements from literature addressing the utilization or merit of Interactive Whiteboards in the K-12 classroom. The resulting scaled items reflected a broad range of contemporary opinions and views with respect to the use and value of Interactive Whiteboards.

Scale items were presented to a panel of 11 judges who were authors of published studies addressing Interactive Whiteboard technology. Judges independently evaluated each item for its favorability toward the use of Interactive Whiteboards. Judges assigned a numerical rating of favorability between 1 (weakest) and 11 (strongest) indicating the degree each item may separate more positive or negative attitudes toward Interactive Whiteboard use. Results were then averaged to arrive at a single numerical rating for each item. Items with the three highest ratings from each of the scale values between 1 and 11 were selected for the final teacher scale, for a total of 30 statements. Design of the statements and rating structure followed Thurstone's (1928) scale design procedures with one exception; judges used a rating scale to rate each item as opposed to Thurstone's initial process of physically placing cards in stacks from least to most favorable (Sommer & Sommer, 2002).

Three sample statements and the average judge's rating are provided in Table 4 to illustrate the process used for statement selection of the final Thurstone teacher scale.

Table 4

Sample Selection of Thurstone Teacher Scale Statements

Statement	Average rating (11 = most favorable)
Interactive Whiteboards facilitate collaborative group work	8.3
Interactive Whiteboards are visually engaging for large group activity	8.9
Interactive Whiteboards allow students to participate more easily	8.0

The resulting survey with the initial 30 statements was pilot tested for usability prior to administration in this study. Statements were presented to five practicing or

retired K-12 classroom teachers for their review of grammar and readability. This resulted in the correction of a number of spelling errors, and the rewrite of instruction for clarity.

Teacher participant results for the 30 statement Teacher Attitude Scale scores consisted of the average of the expert ratings for selected responses. The lowest possible statement rating was 3.5, while the highest possible statement rating was 9.6. A total of 220 teacher participant response values ranged from a minimum of 3.50 to a maximum of 9.48. The average district level teacher participant attitude was 7.42. This first administration of the Teacher Attitude Scale served as an initial reference for future reliability determination. A Cronbach Alpha reliability coefficient of .834 was calculated for the overall attitude scale.

Teacher Level of Use self-assessment. The traditional CBAM-LoU focused interview was adapted into a branching survey specific to Interactive Whiteboards for online administration in this study. An illustration of the CBAM-LoU decision pathways appears in Appendix C (Hall & Hord, 2006). Without asking teacher participants to select a self-diagnosed level of implementation, participants answered questions that replicated the decision points a teacher may make when behaviors transition between levels of technology implementation. The self-assessment verbiage was modified to direct teacher participant focus specifically to their behavior surrounding the use of Interactive Whiteboards. An individual LoU was determined for each teacher participant based on responses provided, although not shared directly with the participant. Participants were then provided a description of their purported Interactive Whiteboard use and asked to confirm. If a participant did not agree with the described behavior, they

were given a list of descriptive levels of use and asked to select the behaviors that most closely reflected their classroom Interactive Whiteboard practice. The authors touted a focus on behavior versus levels of use as a primary success factor with the interview questioning technique, which was altered for online delivery.

All 220 survey teacher participants initiated the self-assessed LoU survey; however, only 186 completed the steps to attain a self-assessed LoU. Many skipped the last step to confirm their assessment, which was considered an incomplete assessment. Individual teacher participant self-assessed Levels of Use (Table 5) show the largest number of teacher participants at the 0 Nonuse LoU and the fewest number of teacher participants at the VI Renewal LoU.

Table 5

Self-Assessed Level of Interactive Whiteboard Use

Self-Assessed Level of Interactive Whiteboard Use	Frequency	Percent
0 Nonuse	41	22.0
I Orientation	28	15.1
II Preparation	11	5.9
III Mechanical Use	14	7.5
IVA Routine	17	9.1
IVB Refinement	36	19.4
V Integration	30	16.1
VI Renewal	9	4.8
TOTAL	186	100.0

This data was further sorted by district school and level of instruction (elementary, middle, and high school).

This first administration of the Teacher Level of Use Self-Assessment served as an initial reference for future reliability determination.

Classroom observations. Observations of Interactive Whiteboard use were conducted in 23 K-12 classrooms. Observations served as a form of concurrent validity evidence for observation teacher participants' self-reported attitude and LoU.

The Observation Protocol (Appendix D) consisted of four sections: Classroom Identifiers (grade level, subject, number of students, furniture configuration), Interactive Whiteboard Activities, Teacher Talk Strategies, and Classroom Interactive Analysis. The Observation Protocol's primary component was inspired by Flanders Interaction Analysis Categories, FIAC (Flanders, 1961b) and was modified to reflect a contemporary emphasis on shared knowledge building (English, Hargreaves, & Hislam, 2002; Smith & Higgins, 2006). The expanded categories included teacher facilitation of knowledge building, teacher collaboration with students for knowledge construction, student-led knowledge sharing, student-to-student collaboration for problem solving, student-to-student collaboration for knowledge construction, and peer-to-peer feedback.

Observations were conducted during a single class block (30 to 90 minutes in length) at the elementary, middle, and high school instructional levels in the fourth and fifth months of the school year. Observers included the researcher and three retired teachers. Training was provided during one session the day prior to the first observation. The training event consisted of a video to introduce the use of Interactive Whiteboards, presentation of the Observation Protocol, examples of appropriate use of the Observation Protocol, and multiple opportunities to complete the Observation Protocol in response to audio recordings of classroom instruction. Observation schedules were provided and adjusted during this same training session.

No observations were longer than 90-minutes in length. As requested by the district, purposeful selection of observation teacher participants and coordination of observation times were handled by a school coordinator. School coordinators were asked to select two teachers differentiated by their perceived level of Interactive Whiteboard use; no definition of LoU was provided. Classroom observation teacher participants were asked to (1) present a lesson using the Interactive Whiteboard that most accurately reflected their normal instructional practices and (2) to provide a copy of the lesson plan for the observed instruction subsequent to the observation to eliminate bias.

Classroom observation summaries (Appendix E) revealed teacher participant command of the Interactive Whiteboard for PowerPoint during lecture-based instruction by nearly all teacher observation participants.

Procedure

This research study was approved by the school district during the 2012-13 school year. An email was distributed to school administrators by the District Superintendent's office introducing the research and requesting feedback with cares or concerns.

Human subject data collection (as approved by Old Dominion University) began with the administration of the teacher survey in November, 2012. Observations followed and continued into December with two delayed until January, 2013.

Teacher survey. An e-mail invitation to participate in the Interactive Whiteboard survey was sent to each classroom teacher from the Superintendent's office during November. The e-mail contained a direct link and password to the survey administered via Survey Monkey. The teacher survey was made available on Survey Monkey for six weeks. Reminder emails were sent weekly. Although offered, no requests for hard copy

surveys were made. Completion of the scale and LoU self-assessment took less than 20 minutes.

Classroom observations. Classroom observations of teacher participant Interactive Whiteboard use were conducted by the researcher and three trained data collectors. Twenty-three observations were completed; at least one observation was completed at each district school. Teachers were made aware of the observations in advance. To minimize classroom disruption, all observations were made from near the back of the classroom and the observers refrained from any interaction with the class. Observations consisted of a single instructional block per teacher participant, which was no more than 90 minutes.

Observers arrived approximately five to ten minutes prior to the start of the class to permit for an introduction to the teacher participant. One or two observers conducted each observation at each school. Multiple observations were completed on the same day at individual schools with a minimum completion rate of one school per day.

The Observation Protocol (Appendix D) assisted in the recording of classroom activities surrounding the use of Interactive Whiteboards. Observation factors included identification of primary Interactive Whiteboard users, purpose of the Interactive Whiteboard implementation, content and delivery mode, and the utilization or not of the Interactive Whiteboard in response to spontaneous learner needs. Use of a unique identifier for each teacher participant completing the online survey provided an opportunity to validate self-assessment use of the Interactive Whiteboard with observed implementation.

The modified Flanders Interaction Analysis/Teacher Talk tool provided for annotation of the observed dialogue interaction. The observer identified the interaction category and recorded the category in the appropriate cell every 15 seconds over a 20 minute time frame.

Observer notes elaborated on classroom activities. When available, lesson plans were collected from teachers subsequent to the observation to assist in isolating intended and demonstrated instructional strategies.

Observers received training one day prior to the initial classroom observations. All data collectors, other than the researcher, were retired educators – a school level Media Coordinator, a secondary Family and Consumer Sciences teacher, and an elementary Spanish/Physical Education teacher. Training included familiarization with the Observation Protocol; a video introduction of Interactive Whiteboard use; joint completion of an Observation Protocol while listening to a classroom audio recording; and subsequent discussion of agreement/disagreement, clarification of any necessary parameters; and a recap to finalize and coordinate understanding of the various observation parameters to maximize consistency between observers. Observers completed two additional practice scenarios using the modified Flanders Interaction Analysis/Teacher Talk protocol until a 90% agreement was quickly and reliably reached. All materials and observation dates, times, and locations were provided to the data collectors at that time.

Analysis

Teacher Survey. Demographic responses were analyzed using frequencies and measures of central tendency to establish a description of the district's classroom teachers who participated in this study.

Teacher attitude scale. Individual teacher attitude scale scores were determined by averaging all attitude scale items selected. Individual scale item ratings ranged between 3.5 and 9.6 as determined during the expert review. Average responses were calculated by first summing the predetermined numerical expert's rating for each statement with which the participant agreed. Mean and SD of all participant attitude scores were calculated at the district and instructional grade levels (elementary school, middle school, and high school).

Item analyses were conducted on the 30 Thurstone scale Teacher Attitude items hypothesized to assess teacher attitude toward Interactive Whiteboards. Each of the 30 items was correlated with the total score for Teacher Attitude (with the item removed). All correlations were greater than .816.

Teacher Level of Use self-assessment. Individual teacher LoU self-assessments were coded according to the LoU (0, I, II, III, VIA, VIB, V, VI). The Mean and SD of the coded self-reported LoU were then calculated at the district and instructional grade levels (elementary school, middle school, and high school).

A one-way analysis of variance (ANOVA) was used to compare differences between teacher attitudes, independent variable, and LoU at instructional grade levels (elementary school, middle school, and high school), dependent variable.

Data was further analyzed for trends at instructional grade levels and across demographic subgroups. This included review of individual participant scores that were extreme (high or low) with consideration for influencing factors such as years in the teaching profession, professional experience prior to entering the teaching profession, Interactive Whiteboard training, and Interactive Whiteboard access at instructional grade levels.

Classroom observations. Classroom observation data were analyzed to determine the level of observed Interactive Whiteboard use, instructional dialogue strategies, and classroom interaction. Data were reviewed for patterns, themes, and categories surrounding K-12 teacher Interactive Whiteboard use.

Results of the Observation Protocol component inspired by the Flanders Interaction Analysis Categories were scored for individual teachers. Recorded observed talk categories were transferred to an Interaction Matrix Analysis (Appendix F) in numbered pairs reflecting the row and column of the matrix. Overlapping pairs were created by combining the first recorded time with the second recorded time, and then the second recorded time with the third recorded time. A set of four recorded times such as 2, 3, 10, 10 would result in transferred pairs of 2, 3; 3, 10; and 10, 10. Talk time percentages were calculated for each of the categories, which were then reviewed for patterns of classroom dialogue. Results are provided in Appendix G.

Lesson plans gathered after the individual classroom observations were reviewed for instructional dialogue strategies evidenced during the observation. The relationship between the teacher's LoU and instructional dialogue strategies were considered as permitted by the unique teacher identifier.

Descriptive summaries (Appendix E) of individual teacher participant observations provide insight into classroom implementation of the Interactive Whiteboard and classroom dialogue that was not reflected in the Observation Protocol. This included, if possible, the annotation of specific software applications and Interactive Whiteboard features observed in use. Finally, observation data was examined for an emergent, organic district LOU for Interactive Whiteboards to guide future professional development.

Table 6

Research Questions and Analysis Methods

Research Question	Variable	Instrument	Analysis
How are Interactive Whiteboards used in the K-12 classroom?	Interactive Whiteboard Use	Classroom Observations	Coding for patterns, themes, and categories
What is the Level of Use, as measured by the CBAM-LoU, of Interactive Whiteboards in the K-12 classroom?	Teacher Level of Use	Teacher Level of Use Self-Assessment	District, elementary, middle, and high school grade level comparisons to assess for implementation trends
To what extent are teachers' attitudes related to the Level of Use, as measured by the CBAM-LoU model?	Teacher Attitude, (Independent) Teacher Level of Use, (Dependent)	Teacher Attitude Scale Teacher Level of Use Self-Assessment	Pearson Bivariate Correlation Coefficients
What is the relationship between instructional strategies and Interactive Whiteboard Level of Use?	Instructional Strategies Teacher Level of Use	Modified Flanders Interaction Analysis Categories (FIAC)/Teacher Talk Classroom Observations Teacher Lesson Plans Teacher Level of Use Self-Assessment	FIAC scoring Coding for patterns, themes, and categories Review for written notation of intended instructional strategies

CHAPTER III

RESULTS

Elementary students gathered in groups of six at the first of 23 district Interactive Whiteboard use observations. Class had already begun in this first grade classroom and children shared conversations as they moved between learning centers. The room, although full of natural light, had no overhead lighting and was punctuated by the bright light of the Interactive Whiteboard's permanently mounted projection screen. Learning centers were monitored by the classroom teacher, an aide, and a volunteer.

One group of students, gathered on the carpet in front of the Interactive Whiteboard beside the portable projector cart, viewed a continuous loop PowerPoint presentation with a classroom aide. Tasked with writing sentences containing specific grammar components, students were provided direction from only the minimally-worded and soundless PowerPoint presentation. Students asked each other questions about the meaning of their assignment and received prompting for unfamiliar words from the aide. Students hesitated to put pencil to paper until one student read her original composition aloud.

"If I was elephant .... I will eat bananas."

Other group members quickly followed suit and worked to transfer their own thoughts to paper. The students completed their task and left the learning center to permit the arrival of another group of students who would repeat the same process.

Research Question 1: Use of Interactive Whiteboards in K-12 Classrooms

This question explored the observed use of Interactive Whiteboards in 23 K-12 classrooms. The Observation Protocol guided the review of classroom observation notes

focused on topics including Interactive Whiteboard users, instructional settings, Interactive Whiteboard features used, and purpose of the Interactive Whiteboard implementation.

Interactive Whiteboards users. Of the 23 observed classroom teacher participants, 19 were the primary users of Interactive Whiteboards across all grade levels in this district. The lack of teacher presence at the Interactive Whiteboard as previously described was repeated in only two other elementary classrooms and one high school classroom as shown in Table 7.

Table 7

Primary Interactive Whiteboard User within Instructional Grade Level

Primary user	Instructional Grade Level		
	Elementary	Middle	High
Teacher	10	4	5
Student	3	0	1
Total	13	4	6

In the majority of classrooms, teacher participants stood at the front of the classrooms commanding student focus on their presence as they stood to the side of the Interactive Whiteboard, occasionally pointing, writing, or circling content for emphasis, just as they might with the use of a traditional whiteboard. Teacher participants frequently made their way from the Interactive Whiteboard to a computer while dodging the projection light to manage the technology remotely. Teacher classroom circulation during instruction was uncommon and observed only at the conclusion of Interactive Whiteboard activities and associated instruction.

Students in multiple classrooms were invited to share the use of the Interactive Whiteboard to write single responses to lesson-related activities. These included the

answer to a math problem, demonstration of how a math problem was worked, or completion of a word in a sentence for grammatical correctness. Most students approached the Interactive Whiteboard without hesitation – younger children skipped. Students who completed math problems occasionally brought their homework paper for reference. Students asked to complete an activity on the board stood with their back to the class as they pondered the correct answer. Students revealed broad levels of acceptance with respect to the technology, reflected in comments such as, "This is fun," "I didn't get a chance," and "Can I write my answer on the whiteboard?"

Implementation distinctions were notable between classrooms in which the classroom teacher was the primary user and classrooms in which students were the primary Interactive Whiteboard users. Two elementary classrooms established stand-alone learning centers for student access, the first of which was described at the outset of this Results section. The Interactive Whiteboard in the other elementary classroom served as a platform for a vocabulary game played by pairs of students that took approximately five minutes to complete. Not monitored at any point in time during the observation by the teacher, one student asked a partner for help with a word, "What's this word?" The partner responded with the word and the pair exchanged ideas about what made the word difficult to recognize. The students returned their focus to the game, completed the game, and moved on to another center. Of six high school classrooms, only one classroom observed students as primary Interactive Whiteboard users. In this class, science students utilized the central projection space to post group activity responses supporting a whole class discussion. Groups of approximately six students analyzed genetic data for specific components and compiled lists of their results. One

group member would then go to the Interactive Whiteboard and post the group's list of results using a digital pen, after which another group member explained the respective group's data interpretation to the class.

Full command of the Interactive Whiteboard by a student during an observation was noted in one classroom where students reviewed for an upcoming Social Studies test while playing a game of Jeopardy. The fourth grade student hostess was in complete control of the Interactive Whiteboard during the entire class and required no direction for calibrating the portable Interactive Whiteboard, calling up a previously saved file, adjusting the application to change the manner in which game questions were presented, and troubleshooting the missing response sounds for right or wrong answers.

Instructional setting during Interactive Whiteboard use. Use of the Interactive Whiteboard had not yet begun when arriving at a second elementary classroom observation. Students had already gathered on the rug in front of the Interactive Whiteboard and were talking in a naturally lit classroom. Sitting off to the side, the teacher participant prepared for the activity at a laptop on a stationary table. Suddenly the projector was powered on and the area around the Interactive Whiteboard was drenched with bright, reflective light.

Darkened classrooms with open blinds were standard practice in all but two of the 23 Interactive Whiteboard use observations. Only two elementary classrooms left the overhead lights on during Interactive Whiteboard use and one of these experienced color saturation difficulties for the projected images. In this class, students had difficulty interpreting a color-coded graph and eventually the teacher participant turned the lights

off at the request of students and then back on for the remainder of the lesson. Blinds were also open during the entirety of the class in both of these classrooms.

Visibility in classrooms without overhead lights was diminished, but there was no sense that the lack of overhead lighting impeded students' ability to see or write at their desk or table. The darkened classrooms were noted to be specific to the use of the Interactive Whiteboard; when the technology was not in use, classroom overhead lighting was on.

The diffused light produced varying effects. Hushed classrooms hosting softly spoken student conversations were common until the overhead lighting was turned on. A few classrooms maintained a high level of energy with the overhead lighting turned off, with one elementary teacher participant moving swiftly between four sides of two long rows to deliver hi-fives to students for correct answers. Another elementary teacher participant led a multiplication fact rap accompanied by rhythmic clapping of students while waiting for an Interactive Whiteboard to recalibrate. At no time were students observed with heads down; all appeared to be focused on the projection screen.

The touch of the light switch acted to signal the start or conclusion of a lesson with minimal teacher participant prompting. Perhaps indicative of a relationship between teacher and students built over nearly a full semester, students at all grade levels easily transitioned to diverse learning modes at the flick of a switch.

Features of Interactive Whiteboard use. Interactive Whiteboard features were used in 11 of the 23 lessons; elementary classrooms accounted for 7 of the 11 features observed. The Observation Protocol specifically noted the use of touch screen, access of onscreen menus, and drawing features.

Touch screen feature. A math money lesson, in an elementary classroom, capitalized on the touch screen feature during which a two sentence story problem was projected. Presenting an item for purchase and its cost, individual students were invited to the Interactive Whiteboard to select coins equal to the value of the item. After a student selected and dragged coins to a box, the teacher participant touched a checkmark for confirmation of a right or wrong answer. Incorrect answers were reworked by another student. Students also completed worksheets at their desks with images and story problems that matched those projected on the Interactive Whiteboard.

Another elementary teacher participant accessed an interactive color-by-number activity to practice both colors and numbers in Spanish. Individual students came to the Interactive Whiteboard and were questioned by the teacher participant (in Spanish) about which color and number they were going to choose. Students stated (in Spanish) the number they would select, the coordinating color, and then activated the color in selected areas by tapping the section with their finger.

The touch recognition feature was slightly more common in elementary classrooms; however, the manner of touch recognition feature implementation at varying instructional grade levels was perceived to be distinctively different. Elementary classroom teacher participants utilized the touch screen feature to simplify ease of use by younger students. Elementary students using the Interactive Whiteboard were asked to drag and drop, touch to select, or highlight. Middle and high school level touch recognition use more commonly supported teacher participant navigation between PowerPoint presentation slides.

On-screen menus. On-screen menus, accessed by interacting directly with the Interactive Whiteboard to transition from one document to another, were observed to be accessed by only the fourth grade student in full command of the Interactive Whiteboard. Access to previously created files or the saving of completed Interactive Whiteboard lessons was observed multiple times; however, the retrieval and saving processes were managed away from the Interactive Whiteboard at a computer.

Drawing. The Interactive Whiteboard drawing feature was observed in use by two teacher participants, one at the elementary level and one at the high school level. An elementary teacher participant created a hand drawn text box for student input after technical issues prevented completion of blanks projected on the screen. A high school teacher participant drew and labeled a graph during a math function lesson, which was then populated with specific function values by students.

Purpose of Interactive Whiteboard use. Projection of non-interactive PowerPoints, videos, word documents, or Internet sites dominated the observed use of Interactive Whiteboards in this district. Similar to feature implementation, the purpose of Interactive Whiteboard use pointed to grade level preferences, Table 8.

Table 8

Purpose of Observed Interactive Whiteboard Use within Instructional Grade Level

Purpose	Instructional Grade Level		
	Elementary	Middle	High
Projection	10	3	3
Dry Erase	2	3	5

Projection. Elementary teacher participants were noted to use the Interactive Whiteboard to project instructional content more frequently than higher grade levels,

which conversely were observed to be more inclined to use the Interactive Whiteboard as a traditional dry erase whiteboard. Projected instructional activities included textbook publisher provided content specifically designed for the Interactive Whiteboard, teacher designed content, Internet sites and worksheets. Projected worksheets, completed as a class activity, were customarily duplicated and distributed to students for completion at their seats.

Internet site access was routinely observed to be controlled from the computer and afforded a wide variety of free instructional resources. One elementary teacher participant accessed an online video of a reading about Amelia Earhart during an artistic interpretation by a trapeze artist. Another elementary teacher participant visited a website to play a sing-along video in support of student speech services. Several online video foreign language lessons were accessed at both the elementary and high school levels. Each of the foreign language lesson videos were stopped and restarted multiple times, affording teacher guidance to students throughout the lessons, "Let's say and review these words together ..."

Dry erase. Use of the Interactive Whiteboard as a traditional dry erase board was the most frequent occurrence of technology sharing with students. The pen was offered to students to write homework responses, share an answer to a classroom activity, or demonstrate the solution to a math problem. High school students who experienced technical problems with a digital pen while using a portable Interactive Whiteboard transitioned without prompting to record answers using their index finger.

Research Question Two: Interactive Whiteboard CBAM Level of Use

This question considered the self-reported LoU of classroom teacher Interactive Whiteboards. Survey participants answered branching questions about their Interactive

Whiteboard use to arrive at a self-reported LoU, which was then confirmed from a listing of all Levels of Use and a one sentence description. The use of a single Interactive Whiteboard feature, observed district wide during nearly every classroom observation, is typical of a Concerns-Based Adoption Model Level III/Mechanical user. Teachers at five of the district's 12 schools self-reported themselves as Level III/Mechanical users. Figure 2 depicts teacher LoU at 11 of the 12 schools in the district, centered on levels II/Preparation, III/Mechanical, and IVA/Routine. One school's results were not included given the small number of faculty and students which were not representative of the district as a whole.

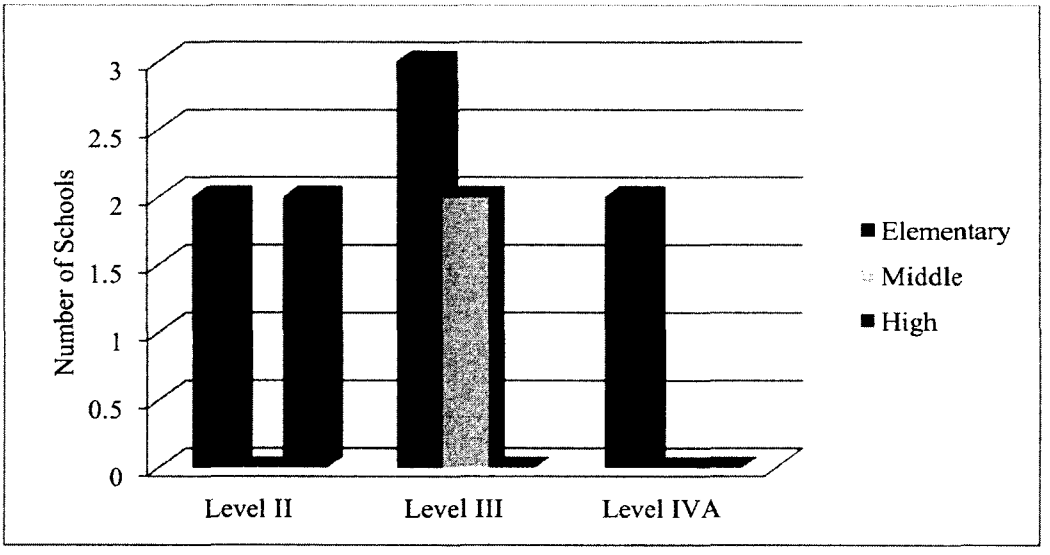

Figure 2. Average district teacher Interactive Whiteboard Level of Use by instructional level. Numbers represent the number of schools at the three most prominent Levels of Use.

Typically, Level III/Mechanical users select one feature of a technology to use and are most comfortable as the primary operators of (in this case) the Interactive Whiteboard. Great care is taken in planning for its use. Entire lessons were observed to

consist of the projection of a single PowerPoint or worksheet; use of the dry erase capability, or viewing of an online lesson.

Survey participants described themselves as Level II/Preparation users at four district schools, and Level IVA/Routine users at two other district schools. Opposite ends of the spectrum, Level II/Preparation users are in the initial stages of Interactive Whiteboard use while Level IVA/Routine users have made the Interactive Whiteboard a routine part of their instruction. The Level IVA/Routine user, according to the Concerns-Based Adoption Model, is on the verge of considering the manner in which the technology may enhance student learning.

Observation participant teacher comments during brief conversations reflected conflict of use and purpose, a sense of ongoing exploration of just how the Interactive Whiteboard technology could support their instruction. One observation teacher participant offered, "I'm still trying to determine just what the best use of this technology is." Another observation teacher participant noted, "Just setting up the board ... for use ... is painful." Yet while two observation teacher participants struggled to isolate how best to use the Interactive Whiteboard, one observation teacher participant shared dependence on the technology, "I would be lost without this ... the projector overheated last week and I panicked ... but transitioned to a document camera."

All observed teacher participants completing the self-assessed LoU survey cited themselves as level IVA/Routine or higher, which confirms their appreciation of the convenience and routine use of the Interactive Whiteboard. However, the limited classroom observation times did not convey the same LoU and were more consistent with the overall district self-assessment at a Level III/Mechanical use.

Research Question Three: Relationship of Level of Use and Teacher Attitude

This question examined the relationship between the self-assessed survey components of district teachers' Interactive Whiteboard LoU and teacher attitude towards Interactive Whiteboards.

Pearson Bivariate Correlation Coefficients were computed between Interactive Whiteboard LoU, teacher attitude, and the instructional grade level. Instructional grade level included three levels: elementary school, middle school, and high school. As shown in Table 9, statistically significant correlations were identified between the Interactive Whiteboard LoU and teacher attitude, and the Interactive Whiteboard LoU and grade level.

Table 9

Interactive Whiteboard Level of Use, Teacher Attitude, and Instructional Grade Level Correlations

Variable	Teacher Attitude	Instructional Grade Level
Teacher Attitude	-	-
Level of Use	.376**	-.142*

** $p < .01$ level (2-tailed), *$p<.05$ level (2-tailed)

This suggests that 14% of the variance in Interactive Whiteboard LoU in the sample can be accounted for in teacher attitude. Additionally, approximately -2% of the Interactive Whiteboard LoU can be explained by the instructional grade level.

In an attempt to explain teacher attitude differences, district documentation was reviewed to ascertain Interactive Whiteboard access. Varying across instructional grade levels, Table10 illustrates access to Interactive Whiteboards across the three instructional grade levels and an increasing teacher to Interactive Whiteboard ratio with each progressive instructional grade level. Thus, it may be said that that teachers are more

likely to have direct access to an Interactive Whiteboard at the elementary grade level than middle and high grade levels.

Table 10

Teacher to Interactive Whiteboard Ratio

Grade Level	Teacher to Interactive Whiteboard Ratio
Elementary	2.1
Middle	2.6
High	3.2
District	2.6

Teacher Attitude Scale. The Teacher Attitude Scale was one component of the online survey. Complete results can be found in Appendix F. The district teacher participant attitude mean of 7.42 was comprised of an elementary instructional grade level mean of 7.76, a middle school instructional grade level mean of 7.32, and a high school instructional grade level mean of 7.12.

The Teacher Attitude Scale score range was 5.98, with a minimum of 3.50, maximum of 9.48, and a standard deviation of 1.09. Participant responses support the indication of a slight attitude and Level of Use variance between elementary and high school grade levels as demonstrated by descriptive statistics in Table 11.

Table 11

Descriptive Statistics, Teacher Attitude Scale

Instructional Level	Mean	Min	Max	Range	Std Dev
Elementary School	7.76	5.65	9.35	3.70	.7108
Middle School	7.32	3.50	8.59	5.09	1.588
High School	7.12	3.80	9.48	5.68	1.226
District Totals	7.42	3.50	9.48	5.98	1.09

This was further reflected in the selection by one-fourth of all high school attitude scale participants of a less positively rated accessibility statement, "I need more access to an Interactive Whiteboard for practice." One high school teacher who was not observed felt so strongly about access issues that an email was received describing the frustration. "To my knowledge there isn't one [Interactive Whiteboard] available to borrow ... another teacher I know that has one has not shared it ... I don't even know how to gain access to one." Yet another high school teacher participant, observed at a different high school, conveyed a more positive attitude that may be reflective of access. "I love my Interactive Whiteboard and what I can do with it that I could not do with an overhead projector, such as pull up interactive math web pages for the students to explore ... and graphics are also clearer."

District policy changes that may have resulted from the increased presence of the Interactive Whiteboard did not go unnoticed or unreported. A conversation with one elementary teacher participant suggested that a once positive attitude toward Interactive Whiteboards had been eroded due to access and support issues. "Initially we had incentives surrounding the use, but ... those have all disappeared ... and the spontaneity is gone. Last week students asked about Iran ... I located a 30 second video, but was unable to access because of the firewall ... it's frustrating."

Research Question Four: Contribution of Instructional Strategies to Level of Use

This research question sought to examine the contribution that instructional strategies, specifically teacher talking strategies, may lend to the LoU.

Pearson Correlation coefficients, Table 12, showed no correlation between the Interactive Whiteboard LoU and teacher talk ($p > .05$) of observed classrooms, implying a teacher-centered instructional setting.

Table 12

Teacher Talking Strategies and Interactive Whiteboard Level of Use

Variable	Level of Use	Teacher Talk
Level of Use	-	
Teacher Talk	.007	
Student Talk	-.037	-.901**

** $p < .01$ level

Interaction Analysis. Teacher talk, as measured by the modified Flanders Interaction Analysis Categories (FIAC), revealed that observed district teacher talk comprised 52.57% of observed classroom instruction time (Classroom Interaction Analysis, Appendix G). Teacher talk encompassed any type of talk delivered by the teacher participant to include laudatory comments, probing, lecture, instructions, and reprimands. Student talk included responsive and student initiated talk along with talk among students only. A final component supported recording of silence by all classroom participants, which included non-instructional class time such as the handling of technological difficulties.

District teacher participant talk surrounding the facilitation or collaboration of student learning (as opposed to direct instruction) with Interactive Whiteboard implementation was ascertained to be 3.23% of the total teacher talk component. Interpreting this teacher talk component consisted of the very specific integration of Interactive Whiteboard into instruction as opposed to the projection of a PowerPoint or document image.

District student talk that reflected student use of the Interactive Whiteboard in nearly any manner was 17.47% of the total student talk component. Student use of the

Interactive Whiteboard was, in all but two classroom observations, short-lived and in response to an invitation to respond to specific questions.

District teacher participants were observed to directly influence students during 34.1% of instructional time, indirectly control extended learning for 29.4% of classroom time, and control student motivation for 26.3.% of the time. Lastly, the steady state instruction (Table 13) was observed to heavily revolve around lecture or direct delivery of instruction. Correlated to subject matter, steady state instruction was lecture-based in liberal arts courses and directional in math courses.

Table 13

Classroom Steady State Instruction

Steady State Instruction	Instructional Grade Level		
	Elementary	Middle	High
Lecture	7	1	1
Gives Direction	2	3	2
Digital Student Collaboration	3	0	1
Digital Teacher/Student Collaboration	0	0	1
Silence/Confusion	1	0	1

Flanders' (1961a) two-thirds rule suggested that two-thirds of class time is talk of which two-thirds (45%) can be predicted to be teacher-owned. Of this two-thirds teacher talk, two-thirds (30%) can be expected to be direct teacher talk. Direct teacher talk included lecturing, providing student direction, or reprimanding students. Direct teacher talk is in contrast to teacher talk, which is more interactive and strives to share the knowledge building process with students. Analysis of classroom observed teacher participant talk in this district showed that only 19 of the 23 teachers exceeded the two-thirds rule prediction as shown in Table 14.

Table 14

Two-thirds Rule Analysis of Observed Classroom Talk

Teacher	Teacher Talk	Teacher Direct Talk
A	55.70%	45.45%
B	00.00%	00.00%
C	50.30%	58.97%
D	77.10%	18.75%
E	48.70%	23.68%
F	66.50%	32.74%
G	58.20%	50.00%
H	64.90%	24.32%
I	00.00%	00.00%
J	50.00%	53.70%
K	61.00%	59.57%
L	54.40%	60.47%
M	55.70%	43.18%
N	71.70%	27.91%
O	60.40%	42.02%
P	69.20%	13.85%
Q	61.00%	50.52%
R	63.50%	18.33%
S	54.90%	41.67%
T	39.00%	20.00%
U	57.00%	45.56%
V	21.60%	13.51%
W	68.30%	38.38%

Teacher Talk Strategies. Closed questioning techniques dominated observed classroom instruction during 16 of the 23 observations, as shown in the summary of observed strategies in Table 15. "Who do you think you will see when we visit the Judicial Branch?" "Who would like to show how they got the right answer?" Examination of the talking strategy observations reveal that teachers were cautious about singling out students and made most frequent use of whole class strategies. Further, individual students providing single-voice responses were given sufficient time to express themselves prior to teacher interruption.

Table 15

Observed Teacher Talking Strategies

Talking Strategy	Grade Level		
	Elementary	Middle	High
Open questions	0	1	0
Closed questions	8	4	4
Probing questions to individual students	1	2	2
Probing questions to entire class	5	3	5
Time for student answers	8	3	2
Time for unexpected student input	3	2	4
Personal strategies explained by students	2	1	2

All answers were appreciated and without rebuke; one class of elementary students applauded every answer regardless of its accuracy. Over and over, entire classes discussed incorrect answers in a supportive and sensitive manner. Students showed no disillusionment. A trio of elementary students struggled to complete even one classroom activity with a correct answer; two of the three had raised their hands and offered inaccurate responses. Determined to experience success, one of the trio took command and encouraged the other two, "We are going to get at least *one* of these right!" However, Flanders Interactive Analysis Categories showed teacher verbalization of student praise limited to one time each by three middle school teacher participants, and teacher acceptance and/or use of student ideas once each by two elementary teacher participants and one high school teacher participant.

Assessment of teacher observations using the Flanders Interaction Analysis Categories revealed absolutely no teacher talk that was intended to criticize or discipline students.

Lesson plans. Requests for the sharing of lesson plans from observed classroom teacher participants met with a lack of enthusiasm. While some teacher participants

shared that they had no lesson plan at all, other teacher participants stated that the use of the Interactive Whiteboard was not reflected in their lesson plans. "I don't have specific [Interactive Whiteboard] lessons yet. I will get there." Still another teacher participant stated, "I don't call out the [Interactive Whiteboard] in my lesson plans."

One high school teacher participant, when prompted for a lesson plan copy, noted, "I do not write up a traditional lesson plan. [The Interactive Whiteboard] is only the surface I use in my classroom for presentation to class or their presentation to the classroom. It is my BOARD [participant emphasis]. We do not use the blackboard."

Lesson plans that were provided were diverse and in multiple formats. One observation teacher participant provided a printed copy of a PowerPoint presentation and another teacher participant provided copies of student handouts. Several math lesson plans included navigational and talking point references with notations of when/where to show transparencies and exercises, and talking points to guide the delivery. One acknowledged the Interactive Whiteboard, the other did not. "Use the following [Interactive Whiteboard] files to introduce and demonstrate the use of each theorem." Another annotated the presence of the Interactive Whiteboard through prompts or reminders in the lesson plan, "[Interactive Whiteboard] notes and activity on Coordinate plane."

CHAPTER IV

DISCUSSION AND CONCLUSIONS

Significant Findings

Interactive Whiteboard investments far exceed evidence of their affordance in the K-12 learning environment (Smith, et al., 2005); however, understanding the classroom use of Interactive Whiteboards is contended to be foremost to successful implementation practices resulting in enhanced student learning (Hall, 2010). In the interest of expanding current Interactive Whiteboard literature, this study sought to understand Interactive Whiteboard use in one school district.

Results of this Interactive Whiteboard use case study revealed that teacher participants in this school district generally have positive attitudes toward the use of Interactive Whiteboards and a high CBAM II/Preparation LoU. Teacher participant attitudes were noted to minimally influence their LoU; however, accessibility at the higher grade levels was shown to have some impact on teacher LoU.

Classroom observations of Interactive Whiteboard use by 23 K-12 teachers suggested its support of routine teaching tasks. Observation teacher participants were mechanically confident in their use of the technology and centered instruction on one or two features, the most common which was PowerPoint presentations. Student use was rare beyond momentary sharing when prompted by teacher participants.

Finally, classroom interaction analysis supported perceived teacher-centered instruction during classroom observations. Teacher talk was commonly in excess of Flanders' (1961a) two-thirds rule purported to represent the average classroom.

Limitations of the Study and Directions for Future Research

This study relied heavily on an original self-report survey to gather data from district K-12 teachers about their purported instructional use of Interactive Whiteboards. Although self-report surveys are suggested to result in concealed or exaggerated responses from participants, a positive relationship with the researcher is purported to minimize this weakness (Gall, Gall, & Borg, 2005). Every effort was taken to establish positive rapport with school leadership at both the district and school levels to gain support and build confidence in the study at hand. Indications were that district and school level leaders endorsed the study through verbal and written communications.

The classroom observations of 23 teachers were critical to establishing the actual use of Interactive Whiteboards in this school district; however, observations have been noted to result in observer bias and encourage atypical participant behavior (Patton, 2002). Observation protocol provided data collection boundaries; specific aspects and features of Interactive Whiteboard use were determined to guide the observations. Attempts to dissuade uncharacteristic participant use of the Interactive Whiteboard during the observation, participant communications clearly conveyed the importance of demonstrating customary instructional use of the Interactive Whiteboard. No further information was provided with respect to levels of use or key points that would be of interest for the observers.

The results of the small number of one-time observations in this study may not have generalizable applicability to other populations; however, the dichotomous relationship between the observed self-reported levels of Interactive Whiteboard use and observed Interactive Whiteboard use warrants further study. It has been offered that the

discrepancy between teacher self-reported Interactive Whiteboard and observed use does not automatically negate instructional transformation (Cuthell, 2003); yet it may be argued that the discrepancy is a more serious indication that teachers comprehending educational technology integration components have no personal reference point for drawing learning-supported Interactive Whiteboard instruction. Understanding the relationship between teachers' prior learning experiences and their learning-supported integration of educational technology may be critical to gaining a foothold on enhanced classroom technology use.

Finally, the general lack of interaction within the observed classrooms in this study justifies future stateside research on the correlation of classroom interactions and Interactive Whiteboard levels of use that realizes unique American cultural nuances not reflected in current literature bearing heavy foreign influence. The interaction between classroom members themselves has shown enhanced student learning and not the interaction between classroom members and the educational technology (Tanner, Beauchamp, Jones, & Kennewell, 2010). This perceived misinterpretation of the interactive aspect reflects earlier calls for Interactive Whiteboard professional development centered on instructional strategies (Lee, 2010; Somekh, et al., 2007) capable of initiating pedagogical change (Beauchamp, 2004; Betcher & Lee, 2009; Lee, 2010). Assimilating the Interactive Whiteboard as a "digital hub" of sorts (Mercer, et al., 2010, p. 206), effective implementation hinges on using the Interactive Whiteboard as a channel for whole class conversations. Attaining success, however, is very dependent on a nontraditional teacher role that demands teacher pedagogical change (Beauchamp & Parkinson, 2005).

Resolve

Although teacher practices were central to this study, the systemic nature of Interactive Whiteboard implementation cannot be ignored (Jones & Vincent, 2010). Sponsors of technological integration must give careful consideration to teacher preparation that has historically provided the language of integration (Swain, 2006) and centered on practiced use of Interactive Whiteboard features (Christensen, et al., 2007). Teachers already in the classroom may more readily embrace pedagogical change provided peer mentoring and ongoing professional development (Jones & Vincent, 2006). Moreover, it is the combination of mentoring and continuing professional development that yields the greatest changes in teacher pedagogy surrounding the use of the Interactive Whiteboard (Glover & Miller, 2001).

Indications from these scholarly observations suggest that this school district may be able to achieve more meaningful student learning through the initiation of a peer mentoring and professional development program directed at the implementation of Interactive Whiteboards. Professional development is key to teaching and learning reforms although the amount of professional development which best correlates to successful instructional change has yet to be explained (Desimone, 2009). Establishing schools as learning organizations demands that teachers invest in their own learning and development to foster new and unique classroom solutions (Fisher, Higgins, & Loveless, 2006).

Conclusion

The presence of the Interactive Whiteboard is relatively new to the instructional setting; however, acknowledging the need for pedagogical change and the importance of

instructional strategies to foster a collaborative learning environment are not. Flanders' (1961b) cited difficulties of in-service training targeted at improved teacher performance "extend like a massive cold front" (p. 1); yet the same challenges for classroom instructional reform abound decades later (Mercer, et al., 2010). Teachers have been and continue to be challenged to prepare and facilitate interactive technological learning that they themselves have not experienced (Miller, Glover, Averis, & Door, 2005). Exposing classroom teachers to collaborative learning environments that use technology in meaningful ways is critical to beginning the transition across the implementation bridge.

Duffy and Cunningham (1996) wrote that, "Culture creates the tool, but the tool changes the culture. Participants in the culture appropriate these tools from their culture to meet their goals and thereby transform their participation in the culture" (p. 180). Notably, participants in this case study were in the throes of transforming their cultural participation with the appropriation of the Interactive Whiteboard.

This case study, as a supplement to current literature, offered insight into the Interactive Whiteboard use of one district's K-12 classroom teachers. Research suggests that transforming this district's teacher technological use should be founded on professional development intended to influence a pedagogical shift (Mercer, et al., 2010; Miller, Glover, & Averis, 2005; Reedy, 2008; Stolle, 2008). A pedagogical reform of sorts may encourage elevated Interactive Whiteboard use through the introduction of instructional strategies intended to stimulate classroom dialogue. Only users at the highest Interactive Whiteboard levels of use show interactive classroom dialogue alleged to result in improved student achievement (Miller, Glover, & Averis, 2005). However, it

may be important to first reassess the perceived accessibility issues if a pedagogic shift is to be realized (Glover & Miller, 2001; Greiffenhagen, 2000).

The recurring challenge of educational technologies cannot be overlooked as a technologically-dependent society nibbles relentlessly at schoolhouse doors. Growing financial obligations for educational technology must be supported by evidence that Interactive Whiteboards are both being used and positively impact student learning. Evidence that can only be obtained through a broad and reflective exploration of the use of the Interactive Whiteboard in United States K-12 schools to ground the preparation of 21st century facilitators of student learning.

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Appendix A: Teacher Consent and Survey Instrument

You are invited to participate in research to explore instructional use of Interactive Whiteboards. The study is being conducted by Dr. Ginger Watson from Old Dominion University. This research is being conducted as part of the dissertation requirements for Jo Thomas.

There are three components to the research – this three-part survey, observations of select classrooms at each school, and follow-up interviews with observed teachers. Results of the research will help to identify district technology needs and guidance for future professional development offerings.

This survey will take approximately 20 minutes to complete and will ask you to provide (1) demographic information about yourself, your teaching experience, and your current teaching assignments, (2) your attitudes toward Interactive Whiteboards, and (3) how you use Interactive Whiteboards in your classroom. All data you submit will be kept confidential. All data will be collected and stored on a non-XXXX site. Only the Old Dominion University researchers will have access to the raw data. Data will be compiled into summary report format for use by XXXX. There are no known risks to this study. Your participation is completely voluntary and there is no penalty or loss of benefits if you choose not to participate in this research study or exit the survey at any time. You may choose not to answer any question just by skipping it. The survey will take approximately 20 minutes to complete.

Clicking the start button will indicate your consent for the answers you supply and participation in this research.

This consent includes potential classroom observations and subsequent interviews. You will be contacted in advance by a designated school coordinator should you be asked to participate in an individual classroom observation.

Thank you for your cooperation.

If you have any questions about the study you may contact Dr. Ginger Watson (gswatson@odu.edu) at 757.683.3246 or Jo Thomas (jthom132@odu.edu) at 252.267.4598.

Q1. Create a unique identifier to maintain your anonymity by answering the following questions:

□ What is your favorite food?

□ What was the model of your first car?

□ Select a number between 0 and 9.

Q2. Select your gender: ___ Female ___ Male

Q3. Select your age range from the list below.

□ 20s
□ 30s
□ 40s
□ 50s
□ 60s

Q4. Select your highest level of education completed:

□ Bachelors degree
□ Masters degree
□ Masters degree +15
□ Doctorate degree

Q5. Select the number of years you have been in the teaching profession.

□ less than 3
□ 5-10
□ 11-15
□ 16-20
□ 21-25
□ 26-30
□ 30+

Provide professional experience prior to entering the teaching profession (if applicable)

_____

Q6. Select the grade level you are teaching this year (check all that apply):

- □ Kindergarten
- □ 1st
- □ 2nd
- □ 3rd
- □ 4th
- □ 5th
- □ 6th
- □ 7th
- □ 8th
- □ 9th
- □ 10th
- □ 11th
- □ 12th

Q7. Select the school you are assigned to for the current school year (check all that apply).
NOTE: List of schools not included to maintain district anonymity

Q8. Select the concentration area for your current teaching assignment (check all that apply):

- □ Art
- □ English and Language Arts
- □ Foreign Language
- □ General Education
- □ Health and Physical Education
- □ History
- □ Mathematics
- □ Music
- □ Physical Education
- □ Science
- □ Social Studies
- □ Speech and Theater
- □ Special Education
- □ Other _____

Q9. I have an Interactive Whiteboard permanent mounted in my classroom

- □ Yes
- □ No

Q10. Select the number of technology-focused college level courses you have completed:

- □ 0
- □ 1
- □ 2
- □ 3+

Q11. Indicate Interactive Whiteboard training you have completed at the district level (check all that apply)

- □ Interactive Whiteboard basic operation
- □ Interactive Whiteboard advanced features
- □ Design of instruction to enhance learning with Interactive Whiteboard implementation
- □ Other: _____

Q12. Indicate Interactive Whiteboard training you have completed outside the district (check all that apply)

- □ College level course covering use of Interactive Whiteboard
- □ Instructional Design that included preparing lessons for Interactive Whiteboards
- □ Other: _____

Q13. This is a scale to measure your attitude toward the use of Interactive Whiteboards. The items pertain to Interactive Whiteboards only – no other type of educational technology. We want to know how teachers feel about Interactive Whiteboards. All responses are anonymous. Please check all statements with which you agree.

- □ Interactive Whiteboards are just another educational fad.
- □ Interactive Whiteboards are very difficult to use.
- □ Interactive Whiteboards make me feel vulnerable in front of a class.
- □ Interactive Whiteboards encourage greater student focus.
- □ I need more access to an Interactive Whiteboard for practice.
- □ I have an Interactive Whiteboard in my classroom, but rarely use it because I don't know how.
- □ Interactive Whiteboard accessibility in my school limits its instructional use in my classroom.
- □ Portable Interactive Whiteboards are difficult to set up in the classroom.
- □ Interactive Whiteboards have not improved student academic achievement.
- □ Interactive Whiteboards require teachers to be confident computer users.
- □ Interactive Whiteboards are a replacement for a whiteboard.
- □ Interactive Whiteboards have not changed the way I teach.
- □ Interactive Whiteboard capabilities can only be perfected with self-teaching.
- □ Student motivation resulting from Interactive Whiteboard use is short-lived.
- □ Interactive Whiteboards increase my instruction preparation time.
- □ I share Interactive Whiteboard files with other teachers in my school.
- □ Interactive Whiteboard training should cover advanced features.
- □ Interactive Whiteboard training should be subject area specific.
- □ Using different Interactive Whiteboard tools increases student achievement.
- □ Interactive Whiteboards encourage the design of instruction that focuses on learner pedagogical needs.
- □ Interactive Whiteboards have changed my teaching philosophy.
- □ Interactive Whiteboards promote a community of inquiry.
- □ Interactive Whiteboards challenge students to use higher order thinking skills.
- □ Interactive Whiteboards facilitate collaborative group work.
- □ Interactive Whiteboard training should emphasize strategies for a change in teaching approach.
- □ Interactive Whiteboards help teachers model 21st century skills.
- □ Interactive Whiteboards help me be a better teacher.
- □ Interactive Whiteboards help me design better lessons.
- □ Interactive Whiteboards facilitate active learning.
- □ Interactive Whiteboards make a positive difference in the learning environment.

Q14. Does your classroom instruction include the use of an Interactive Whiteboard?

- □ Yes [GO TO Q16]
- □ No [GO TO Q15]

Q15. Have you decided to use an Interactive Whiteboard and set a date to begin to use it?
□ Yes [GO TO Q23]
□ No [GO TO Q20]

Q16. What kinds of changes are you making to your instruction as the result of your use of the Interactive Whiteboard?
□ User centered [GO TO Q24]
□ Student achievement centered [GO TO Q8]
□ No specific changes [GO TO Q25]

Q17. Are you coordinating your use of the Interactive Whiteboard with other teachers, including others not in your department?
□ Yes [GO TO Q19]
□ No [GO TO Q18]

Q18. Are you planning or exploring making major instructional modifications to replace the Interactive Whiteboard?
□ Yes [GO TO Q28]
□ No [GO TO Q26]

Q19. Are you planning or exploring making major instructional modifications to replace the Interactive Whiteboard?
□ Yes [GO TO Q28]
□ No [GO TO Q27]

Q20. Are you currently looking for information about the Interactive Whiteboard?
□ Yes [GO TO Q22]
□ No [GO TO Q21]

Q21. Your responses indicate that you do not use the Interactive Whiteboard and have little knowledge of use of the Interactive Whiteboard for instruction. You are making no effort to use the Interactive Whiteboard and try to avoid its use.

Is the statement above a fairly accurate account of your Interactive Whiteboard use or nonuse?

□ Yes [GO TO End of Survey]
□ No [GO TO Q29]

Q22. Your responses indicate that you have taken steps to learn about the Interactive Whiteboard and have realized that it may be able to add value to your classroom instruction.

Is the statement above a fairly accurate account of your Interactive Whiteboard use or nonuse?

□ Yes [GO TO End of Survey]
□ No [GO TO Q29]

Q23. Your responses indicate that you currently do not actually use the Interactive Whiteboard during instruction, but you are preparing for a first-time use in your classroom instruction.

Is the statement above a fairly accurate account of your Interactive Whiteboard use or nonuse?

□ Yes [GO TO End of Survey]
□ No [GO TO Q29]

Q24. Your responses indicate that you carefully plan for the implementation of the Interactive Whiteboard during instruction, but are still mastering its use. You might have one or two features that you are familiar with and are most comfortable if you are the primary user of the Interactive Whiteboard during instruction.

Is the statement above a fairly accurate account of your Interactive Whiteboard use or nonuse?

□ Yes [GO TO End of Survey]
□ No [GO TO Q29]

Q25. Your responses indicate that you plan and use the Interactive Whiteboard during instruction on a routine basis. You may be most focused on its convenience for delivering instruction and haven't given much thought to how it may enhance student learning.

Is the statement above a fairly accurate account of your Interactive Whiteboard use or nonuse?

□ Yes [GO TO End of Survey]
□ No [GO TO Q29]

Q26. Your responses indicate that you plan and use the Interactive Whiteboard during instruction on a routine basis. You have also started to plan your use of the Interactive Whiteboard around the way in which its presence can enhance student learning.

Is the statement above a fairly accurate account of your Interactive Whiteboard use or nonuse?

□ Yes [GO TO End of Survey]
□ No [GO TO Q29]

Q27. Your responses indicate that you plan and use the Interactive Whiteboard during instruction on a routine basis. You also collaborate with colleagues to design Interactive Whiteboard materials that enhance student learning.

Is the statement above a fairly accurate account of your Interactive Whiteboard use or nonuse?

□ Yes [GO TO End of Survey]
□ No [GO TO Q29]

Q28. Your responses indicate that you plan and use the Interactive Whiteboard during instruction on a routine basis. You also consider the way in which different uses of the Interactive Whiteboard actually influence student learning. You are not content with simply one feature of the Interactive Whiteboard and have established new ways of using the Interactive Whiteboard.

Is the statement above a fairly accurate account of your Interactive Whiteboard use or nonuse?

□ Yes [GO TO End of Survey]
□ No [GO TO Q29]

Q29. Selecting "no" on the previous question suggests that your responses may not have accurately represented your classroom use of Interactive Whiteboards.

- □ I have little or no knowledge of Interactive Whiteboards and I am doing nothing to use the Interactive Whiteboard during my classroom instruction.
- □ I am working to find out more information about Interactive Whiteboard use in my classroom, but I have not yet started to use the Interactive Whiteboard during instruction.
- □ I am preparing for the first use of the Interactive Whiteboard in my classroom.
- □ I focus on the day-to-day use of the Interactive Whiteboard in my classroom.
- □ I feel comfortable using the Interactive Whiteboard and utilize many different features; however, I have put little thought and effort into the improved use of the Interactive Whiteboard in my classroom.
- □ I vary the use of the Interactive Whiteboard in my classroom to enhance student achievement. I work hard to use the Interactive Whiteboard to maximize its impact on student learning.
- □ I work together with other teachers and colleagues to use the Interactive Whiteboard in a way that optimizes its impact on student achievement. This means that we might prepare lessons together and share files.
- □ I am confident in the use of the Interactive Whiteboard, reflect on my use of the Interactive Whiteboard in my classroom, and continue to search for new ways that it can influence student learning. I explore new goals for myself and my school district, including alternatives to the Interactive Whiteboard given emerging technologies.

Appendix B: Survey Results

Gender	Frequency	Percent
Female	180	85.3
Male	31	14.7
TOTAL	211	100.0

Age Range	Frequency	Percent
20s	23	10.9
30s	63	29.9
40s	57	27.0
50s	54	25.6
60s	14	6.6
TOTAL	211	100.0

Highest Level of Education Completed	Frequency	Percent
Bachelor's degree	117	56.0
Masters degree	72	34.4
Masters degree + 15	19	9.1
Doctorate	1	0.5
TOTAL	209	100.0

Years Teaching	Frequency	Percent
<3	26	12.3
5-10	58	27.5
11-15	44	20.9
16-20	38	18.0
21-25	18	8.5
26-30	13	6.2
30+	14	6.6
TOTAL	211	100.0

Grade Level (check all that apply)	Frequency	Percent
Kindergarten	32	15.5
1st	33	16.0
2nd	36	17.5
3rd	28	13.6
4th	33	16.0
5th	34	16.5
6th	25	12.1
7th	29	14.1
8th	22	10.7
9th	68	33.0
10th	79	38.3
11th	79	38.3
12th	78	37.9
TOTAL	206	

Concentration Area (check all that apply)	Frequency	Percent
Art	11	6.1
English/Language Art	58	32.4
Foreign Language	7	3.9
General Ed	22	12.3
Health/PE	6	3.4
History	14	7.8
Mathematics	66	36.9
Music	7	3.9
Physical Ed	2	1.1
Science	51	28.5
Social Studies	52	29.1
Speech/Theater	1	0.6
Special Education	24	13.4
TOTAL	179	

Interactive Whiteboard Mounted in Classroom	Frequency	Percent
Yes	46	22.2
No	161	77.8
TOTAL	207	100.0

Technology-focused College Level Courses Completed	Frequency	Percent
0	45	21.7
1	35	17.0
2	40	19.3
3+	87	42.0
TOTAL	207	100.0

Interactive Whiteboard Training at District Level (check all that apply)	Frequency	Percent
Basic Operation	151	89.9
Advanced Features	47	28.0
Design of Instruction to Enhance Learning with Interactive Whiteboard Implementation	13	7.7
Other	19	11.9
TOTAL	168	

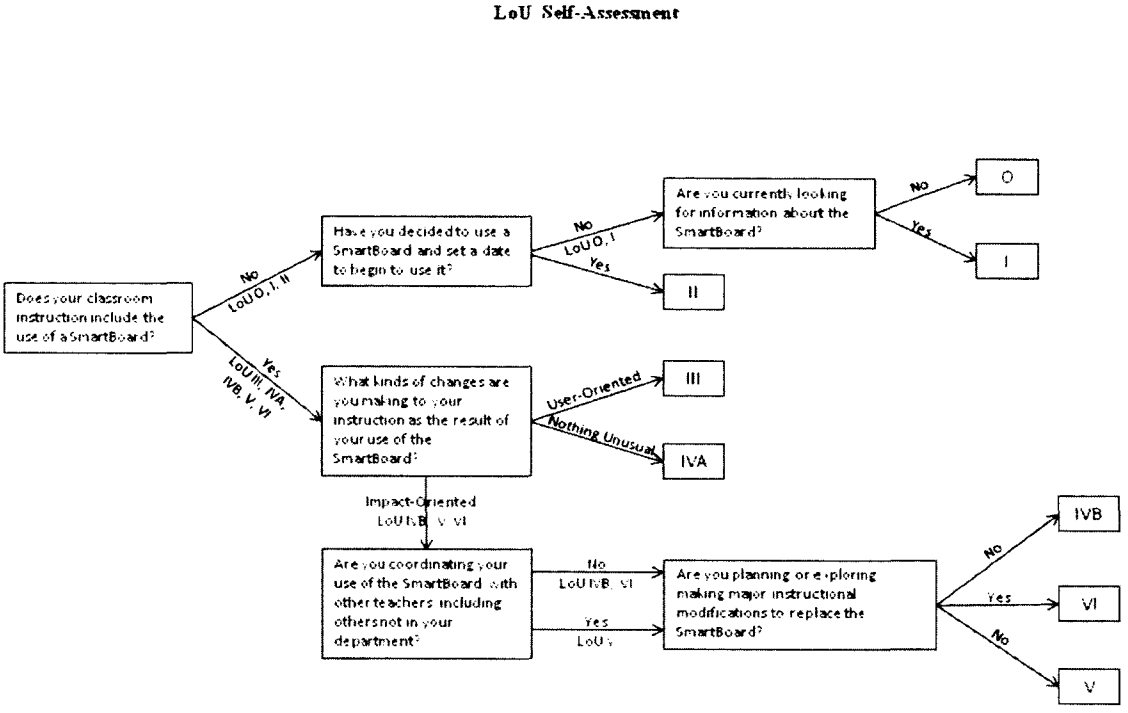
Interactive Whiteboard Training Outside District	Frequency	Percent
College Level Course	21	24.1
Lesson Preparation using Interactive Whiteboard	38	43.7
Other	28	32.2
TOTAL	87	100.0

Teacher Attitude (choose all that apply)	Frequency	Percent
Q1 are just another educational fad	16	8.0
Q2 are very difficult to use	10	5.0
Q3 make me feel vulnerable in front of class	5	2.5
Q4 encourage greater student focus	135	67.2
Q5 need more access to IWB for practice	74	36.8
Q6 rarely use because don't know how	5	2.5
Q7 accessibility limits instructional use	47	23.4
Q8 difficult to set up portable in classroom	42	20.9
Q9 have not improved academic achievement	9	4.5
Q10 require teachers to be confident computer users	43	21.4
Q11 are replacement for whiteboard	29	14.4
Q12 have not changed way I teach	22	10.9
Q13 capabilities perfected with self-teaching	26	12.9
Q14 student motivation from IWB short-lived	12	6.0
Q15 increase instruction preparation	47	23.4
Q16 share IWB files with other teachers in school	42	20.9
Q17 training should cover advanced features	59	29.4
Q18 training should be subject area specific	61	30.3
Q19 different IWB tools increases student achievement	89	44.3
Q20 encourages instruction design that focuses on learner pedagogical needs	65	32.3
Q21 changed my teaching philosophy	29	14.4
Q22 promote community of inquiry	65	32.3
Q23 challenge student use of higher order thinking skills	77	38.3
Q24 facilitate collaborate group work	75	37.3
Q25 training should emphasize strategies for change in teaching approach	66	32.8
Q26 help teachers model 21st century skills	130	64.7
Q27 help me be a better teacher	80	39.8
Q28 help me design better lessons	88	43.8
Q29 facilitate active learning	130	64.7
Q30 make positive difference in learning environment	118	58.7
TOTAL	201	

Classroom Instruction Includes use of Interactive Whiteboard	Frequency	Percent
Yes	103	50.2
No	102	49.8
TOTAL	205	100.0

Self-Assessed Level of Interactive Whiteboard Use	Frequency	Percent
0 – Nonuse	41	22.0
I – Orientation	28	15.1
II – Preparation	11	5.9
III – Mechanical Use	14	7.5
IVA – Routine	17	9.1
IVB – Refinement	36	19.4
V – Integration	30	16.1
VI – Renewal	9	4.8
TOTAL	186	100.0

Appendix C: CBAM-Level of Use Decision Paths

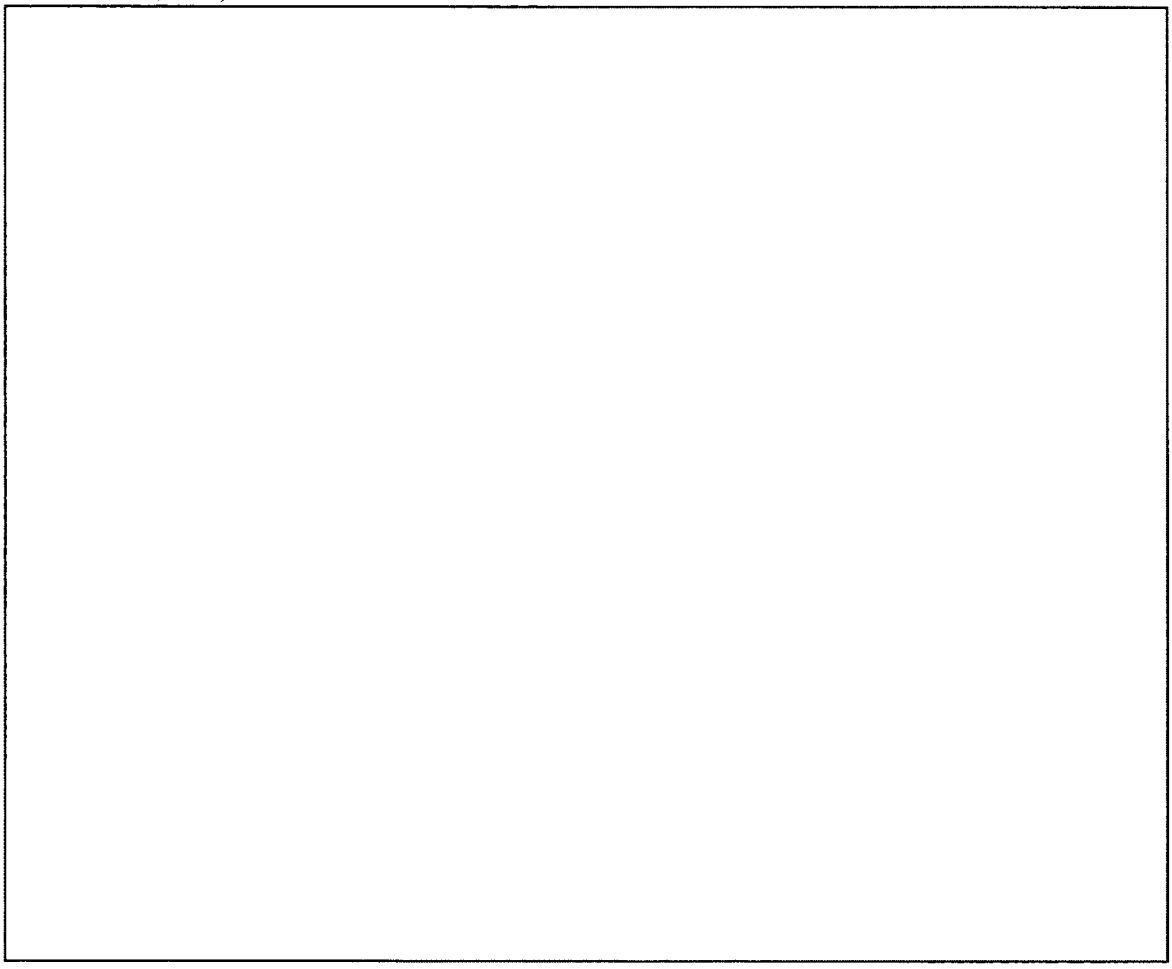


Format for LoU Branching Interview as adapted from Hall & Hord, (2006, 2001)

Appendix D: Observation Protocol

DATE:			
TEACHER UNIQUE IDENTIFIER:			
Favorite food	Model of 1st car	Number between 1 and 9	
School & Grade level:			
Subject:			
Number of students:	Male:	Female:	
Desk configuration:	Rows	Groups	NO DESKS

CLASSROOM LAYOUT (location of Interactive Whiteboard, teacher, students, desks/tables, etc.)



General Interactive Whiteboard (IWB) features used during observation:

ACTIVITY		√	
		Teacher	Student
USE	Interactive Whiteboard used during observations		
	Interactive Whiteboard not used during observation		
NAVIGATION	Touch recognition		
	On-screen menus		
USER	Teacher primary user of SB		
	Teacher shares use of SB with students		
	Students primary users of SB		
FEATURES	PowerPoint		
	Writing/Digital Pen		
	Multi-user (split screen)		
	Clicker response		
PURPOSE	Video presentation screen		
	Dry erase		
	Web access		
MATERIALS	Teacher-designed instructional materials		
	Textbook or purchased instructional materials		
	Web-based materials accessed during instruction		
	Teacher *hyperlinks* to external sources (file or web-based)		
	Saves content for future use		
SB PRESENCE DURING INSTRUCTION	IWB key in teacher delivery of instruction		
	Teacher uses IWB to respond spontaneously to learner needs		
	Teacher leaves IWB to respond spontaneously to learner needs		

General Teacher Talking Strategies employed during observation

TEACHER TALKING STRATEGY	√
Primarily asks open questions (more than one correct response)	
Primarily asks closed questions (one correct response)	
Probing questions to individual students	
Probing questions to whole class	
Allows time for students to answer questions	
Allows time for unexpected student input	
Asks students to explain personal strategies	

Instructions for Classroom Interactive Analysis:

Identify the talk category below that most closely represents observed classroom interaction. THEN write the category in the space provided in the table to the right. Record observed categories at 15 second intervals for 20 minutes. Use a second sheet if observation exceeds 20 minutes in length.

TALK CATEGORIES		
TEACHER	1	Accepts feeling
	2	Praises/Encourages
	3	Accepts/Uses student ideas
	4	Asks questions
	4a	Facilitates exploration of real-world issues and solve authentic problems using digital tools
	4b	Collaborates with students to construct knowledge using digital tools
	5	Lectures
	6	Gives direction
	7	Criticizes/Justifies authority
	8	Student responds
	9	Student initiates talk
	9a	Student presentation
	9b	Students work together to explore real-world issues + solve authentic problems using digital tools
	9c	Students collaborate to construct knowledge using digital tools
	9d	Peer-to-Peer feedback
10		Silence/Confusion

MINUTE	OBSERVED TALK CATEGORY 15 second intervals (each line = 1 minute)			
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Appendix E: Classroom Observation Summaries

Classroom Observation: Teacher A
Highest level of education: Master's degree
Years teacher experience: 16-20
Training: SMARTBoard Advanced Features, district level professional development

The Interactive Whiteboard was the central focus of a twenty minute, one-on-one student session delivered by Teacher A, an elementary Speech Resource teacher. The permanently mounted Interactive Whiteboard, was located at the front of a room without overhead lighting and drawn blinds. The classroom was equipped with three tables and no desks; one rectangular table and two half-circle tables, each capable of seating six students. Tables were on the perimeter of the classroom, leaving the center open with only the projector cart for the Interactive Whiteboard. Cables/cords ran across the floor between the projector and the Interactive Whiteboard, as well as the outlet.

The teacher, prior to locating the kindergarten student in another classroom, initialized the Interactive Whiteboard and opened a Buddy Bear Software exercise for the student session. The teacher returned to the classroom and stood with the student approximately three feet in front of the Interactive Whiteboard. The teacher touch screen activated the software exercise, which read aloud a short story consisting of three to four short sentences. Related visuals were displayed during the reading. Following the short reading, select noun and verb visuals from the sentence were displayed. These were read aloud by the teacher followed by a prompt for the student to select the corresponding visual on the Interactive Whiteboard. The software offered praises for correct responses and "oops" if wrong. The student was unable to reach the Interactive Whiteboard

without assistance and was lifted by the teacher in response to a request, "up, please." This activity lasted for approximately five minutes.

The teacher accessed three other applications during this session including a student-controlled snowball fight, picture coloring activity online at www.starfall.com, and a sing along on www.schooltube.com. The snowball fight, in particular, was especially appealing to the non-reading student who quickly learned the onscreen navigation button to restart the game. The teacher posed questions through the activities in an attempt to initiate dialogue with the student.

All observed Interactive Whiteboard activities were completed by teacher touch screen actions. Recalibration of the Interactive Whiteboard was not necessary and permitted the teacher dedicated student time.

Classroom Observation: Teacher B

Class had already started upon arrival to this first grade classroom. The classroom, naturally lit, organized groups of six students between three learning centers. One learning station group was hosted by the classroom teacher who introduced reading concepts. Another learning station group was hosted by a classroom aide who helped students use letter tiles to create words. The third and final learning station was hosted by Interactive Whiteboard technology -- a continuous loop PowerPoint presentation projected on a permanently mounted Interactive Whiteboard projection screen. A student aide supervised the area surrounding the computer and projector, which were situated on a portable cart.

An overcast day, a single bank of windows on one side of the classroom shed the only light into the instructional workspace. The learning center with the classroom

teacher was at a table on a side of the room that was darkest, while the learning center with the classroom aide was brighter and near the windows. Yet while the Interactive Whiteboard hosted learning center reflected an intense, bright light off the projection screen, the area around the students seated on the floor was dimly lit and gained no benefit from the projected light.

The Interactive Whiteboard presentation operated without error and was never restarted despite the rotation of student groups from one learning station to another. Each student had a paper schedule that coordinated their movement between the three learning centers, which was based on completion of the learning station hosted by the classroom teacher.

Students arriving to the Interactive Whiteboard sat on the carpet and began the writing lesson at the precise point in the PowerPoint presentation, which may or may not have been the beginning of the technology-hosted lesson. Students came to the learning center with a pencil and single piece of paper. The minimally-worded and soundless PowerPoint presentation was intended to guide students through the task of writing a sentence consisting of an adjective, verb, and noun. Presentation slides provided sample sentences and abbreviated explanations of the use of nouns, verbs, and adjectives. "Verbs show action." "Adjectives describe animals."

Students were not quick to complete the sentence writing task. Students viewed the slide presentation for more than one evolution – the completion of which took approximately three minutes. Students shared their frustration among themselves until one student began to write. "If I was elephant I will eat bananas." Another quickly followed and wrote, "If I was elephant the first thing I would do is eat." The

appropriateness of the student responses was not confirmed. Students left the learning center with their lesson product.

Students, for the most part, were attentive to the task at hand. There were several students who laid and rolled around the carpet while looking at their pencils throughout the time spent at the Interactive Whiteboard learning center. No behavior corrections were offered and several students left the center without having completed the task.

Clip art graphics in the PowerPoint closely aligned with the instructional message and included jungle animals -- a rhinoceros, giraffe, crocodile, and elephant. The PowerPoint presentation was brightly colored and visually attractive.

Classroom Observation: Teacher C
Highest level of education: Bachelor's degree
Years teacher experience: 16-20 years
Training: SMARTBoard Basic Operation, district level professional development

The first grade students had not yet arrived to this elementary Spanish classroom, which was brightly lit by only windows across one side of the classroom. Overhead lights were off and the permanently mounted Interactive Whiteboard was turned on. The classroom's overhead projector was managed by the teacher from the computer on a cart to the left side of the Interactive Whiteboard at the front of the classroom. The classroom was furnished with four rectangular tables and one circular table in the middle, each equipped with chairs to seat six students.

The first activity was a video introducing Spanish color words in sentences. The narrator, familiar to the students and warmly welcomed on sight, read color-related sentences as they were displayed onscreen. The teacher stopped the video after the narrator's reading and read the displayed sentence to the class. Students were then prompted to read the sentence together as the teacher pointed to the words onscreen.

Students were selected to identify the Spanish color word in the sentence and provide the English translation. This activity proceeded until all primary colors had been reviewed.

The second exercise was a primary language activity retrieved from the British Broadcasting Corporation (BBC) website. The Magic Cards, a vocabulary card matching game, displayed sets of eight cards – four with Spanish color words and four with corresponding colors. Hosted by an animated magician, individual students were called to the Interactive Whiteboard to test their color word knowledge. The accompanying sound effects were heartily enjoyed by students and conveyed successful or unsuccessful matches. Both students and teachers encouraged those who were not successful, although no second attempts were given in an effort to afford all 22 students an opportunity to come to the Interactive Whiteboard.

A color-by-number activity was the third and final activity. Retrieved from an online subscription service, an outlined picture with numbers inside was displayed on the Interactive Whiteboard. A table below the picture displayed the Spanish primary color words and corresponding number. Students were invited individually to approach the Interactive Whiteboard and pointed to the color word of choice. Students were asked by the teacher (in Spanish) what color and number they would select. Students stated (in Spanish) the number they would select, the coordinating color, and then activated the color in selected areas by tapping the section with their finger. Successes were met with student applause and teacher encouragement.

At the conclusion of the 45-minute class, students were still engaged and disappointed to leave. The teacher asked students why they liked the Interactive

Whiteboard. Responses varied and included, "For games!" "For art!" "For fun!" "Because you learn!"

Classroom Observation: Teacher D

Preparation in this media center setting began just minutes before a classroom of students arrived. A portable Interactive Whiteboard had been placed at one end of the large, open room. The projector cart and a media coordinator's chair were situated in the center of a carpeted floor area for student seating. Bookshelves on both sides provided an informal perimeter. Lighting remained on in the media center with the exception of the row of lights directly over the Interactive Whiteboard.

The class of 26 second graders arrived and was directed by their classroom teacher to seat themselves on the floor in a semi-circle around the media coordinator's chair. The closest student was approximately 10-20 feet away from the projection display. Preparation for the presentation did not begin until the class of students arrived. The media coordinator accessed a personally prepared Prezi presentation entitled, "Christmas Around the World," embedded in a Smart Notebook file. It was explained that this storage solution was the result of the district's increased security for online access.

The presentation was initially managed in its entirety using touch screen capabilities; however, navigation issues prompted the media coordinator to return to the computer for keyboard control of movement between slides. The media coordinator would then return to the projection screen during the presentation. Images were sized at the Interactive Whiteboard using touch screen manipulation capabilities.

The countries selected for the Christmas presentation were introduced at the outset with the display of a world map and included Africa, Italy, France, Germany, and Mexico. A slide was projected in turn for each country that included a small amount of text and a clipart image. The media coordinator read the text and provided additional comment with respect to holiday customs of the respective country. Questions were posed to students during the presentation yet no students approached the Interactive Whiteboard during the presentation.

At the conclusion of this 30-minute presentation, the media coordinator shared that initial district incentives for Interactive Whiteboard use had been discontinued. This included monetary compensation for professional development. The media coordinator further noted that, at least in this school, there appeared to be a correlation to the diminished interest in creative Interactive Whiteboard instructional solutions and the lack of district incentives.

Classroom Observation: Teacher E

A mid-morning visit to a second grade classroom found students in transition to a math lesson that featured the use of a portable Interactive Whiteboard. The projector cart, located in the center of the classroom, was surrounded by five rectangular tables around which 11 students were seated. The blinds were drawn and the overhead lights remained on.

Two sentence story problems, displayed at the top of the Interactive Whiteboard, introduced an item for purchase and its cost. Coins were displayed immediately below the story problem from which selected students were asked to choose coins that would permit the item's purchase and place in a designated box. Students not selected

simultaneously completed a paper-based worksheet that matched the story problems displayed on the Interactive Whiteboard; the expectation was conveyed for all students to complete the worksheet for submission.

Story problems were first read together by the teacher and students. A student was then invited to the Interactive Whiteboard to name and select the coins that would complete the item's purchase. Students dragged coins to the box after which the teacher confirmed the accuracy by touching a checkmark. The teacher did not provide guidance and other students waited quietly while watching their fellow classmate determine the solution; some students completed the problem at their seat and were visibly anxious to help the student at the Interactive Whiteboard. Students who did not choose the correct combination of coins were assisted by another student who not only selected the correct coins, but was asked to explain the solution

This older Interactive Whiteboard required frequent teacher recalibration not as a result of user issues. Downtime during sometimes lengthy reorientations was spent by recitation of multiplication tables accompanied by clapping. Despite the distraction one student was overhead to say, "This fun!"

Students completed the 25-minute activity and submitted their completed worksheets. The teacher turned off the Interactive Whiteboard and quickly moved students to reading centers for their next lesson.

Classroom Observation: Teacher F
Highest level of education: Bachelor's degree
Years teacher experience: 5-10 years
Training: SMARTBoard basic operation, district level professional development

Dim, natural lighting encouraged a natural hush over this third grade classroom as they began their reading lesson. Thirteen students moved to the carpeted floor below the

permanently mounted Interactive Whiteboard at the front of the classroom while their teacher provided direction. This classroom's overhead projector eliminated the need for a projector cart and was remotely operated from a computer at the teacher's desk on the right side of the Interactive Whiteboard.

The reading lesson was centered on Amelia Earhart, part of a unit on women in history. The first of three different uses of the Interactive Whiteboard was a video the teacher accessed on the Internet for display on the projection screen. The video of Amelia Earhart's life consisted of a woman in a flight suit on a trapeze with a voice over story of Amelia Earhart.

The second activity used the document camera to display text of an America Earhart story. Adjusted to permit reading of different sections of the text, the teacher read the story to the class and followed with questions to students.

The final activity was a quiz over the video and reading utilizing clickers. The quiz questions were displayed on the Interactive Whiteboard with student response numbers displayed; however, technical issues surrounded this implementation and resulted in the teacher starting the assessment for each question. Both teacher and student frustration grew with one student commenting they didn't like this and the teacher responding, "I know – you liked it last time." Students had a difficult time staying on task given the need to wait for all 13 students to complete one question prior before advancing to the next. The lesson was completed without all students having finished the quiz given technical difficulties.

Classroom Observation: Teacher G

The third grade class teacher was preparing for a language arts lesson following the class' return from another activity. The classroom blinds were pulled emphasizing the bright projection light on the permanently mounted Interactive Whiteboard screen. The teacher sat in the middle of the room next to a portable cart on which the projector and computer were located. Clustered groupings of four student desks provided seating for 10 students.

Two activities were accessed directly from online resources, Scholastic Literacy Place and Tune into Learning. Students took turns reading aloud after which the teacher introduced short segments of instruction. The teacher remained seated next to the computer and projector in the center of the room. Multiple choice questions were projected on the screen for which individual students were asked to go to the Interactive Whiteboard to select the answer using the touch screen feature. An overly sensitive Interactive Whiteboard resulted in technical navigation issues. The teacher attempted to troubleshoot during which time multiple students offered ideas for a solution – "recalibrate" was the most frequent suggestion. Unable to recalibrate the Interactive Whiteboard, students selected their answers at the computer.

The many difficulties with the first activity prompted the introduction of a new activity in which students read a story and then answered questions. The story was on one screen while the answers were on another forcing the teacher to quickly move back and forth between the two sources. Comments encouraged the teacher to again shift gears.

The third activity was well-received by the students and required them to compare and contrast content using a Mother Goose Webquest. A reading selection was projected

and students were asked to individually go to the Interactive Whiteboard to highlight (with their finger) sections or words that were compare and contrast in nature. The initially responsive projection screen again had technical difficulties, requiring students to once again highlight their selections directly at the computer.

The lessons concluded with the class reading a projected word list together and the teacher reminding students of a related assignment.

Classroom Observation: Teacher H

A group of 22 third grade students had just arrived for their math lesson in a room lit brightly by both overhead and natural sources. The permanently mounted Interactive Whiteboard, at the front of the classroom, was operated from the computer on a portable cart at the front of the classroom located next to a second cart with the projector. The carts were flanked by long rows of student desks facing each other. Additionally, five individual desks were placed around the classroom.

Interactive Whiteboard activities for this lesson were secured directly from the Base Blocks lesson hosted by the National Library of Virtual Manipulatives (NLVM). Students were introduced to a problem and solved with the help of a partner. Discussion between teacher and students followed in respect to the solution. Students identified with the correct answer were met with a surprising high five from the teacher who quickly moved up and down the rows.

Color saturation of the projected content proved to be difficult to see given the bright light levels several times during the lesson. On request, a student would turn the lights off only for a period of time that was long enough to better see the projected image. The lights were then turned back on. It was clear that this was a standard practice.

The lesson concluded with directions for measuring the perimeter of a piece of paper. The teacher projected a ruler that aided in the discussion of measurement accuracy and the different place values. The Interactive Whiteboard was no longer used and students proceeded to work in pairs to complete the assignment.

Classroom Observation: Teacher I
Highest level of education: Bachelor's degree
Years teacher experience: 16-20 years
Training: SMARTBoard basic operation, district level professional development

This fourth grade language arts lesson had already begun prior to the observer's arrival. Fourteen fourth graders in this brightly lit classroom moved quietly in pairs between four work stations. One work station option was a game, Wipe-Out, hosted at the permanently mounted Interactive Whiteboard. There was no teacher interaction and students appeared familiar with the unsupervised touch screen operation of the Interactive Whiteboard. The game was not a required activity and was one of four options listed under the Vocabulary section.

A full game took about five minutes for completion and was the selected option for three different pairs of students. The game moved students across a game board-like surf trail with hazards along the way. Students were presented a sentence with a highlighted word and asked to select the meaning of the highlighted word from a list of three words. Successful selection moved the player closer to the finish.

The game's competitive nature was downplayed by participants; paired students did not hesitate to collaborate, both offering and receiving assistance from their rival. "What's this word?" Two pairs of students completed the game while one pair of students became bored after just over a minute and quit.

The teacher noted that this Interactive Whiteboard experience is a career first and has been difficult to determine ways to use with the students.

Classroom Observation: Teacher J

Twenty-one fourth grade students were just taking their seats for a math lesson as this observation began. Student desks were located around the room in groupings of two, seven, and eight – with a scattering of three single desks. The portable Interactive Whiteboard had been positioned at the front of the classroom, directly in front of the whiteboard. The classroom was brightly lit with overhead lights throughout the lesson.

The math lesson on adding fractions began with the distribution of a worksheet as the teacher retrieved the same saved worksheet for display on the Interactive Whiteboard. The projection screen was split with the problem on the right and labeled fraction parts on the left. Student pairs were provided tactile manipulatives matching the projected fraction parts for use at their desks. The teacher initially displayed a math equation on the Interactive Whiteboard, provided no explanation for how to use the tactiles in solving the problem, and afforded nearly 10 minutes for student pairs to explore. The teacher left the Interactive Whiteboard during this time and walked between pairs of students, inquiring about their attempted solutions. One pair of boys thought they could provide an answer and stood up to explain their method to the class. Although close, no students were able to independently grasp the prescribed method for solving. The teacher then demonstrated the process for using the manipulatives to solve the math problem. The solution for one problem, 1/2 + 1/3 = T, was shown and placed the tactile labeled 1/2 next to the tactile labeled 1/3, moving combinations of the other tactiles to equal the length of the combined length of the tactiles labeled 1/2 and 1/3. The teacher then led the students

through the remaining problems on the worksheet, first letting them attempt to solve in pairs and then demonstrating the solution on the Interactive Whiteboard. The teacher continued to circulate around the classroom while students worked, never giving answers but asking probing questions with respect to attempted student efforts.

Following the observation, the teacher offered that the Interactive Whiteboard had originally been permanently mounted in an awkward location and was moved to a stand for ease in use. The teacher noted that Interactive Whiteboard use had become second nature and challenged instructional plans if unavailable. The projector had overheated last week and forced the transition to use of the document camera. During the observation the Interactive Whiteboard was flawless.

Classroom Observation: Teacher K
Highest level of education: Bachelor's degree
Years teacher experience: 16-20 years
Training: SMARTBoard basic operation, district level professional development

Twenty-three fourth graders had just settled into a social studies lesson in a naturally lit classroom. Student tables were grouped to permit combinations of as many as six students to sit in a group. The computer and projector card were located in the middle of the student tables, directly in front of the portable Interactive Whiteboard at the front of the classroom. The Interactive Whiteboard was shared with a teacher across the hall.

The lesson on state government branches was driven by the projection of a templated worksheet, which students were also provided to simultaneously complete at their seats. Individual students took turns reading from the text and then worked together as a class to identify main ideas in content. The oral interpretations were then placed on

the worksheet. Discussion often turned to the anticipated trip to the state capitol and considerations for what they might see.

Selected students were asked to approach the Interactive Whiteboard to complete the answers on the projected worksheet. The Interactive Whiteboard was initially responsive with use of the technology's pen feature. The teacher attempted to resolve the board's responsiveness by drawing both squares and circles for student input; however, once technical difficulties began, no amount of calibration resolved the problem. The teacher transitioned students to inputting their answers directly on the computer for projection. One student was not tall enough to see the computer keyboard on the cart and attempted to use the Interactive Whiteboard pen feature once again and was successful.

Classroom Observation: Teacher L

Nine fifth grade social studies students were just settling into their assigned seats at pair of tables capable of seating four students each. A line of three paired tables were split from two paired tables by a wide aisle. The projector and computer cart were located in the middle of this aisle, positioned in line with the portable Interactive Whiteboard at the front of the classroom. Bright, natural light flooded the classroom from a large bank of windows.

The teacher selected two students as team captain's to choose team members. During this selection process, a student identified as "the hostess" initiated the Interactive Whiteboard. The teacher proceeded to establish game rules and guidelines, explaining that this was a Jeopardy review for an upcoming social studies test.

The hostess retrieved the teacher designed PowerPoint game, adjusted the application to change the manner in which game questions were presented, and was able

to troubleshoot missing response sounds for right and wrong answers ("yay" and "aww"). The teacher read questions, teams provided answers, and the hostess controlled the game operation using the touch screen feature. Score was kept by the hostess on an adjacent whiteboard.

The Interactive Whiteboard required recalibration multiple times during this game, but the process was handled flawlessly by the fifth grade hostess. This teacher attributed the observed technology challenges to the cart-based projector and computer, not the portable Interactive Whiteboard. The game concluded and students proceeded to another class.

Classroom Observation: Teacher M

A blended, elementary special needs class of eight students had moved chairs to form a split semi-circle around the permanently mounted Interactive Whiteboard at the front of the classroom. The computer and projector were located on a cart situated in the middle of the split semi-circle. Two teachers sat at one end of the semi-circle, one at the opposite end of the semi-circle, and the lead teacher stood behind the computer and projector cart in the center. Blinds were closed and select overhead lights remained lit.

The reading and vocabulary lesson began with students taking turns reading a The Little Red Hen story as it was projected on the Interactive Whiteboard. The story was a stored file retrieved by the teacher. The teacher used a laser pointer to guide student attention to words on the screen as they were read. Students then took turns completing three story-related Interactive Whiteboard activities. The first activity projected pictures and words used in the story. Students took turns dragging words into blanks next to the appropriate picture. All students were provided teacher support for ensured success,

including a student who signed responses. A second interactive activity presented images with a word hidden beneath. Students moved the image and then read the uncovered word. The final activity offered images concealing questions beneath. Students took turns moving the image after which the teacher guided students through answering the questions. Closed questions were addressed to the group.

The teacher then accessed an online activity at exchangesmarttech.com. The online connectivity was slow to respond, but students waited patiently. Both the lead teacher and a student attempted to reorient the Interactive Whiteboard with no success. Technical issues prompted the completion of the activity and students were redirected to the tables.

Classroom Observation: Teacher N
Highest level of education: Master's degree
Years teacher experience: 26-30 years
Training: SMARTBoard basic operation, district level professional development
College level course covering use of Interactive Whiteboard

A sixth grade math class of 11 students was seated at two long lines of tables, split by a wide aisle. The portable Interactive Whiteboard was situated in line with a portable card carrying the projector and computer placed in the aisle. The classroom as very dark with blinds drawn and only the projector lighting the room.

The lesson began with a review of integer addition when signs were the same and different. Projected images were of keyed instructions that explained the addition of equations. Finally, a number line was projected from which the teacher illustrated two equation solutions. Students then solved a number of projected math problems with instructions posted. For example, "solve [(-55 ÷ (-5))] using a calculator." The teacher

circulated around the classroom, monitoring student progress while completing the exercises.

The teacher led students through the creating of a "foldable" intended to guide them through math problem solutions and then smoothly transitioned to a projected whole-class Jeopardy game.

Accessed online at superteachertool.com, the teacher managed the Jeopardy game while students completed associated math problems. Students participated on one of four teams to select and complete math equations provided in Jeopardy options. Teams worked together to find a solution and respond, playing until one team was declared the winner and class was dismissed.

Classroom Observation: Teacher O

Twenty-two, sixth grade math students chatted as they located their seat at one of seven groupings of four desks in the classroom. Blinds closed and the overhead lights on, the portable Interactive Whiteboard was situated in a corner at the front of the classroom in line with a desk where the computer and projector were located.

The lesson began with a review of quadrants. One image of an x,y axis were projected throughout as students were asked to name points placed on the graph by the teacher. Students were then provided graph paper and asked to complete a brief classroom assignment. The teacher projected the following instructions on the Interactive Whiteboard, "Graph the following points on your graph paper (0,5), (9,3), (2, -3), (-2, 2), (2, -3)." This activity completed the lesson and class.

The teacher indicated that all content is saved to the Interactive Whiteboard notebook and printed for students with the intention of maintaining student focus on

instruction during class (not taking notes) and also for students who may be absent. The teacher does not maintain a website for posting the content "because students would need to get the [Interactive Whiteboard notebook software]." The teacher noted that most of the Interactive Whiteboard instructional content was original; however, the textbook did offer some resources.

Classroom Observation: Teacher P

Twenty-eight, seventh grade math students had just taken their seats at one of five groupings of six desks in this naturally lit classroom. The Interactive Whiteboard was already lit and displayed an integer problem with answer options on the Internet site, www.polleverywhere.com. The teacher provided students with verbal instructions to solve the equation and text the correct answer from the options provided. Many students had cell phones in their possession; however, those students without cell phones borrowed from their neighbor. The teacher had enabled the Poll Everywhere feature that permitted more than one response from a cell phone. Students closely watched the results displayed on the Interactive Whiteboard.

The integer math lesson was accompanied by frequent requests to text responses to Poll Everywhere. Students did not go to the board and participation declined over time. Initial results showed all students responding yet later efforts showed the opposite. The teacher did not insist on student completion of the surveys and discussed the results with those that did.

The class concluded with students playing a game of Integer Golf with their teams and the teacher disabling the Interactive Whiteboard.

Classroom Observation: Teacher Q

A seventh grade science class had already begun for seven students seated at individual desks across the classroom. The portable Interactive Whiteboard was in a corner of the classroom with the computer and projector cart aligned. Students facing the front of the classroom turned their heads to the right to see the projection screen, which was actually perpendicular to their body as opposed to directly in front. The classroom was dimly lit.

A science review session using the Interactive Whiteboard and teacher-produced materials. The Interactive Whiteboard was managed by the teacher and was used as a focus for student discussion. Many students spoke at one time; no students approached the Interactive Whiteboard.

Classroom Observation: Teacher R

A blended high school level Math Foundations course had just begun for 12 students. The portable Interactive Whiteboard was at the front of the room and supported by a computer and projector located in the middle of a wide aisle. Students were seated in individual desks arranged in six rows, three rows on each side of the wide aisle.

The lesson began with students going to the Interactive Whiteboard and writing a homework problem solution using the interactive pen feature. Students not only displayed their answers, but were asked to explain how they arrived at the solution to the class.

Once the homework review was complete, the teacher used the Interactive Whiteboard line feature to draw a line and discuss straight lines. Ownership of the Interactive Whiteboard technology exchanged hands several times during the class with periods of time dominated by students, and other periods of instruction commanded by

the teacher. Teacher and students alike were confident with their use of the Interactive Whiteboard. The teacher moving smoothly between stored documents, accessed both from the computer and using the touch screen navigation feature.

The lesson ended with the presentation of an animated feature showing the translation of a rectangle and an audio explanation.

Classroom Observation: Teacher S
Highest level of education: Master's degree
Years teacher experience: 21-25 years
Training: SMARTBoard basic operation, district level professional development

Sixteen high school students had settled into a high school Math Functions class. Students were seated at one of five groups of four desks in the naturally lit classroom. The portable Interactive Whiteboard was situated in the left corner of the room, aligned with a cart equipped with a computer and projector. The aisles between student desk groups were narrow; it limited the teacher's movement between the front of the classroom and the cart.

The lesson began with a revisit to the prior day's topic of trigonometric functions and the projection of an x,y graph. Students guided the teacher's labeling of the unit circle using a digital pen directly on the Interactive Whiteboard. The review was followed by a whole class homework check, during which select students used the digital pen to plot and label the homework answer on a refreshed, projected graph. Once the answer was plotted, students explained their answer to the class. At one point, degrees and radians were discussed. The teacher left the Interactive Whiteboard and demonstrated the conversion from degrees to radians on a whiteboard opposite the Interactive Whiteboard.

The Interactive Whiteboard required multiple calibration efforts during instruction. Students, in frustration, shared their thoughts and previous experience in other classes with correcting the malfunctioning technology. The teacher welcomed student assistance. Several students approached both the computer and Interactive Whiteboard in an effort to resolve the issue. Much talk between the students and teacher surrounded the instructional delay.

The class ended with homework instruction and students beginning their assignment.

Classroom Observation: Teacher T
Highest level of education: Bachelor's degree
Years teacher experience: 0-3 years
Training: 3+ Technology-focused college level courses
College level course covering use of SMARTBoard
Instruction design training/course that included preparing lessons for SMARTBoard

Twenty-three students were filing into a high school Foundations of Geometry class and taking their seat in one of the pairs of student desks. Three single desks were in the wide center aisle, while other paired desks were spread between four rows of three. The portable Interactive Whiteboard was centered at the front of the classroom with the computer and projector cart aligned in the wide aisle.

Instruction began with the projection of ratio word problems that students worked at their desk. The word problems were copied from an MS Word document to the Interactive Whiteboard notebook. Selected students would provide the correct answer by walking the teacher through the solution. The teacher completed all problems at the Interactive Whiteboard for this lesson segment.

A mid-lesson lecture was presented using PowerPoint, which included embedded videos. Students took notes during this time and did not interact.

Students were then provided a handout with word problems to complete at their desk while the teacher opened the same handout online at www.mathslice.com/ratios. Given time for completion, selected students were asked to write their solutions on the Interactive Whiteboard using the digital pen. One student preferred to write on the whiteboard. Solutions were then verified by placing the response in the corresponding form and submitting. Correct answers were revealed and a score was maintained.

The student then verified their solution by placing their answer in an online form accessed at www.mathslice.com/ratios. This activity concluded the class.

Classroom Observation: Teacher U
Highest level of education: Master's degree
Years teacher experience: 26-30 years
Training: None

Six students in this high school math class sat at individual desks in five rows placed directly in front of a teacher's desk. The Interactive Whiteboard was perpendicular to the student seating in the far, right-hand corner of the classroom. The portable cart with projector and computer were placed directly in line with the Interactive Whiteboard. The classroom blinds were open and natural light fell into an otherwise unlit classroom.

The class began with a homework review utilizing the Interactive Whiteboard for student presentation of math problem solutions. Students were invited to not only display their answer, but demonstrate and explain the method of solving using the digital pen feature. Teacher interaction included facilitation of classroom discussion surrounding the presented homework answer.

A lecture lesson introducing congruent triangles followed, which was driven by PowerPoint and problem solving demonstration using the digital pen feature. Students took notes during the lecture. The teacher provided direction for the day's homework assignment and gave students time for completion, offering assistance or giving approval to student work during the final minutes of the class.

Classroom Observation: Teacher V

Students in this high school science class were seating around tables that created a partial perimeter around the classroom. The dark classroom was punctuated by a dully lit portable Interactive Whiteboard at the front of the classroom. The computer and projector were located on a cart in front of the Interactive Whiteboard.

Class had already started for the 21 students who were working in groups, frequently referencing genetic trait information projected in an MS Word documents on the Interactive Whiteboard. Each student group had been given a different genetic profile and had been tasked with evaluating markers to establish personal characteristics. Midway through the student group analysis, the teacher transitioned the projection display from an MS Word document to a PowerPoint which included additional guidance on the process. The PowerPoint was displayed from a "design" and not "show" view, minimizing the content's legible size but permitting view of multiple slides.

At the completion of the analysis, a single representative from each student group took turns presenting their data on the Interactive Whiteboard and explaining identifying traits of their assigned profile. The teacher and students posed probing questions, which were answered by group members that may or may not have been standing at the Interactive Whiteboard.

A request for a lesson plan from this teacher led to a brief discussion about the Interactive Whiteboard's role in this classroom. "I do not write up a traditional lesson plan. [The Interactive Whiteboard] is only the surface I use in my classroom for presentation to class or their presentation to the classroom. It is my BOARD [teacher emphasis]. We do not use the blackboard."

Classroom Observation: Teacher W

A high school Spanish class of 19 students had settled into a classroom with closed blinds and light only from the portable Interactive Whiteboard at the front of the classroom. A cart was aligned in front of the Interactive Whiteboard and was equipped with a projector and computer. Student desks were clustered in straight line groupings of three or four desks across the classroom.

The lesson began with an animated demonstration of the process for conjugating verbs. Students took notes from a conjugating verbs lecture supported by a teacher retrieved PowerPoint document. A PowerPoint embedded video of a native Spanish speaker was played showing the use of verb conjugation accompanied by onscreen visual of the conjugated verb. A second PowerPoint embedded video was shown, which concluded with a quiz that was paused to permit individual student completion.

The teacher then retrieved several activities including a sentence completion, word search, concentration, and matching game. The sentence completion was a collaboration activity between the teacher and a selected student. The teacher read the sentence and asked for a student volunteer to approach the Interactive Whiteboard. The student then read the sentence and word options, followed by both the verbal and touch screen selection of the correct word choice.

Although initially responsive during student interaction, the unresponsive touch screen feature prompted multiple recalibrations and forced the transition to computer keyboard entry for activities. Activities continued until the last few minutes of class during which the teacher provided homework reminders.

Appendix F: Interaction Matrix Analysis

INTERACTION MATRIX ANALYSIS

TEACHER: **OBSERVERS:** **GRADE:** **LESSON/SUBJECT:**

CATEGORY	1	2	3	4	4a	4b	5	6	7	8	9	9a	9b	9c	9d	10	TOTALS
1																	
2																	
3																	
4																	
4a																	
4b																	
5																	
6																	
7																	
8																	
9																	
9a																	
9b																	
9c																	
9d																	
10																	
TOTALS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of TOTALS																	

TEACHER & STUDENT DIGITAL TOOL USAGE: 0.0%

TEACHER DIRECT INFLUENCE	[FORMULA = Columns 1-4/Columns 1-7]
Control of motivation direct or indirect	[FORMULA = SUM Columns 1-3/SUM Columns 1,2,3,6,7]
Level of extended indirect control	[FORMULA = SUM of percentages for columns 4 and 5]
Indirect to direct	[FORMULA = SUM (8,1;8,2;8,3;9,1;9,2;9,3)/SUM(B23;C23;D23;E23)] [FORMULA = SUM (8,5;8,6;8,7;9,5;9,6;9,7)/SUM(H23;I23;J23)]

Appendix G: Classroom Interaction Analysis

Teacher	Grade	Observed Lesson	Self-Assessed		Observed Classroom Talk							
					Teacher						Student	
			Attitude	Level of Use	Total	Digital Tool	Direct Influence	Extended Direct Control	Control of Motivation	Steady State	Total	Digital Tool
A	K	Speech	8.35	IVB	55.7%	0.0%	45.50%	39.2%	16.7%	Lecture	36.7%	8.9%
B	1	Reading			0.0%	0.0%	0.0%	0.0%	0.0%	Digital Student Collaboration	36.7%	76.6%
C	1	Spanish	8.2	V	50.3%	0.6%	59.0%	18.7%	35.4%	Digital Student Collaboration	43.9%	27.1%
D	2	Geography			77.1%	0.0%	18.8%	70.0%	66.7%	Lecture	12.0%	0.0%
E	2	Math			48.7%	7.7%	23.7%	16.7%	8.0%	Gives Direction	34.6%	23.1%
F	3	English/LA	7.91	IVB	66.5%	6.5%	32.7%	44.1%	23.7%	Lecture	24.1%	1.8%
G	3	English/LA			58.2%	3.8%	50.0%	55.7%	50.0%	Lecture	27.8%	11.4%
H	3	Math			64.9%	0.0%	23.3%	26.3%	4.6%	Gives Direction	15.8%	3.5%
I	4	English/LA	8.16	IVB	0.0%	0.0%	0.0%	0.0%	0.0%	Digital Student Collaboration	100.0%	100.0%
J	4	Math			50.0%	0.0%	53.7%	27.8%	25.0%	Silence/Confusion	20.4%	3.7%
K	4	Social Studies	7.51	VI	61.0%	0.0%	59.6%	37.7%	44.4%	Lecture	31.2%	3.9%
L	5	Social Studies			54.4%	0.0%	60.5%	17.7%	44.8%	Lecture	27.8%	2.5%
M	Spl Ed	Reading			55.7%	0.0%	43.2%	38.0%	14.3%	Lecture	36.7%	8.9%
N	6	Math	8.28	IVB	71.7%	4.4%	27.9%	31.1%	17.8%	Gives Direction	15.0%	2.2%
O	6	Math			60.4%	1.0%	42.0%	30.5%	17.0%	Gives Direction	14.7%	0.0%
P	7	Math			69.2%	0.0%	13.9%	8.4%	0.0%	Gives Direction	15.0%	0.0%
Q	8	Science			61.0%	3.1%	50.5%	34.0%	70.0%	Lecture	35.2%	15.7%
R	9-12	Math			63.5%	4.8%	18.3%	33.3%	12.3%	Gives Direction	25.4%	19.0%
S	9-12	Math	6.70	IVA	54.0%	0.7%	41.7%	28.0%	14.3%	Gives Direction	28.1%	13.7%
T	9-12	Math	7.92	V	39.0%	0.6%	20.0%	16.0%	8.3%	Silence/Confusion	25.3%	16.9%
U	9-12	Math	8.22	IVB	57.0%	18.4%	45.6%	37.3%	67.7%	Digital Teacher/Student Collaboration	39.9%	20.9%
V	9-12	Science			21.6%	0.0%	13.5%	8.2%	8.7%	Digital Student Collaboration	57.3%	38.0%
W	9-12	Spanish			68.3%	22.8%	38.4%	58.0%	56.3%	Lecture	30.3%	4.1%

VITA

Jo Ann Thomas
Old Dominion University
STEM and Professional Studies, Darden College of Education
Norfolk, Virginia

Jo's professional career for the first 20 years consisted of business management and training. Diverse corporate settings afforded the opportunity to prepare/manage/track grants, manage federal contracts at the highest levels, and train in support of standardized benchmarks. An opportunity to enter the educational arena permitted Jo to teach Business and Technology courses at the high school level where the presence of educational technologies were growing exponentially. Jo's passion was quickly realized and fueled by the challenge presented to many classroom teachers who were unprepared to fully implement the technologies into their classroom instruction.

Accepted to Old Dominion's Instructional Design and Technology doctoral program, Jo taught undergraduate technology courses as a Graduate Teaching Assistant from 2008-2010. The higher education setting sustained her interest in educational technology , which supported the delivery of a number of conference presentations and papers.

Jo is currently an Instructional Designer supporting the training of aviation air crews for the U.S. Coast Guard.

Education

Doctor of Philosophy – Darden College of Education
Old Dominion University, Norfolk, VA
Instructional Design & Technology program, 2014

Master of Arts – Graduate School of Education and Human Development
George Washington University, Washington, DC
Graduated, Educational Technology Leadership Program, 2009

Bachelor of Science – Krannert School of Management
Purdue University, West Lafayette, IN
Graduated, Management Program, 1987

Scholarly Papers and Presentations

Hawkins, C. & Thomas, J. (2009, April). *Digital natives and Web 2.0.* Presentation at On Course National Conference 2009, Raleigh, NC.

Thomas, J. (2009, August). *Integration of Web 2.0 technologies in the academic environment.* Presentation at Interactive Technologies SALT Conference 2009, Arlington, VA.

Thomas, J. (2010, April). *An analysis of the value of animated pedagogical agents in instructional simulations.* Presentation at VMASC 2010 Student Capstone Conference, Suffolk, VA.

Thomas, J. (2010, May). *Integrating Web 2.0 technologies into your online course.* Online presentation for Instructional Technology Council, Washington, DC.

Professional Affiliations

- Association for Advancement of Computing in Education (AACE)
- Association for Educational Communications and Technology (AECT)

Professional Experience

Lockheed Martin – Elizabeth City, NC May, 2011 – present

Advanced Distributed Learning Specialist and Site Team Lead

- Full design support of aviation air crew training not delivered in traditional classroom setting
- Team lead for redesign of Airman Training Program
- Author of manual for air station personnel required to design and deliver training
- Design team member for blended-format Mid-Level Officer Management Course

Old Dominion University September 2008 to June 2010

Graduate Teaching Assistant

- Instructor of undergraduate courses in Technology and Computer Applications
- Administrative and course management support to faculty member

Elizabeth City-Pasq. Public Schools - Elizabeth City, NC May, 2007 to June, 2008
August, 1998 to June, 2001

Classroom Teacher

- Graduation Project Coordinator
- Taught Business, Computers Applications, Digital Communication Systems, and Mathematics courses to grades 9, 10, 11, 12
- Member of School Improvement Team, Information Technology Board, and Superintendent's Advisory Board
- Student Government Advisor

vectorCSP – Elizabeth City, NC July, 2006 to May, 2007

Analyst

- United States Coast Guard Logistics Transformation Project
- Team Lead for redesign of Aviation Process Guide
- Mapping team member for USCG Logistics Transformation architecture
- Database management

Ridley & Lowell Business Institute – New London, CT October, 2003 – April, 2004

Business Education Instructor

- Computer instruction delivered to diverse adult population
- Instruction of all levels of MS Word, Excel, PowerPoint, WordPerfect and Access
- Instruction of courses in Business Law, Business Management, and Work Place Preparedness
- Developed classroom awareness program aligning student performance with perceived workplace needs

Perot Systems Government Services – Fairfax, VA July, 2001 – June, 2003

Senior Project Manager/Senior Analyst

- Spearheaded revitalization and recovery of floundering federal contracts to jumpstart stalled revenues regenerate profits, and smooth client relations. Selected contracts supported included:
- U.S. House of Representatives
- Federal Deposit Insurance Corporation (FDIC)
- Naval Medical Information Management Center (NMIMC)
- Executive Office of the President
- Environmental Protection Agency Enterprise Architecture