INVESTIGATING THE IMPACT OF INTERACTIVE WHITEBOARD PROFESSIONAL DEVELOPMENT ON LESSON PLANNING AND STUDENT MATH ACHIEVEMENT

by

Rodney Lee Winkler

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Investigating the Impact of Interactive Whiteboard Professional Development on Lesson Planning and Student Math Achievement

by Rodney Lee Winkler

APPROVED:

COMMITTEE CHAIR	David E. Holder, Ph.D.
COMMITTEE	Randall Dunn, Ed.D.
COMMITTEE	Steven A. McDonald, Ed.D.
CHAIR OF GRADUATE STUDIES	Scott B. Watson, Ph.D

ABSTRACT

Rodney L. Winkler. INVESTIGATING THE IMPACT OF INTERACTIVE WHITEBOARD PROFESSIONAL DEVELOPMENT ON LESSON PLANNING AND STUDENT MATH ACHIEVEMENT

K-12 teachers lack training in best practices of interactive lesson development. It is essential that teachers utilize interactive whiteboards effectively. Using a collaborative mentor training, this factorial between-within groups study investigated how student achievement was impacted when teachers applied a set of effective interactive technology methods to math lessons. The research population consisted of 18 teachers randomly assigned training, with 311 elementary students. The study found a significant difference between feature-trained and non-feature-trained teacher instructional practices and student test scores for the two teacher groups. Statistical significance was also found for the interaction effect of teacher groups and observation rubric scores, the within-groups difference of mean scores pre-intervention to post-intervention, and mean observation rubric scores between the teacher groups.

Keywords: interactive technology, teacher education, instruction, professional development, lesson planning, math achievement

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Chapter 1: Introduction

Background of Study

The past decade has seen a shift in the primary technology acquisition for classrooms from computers to interactive white boards (IWB) and other interactive technologies, primarily due to the fact that the IWB has become the new symbol of the 21st century classroom (McCrummen, 2010). Many consider the IWB to be the answer to multimedia in the classroom with enhanced lessons that will lead to greater understanding of content by students (McCrummen, 2010). Proponents say that multimedia is a critical beneficial factor in subjects that have feature-rich content with a greater amount of technical vocabulary, such as science, social studies, or math; yet, Clarke and Mayer (2008) have reported that instructional leaders need to consider how feature-rich media should be due to its relation to learner cognitive ability which they term *cognitive load theory*. Since 2000, the United Kingdom has undertaken a widespread installation of IWBs in its schools (British Educational Communications and Technology Agency (BECTA), 2003). British educators using the IWBs have stated that it is not the technology that matters, but what is done with that technology (Smith, Mroz &Wall, 2004). Their statement could apply to any classroom technology and can pinpoint a problem with generalized technology use and student achievement.

The U.S. Department of Education's No Child Left Behind (NCLB) legislation and the accompanying integrated Reading First program reformed American elementary education in a significant way. Schools have seemingly benefitted from a more specific tracking of student performance and the application of data-driven instruction (Gohring, 2000). There has also been a resulting reactionary change in the learning environment in curriculum and scheduling. It would appear from current practice-that educational leaders have responded to the increased accountability by altering curriculum to resemble traditional didactic instructional methodologies focusing on drill and practice of basic foundational skills following scripted lesson formats. As a result, opportunities for the application of skills, often referred to as authentic learning activities associated with higher order thinking, have been minimized due to required time constraints. This change seems to have recently spawned an increasing interest in questioning techniques to address the need (Crowe & Standford, 2010; Orlich, & Harder, 2009; University of Southampton, 2010). The focus on schedule and method may be evidenced by the Reading First requirements of 90-plus minutes each day for reading and practice. The resulting schedule would indicate that at least half the students' daily instructional regimen in a typical 6-hour elementary day is comprised of basic reading skills and the accompanying assessments (U.S. Department of Education, 2002). Although Reading First targets primary grades, many schools implement the curricular changes in all grades. The remaining academic 2 hours- after lunch, special area class, transitional time/bathroom, and recess-are divided among all of the other subjects—: science, social studies, writing and mathematics. NCLB addresses learning performance, yet surprisingly, one of the most potentially powerful learning and instructional tools, the computer, is reduced to serve as a practice kiosk in a classroom center strategy of instructional learning by repetition or a classroom practice page center (Starkman, 2007) rather than being used to develop technology literacy through student product creation within assignments as effective technology standards for students are defined ("NETS for Students 2007," 2007).

Booher-Jennings (2006) reported that many schools out of necessity, have chosen to follow the philosophy of *the end justifies the means.* In an attempt to meet NCLB's Adequate Yearly Progress (AYP) goals, many educational leaders are forced to divide students in their schools into three learning groups: (1) those who will make the required score on the test, (2) those who will make the score with a little extra assistance, and (3) those who have the least possibility of making the score no matter how much help they are given. Teachers are strongly encouraged to primarily target the second group of students (Booher-Jennings, 2006). Some educators have expressed the difficulty of having to focus on one group of students to the exclusion of challenging other students in the classroom (Booher-Jennings, 2006). The students' attitude toward learning becomes a concern for teachers as they struggle to make the practice meaningful to all groups of students.

NCLB and Technology

These two observations, both related to the implementation of NCLB, would appear to cause friction with other established criteria for education – namely, following best practices for effective use of technology established by the International Society for Technology in Education (ISTE) and their National Education Technology Standards for Students (NETS-S) and teachers' professional duty to challenge all learners. Several states and 22 other countries provided input for the publication of the National Educational Technology Standards "NETS for Students 2007," (2007). Most states have adopted the NETS standards. These standards establish a definition of technology literacy; however, the student NETS-S and NETS-T teacher standards were revised late in 2007 and in 2008, eliminating vague standards such as, “students will use technology to solve problems,” “students will understand,” or “students will practice,” and replacing them from a active learning verb bank containing “analyze,” “synthesize,” “collaborate,” etc. This change would seem to clarify the role of technology in schools. The defined proficiency standards for students (NETS-S), for teachers (NETS-T), and for administrators (NETS-A) provide a performance framework for each of these three school sub-groups (“NETS for Students 2007,” 2007). The new revision establishes questions for students – the how and why of technology focusing on the students’ role in the use of technology and its impact on society. More importantly, the revision establishes a more accurate congruence between the task and the goal of technology literacy.

Interestingly, NCLB includes a legislative technology component designed with guidance from ISTE, known as the Enhancing Education Through Technology Program (E2T2) which specifically targets technology literacy for every student by eighth grade (“Enhancing education,” 2001), and the development of the professional use of technology and provides technology funding (“No Child”, 2002). The required technology instructional plan represents how schools will foster teacher and student learning; however, Cech (2011) stated that there was no required measure established that reported the technological capability of students. Some states have developed or contracted with companies marketing tests that target technology literacy, but the assessments are, in most cases, not validated and are optional for schools (Cech, 2011). Naturally school districts continue to focus their attention on subject content that is accountable through NCLB required assessments.

Classroom Use of Technology

Technology potentially benefits all learners in an active classroom as a personal learning tool or as a means to broaden curricular topics and provide depth (Leonard, Noh and Orey, 2007). Computers have been a part of classrooms for nearly 25 years. Initially their inclusion in the classroom was considered a way to improve learning achievement by way of simplistic practice. The benefit of technology has a great deal to do with how it is used. More recently, interactive technologies have become the new classroom tool as an instructional complement. Technologies such as the Interactive Whiteboard (IWB), Student Response Systems (SRS), and Interactive Tablets address certain issues related to integration and use in the classroom setting by their design as interactive tools for managing information. They bridge a gap in the classroom, providing an interface that is familiar to both the teacher and the student as a regular whiteboard or a remote. The IWB effectively acts as a large presentation touch screen managing all projected computer functions and becoming an instructional tool. Included software allows for multimedia lesson development for use in class. SRS remotely provide feedback response when used with a computer application designed for their use—also acting as an instructional tool for engagement or participation (Carson, 2003). Interactive Tablets essentially provide IWB features from anywhere in the classroom. The benefit of these technologies to the classroom resides in the interactive element. This interaction is a primary objective for educators supporting interactive technologies as it provides a level of participation by students that will involve them in lessons (Carson, 2003).

Professional Development

Previous studies on integrating IWB training cite a lack of time for lesson development and implementation along with too little professional development in the operation and integration of interactive technology, as primary hindrances to regular use in the classroom (BECTA, 2003). Holmes (2009) stated that until teachers' knowledge, attitudes, and beliefs are addressed, no change will occur in classroom pedagogy. The purpose of this study is to address the concerns of training by focusing on 16 learning influencer *features* used with Interactive Whiteboards. These include planned features such as (1) creating a lesson *template*; (2) saving a lesson; (3) building a *library* of gallery created items ; (4) utilizing *capacity* of storage through the retrieval of related content; (5) extending the *range* of lessons with externally located content; (6) using planned visual *links* to source material; (7) *dynamism*--manipulation and animation in lessons; (8) effective use of interactive *automation*; (9) benefitting from tools of *accuracy*; (10) using tools of *emphasis*; (11) *timeliness*--keeping lessons current; (12) using *listing* in group activities; (13) edit-ability/transformability in lesson format; (14) providing alternative forms of *feedback*; (15) *simultaneity* of concept(s); and (16) *multimodality*. In addition, three critical factors in multimedia lesson design and implementation of interactive lessons were included: (1) the principle of contiguity and multimedia; (2) the principle of modality; and (3) the principle of practice. The 19 elements of design are cited from the previous research of Kennewell and Beauchamp (2007); and Clark and Mayer (2008), whose work defined the content of the professional development in this study.

Two teacher observation instruments were used in this study: (1) the observation rubric focusing on the role of teacher and student during interaction in lessons incorporating the elements of design, and; (2) the observation checklist, quantifying the usage and level of application of the design elements during instruction.

Additionally, the study used two instruments as management items for training feedback: (1) a Weekly Teacher Training Reactive Survey to better address training needs and; (2) a Teacher Confidence Survey to gauge teacher confidence in using interactive technologies after the conclusion of the study. Kirkpatrick and Kirkpatrick (2010) outlined the need for such instrumentation as an important factor in aligning the training content to learning need and, eventually, successful implementation. Neither of these instruments was used to address the research questions within the study; however, the results were reported later in chapter 5.

Statement of Problem

One concern for schools is that while classrooms may be equipped with the latest technology, teachers are unfamiliar with how to use it effectively for instruction. A lack of ongoing support to implement any reform often leads to reactive resistance by trainees who are given minimal or poor training and ultimately to the failure of the attempt to change behavior (Kirkpatrick and Kirkpatrick, 2010). The teacher is the instructional leader in the classroom. If there is no change in behavior of teachers during or after training, then any new implementation may fail and potentially hinder student progress. If teacher training concerns, cited in research are not addressed, will teachers using the interactive tools make a difference? It is this possibility that has led to the development of the following questions for investigation:

RQ$_1$ How will professional development in interactive technologies best practice, supported through a mentor model, transfer to classroom instructional practice?

RQ$_2$. What effect will lessons utilizing mentored best practices for interactive technology have on student achievement?

Hypotheses. This study tests six null hypotheses.

$H_0$1 There will be no statistically significant mean difference between the two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to pre and post intervention scores on the observation rubric.

$H_0$2 There will be no statistically significant median difference between the two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to scores on the observation checklist.

$H_0$3 No statistically significant mean difference will be found between interactive whiteboard kindergarten feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Stanford Achievement Test Series 10 (SAT 10).

$H_0$4 No statistically significant mean difference will be found between interactive whiteboard first-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

$H_0$5 No statistically significant mean difference will be found between interactive whiteboard fourth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

$H_0$6 No statistically significant mean difference will be found between interactive whiteboard fifth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

Professional Significance of Study

Currently there are few studies on effective use of interactive technologies in education. Most studies include the IWB and are generally qualitative studies that report teacher and student perceptions of the technology with a favorable response. These studies' surveyed perceptions indicate favorable support by teachers for both increased student participation and engagement (BECTA, 2003; Smith, 2001; Smith et al., 2004). Student perceptions describe more interesting lessons as a result of interactive technologies. Other related studies report on professional development and teacher implementation; however, they mention that effective teacher utilization of interactive whiteboards will impact student achievement, with call for further study relating to student learning impact. This study focuses on professional development leading to regular use of the technology within integrated lessons specifically designed for their use, and will go on to measure student achievement in a core subject area taught with elements applied from professional development.

Few studies have addressed achievement quantitatively and even fewer have compared interactive technologies in their degree of impact on learning. While the previously noted research surveys indicated that students and teachers enjoy the use of the technology and have a greater interest in lessons that utilize these tools, the critical factor for educators is if those feelings have equated to greater learning. This consideration is of prime benefit to the body of knowledge related to instructional pedagogy, classroom management, and the integration of technology. Teachers' and students' technology literacy and proficiency are a requirement within NCLB school reform. While schools may obtain the technology, installation does not guarantee that it is being used effectively. The study integrates empirically tested principles of lesson planning and instruction using interactive whiteboard technology, with the goal of measuring how it benefits the learner.

It is also beneficial for school districts to know what impact interactive technologies have on learning for both teacher training and purchase decisions. Studies using IWB and SRS technologies have focused on whole group instruction and centered on collaboration and discussion--aspects of social interaction that may not match certain curricular models. Teachers would benefit by knowing what particular interactive activity and instructional strategy would potentially provide optimum student engagement through the comparison aspect of this study. Teacher planning is impacted by the use of these tools (BECTA, 2003). Additional time is usually needed to develop IWB lessons that utilize their features. Educators will likely spend the time if the effort provides improved student learning.

Definition of Terms

No Child Left Behind (NCLB): The Federal legislation focusing on standards-based educational reform. States are required to develop educational plans and set achievement goals for students who are to be assessed at certain grade levels, if the states want to receive federal funding. Socio-economic and ethnic groups are also tracked to determine whether they meet Adequate Yearly Progress (AYP), one of several policies included from earlier legislation known as the Improving America's Schools Act of 1992 to ensure that all children are learning. The current adaptation of NCLB known as Race to the Top incentive legislation includes a national achievement goal and assessments instead of the original state goals.

Interactivity: Defined within the context of this paper as the activities that include the use of interactive technologies within discussion, feedback, assessment and other activities in a learning environment.

Interactive Tablet: A touch-sensitive handheld device that remotely controls computer functions. This control is the equivalent to an interactive whiteboard.

Interactive Whiteboard (IWB): A touch-sensitive device that is used in conjunction with a digital projector and a computer to project any images normally seen on a computer monitor with the added benefit of being able to control the computer by touching the electronic whiteboard's touch-sensitive surface. The IWB is also known by several brand names such as SMART board, Mimio, and Promethean.

Student Response System (SRS): A generic name given to a product that consists of a set of remotes used to respond in conjunction with software that is projected on a digital projector. Responses can be within discussions or in assessments. Information gathered within groups is usually aggregated to provide feedback to individuals and groups. SRS are also known as clickers, classroom response systems and audience response systems.

ISTE NETS-S: The International Society for Technology in Education, a driving force in technology education. NETS-S refers to the National Education Technology Standards for Students. These standards are grouped into six strands and further defined by age group performance standards from Kindergarten through 12th grades.

Information and Communication Technologies (ICT): Skills that pertain to computers and the ethical and social behavior associated with their use. The term also refers to the use of digital information development such as audio, and video and its use.

Multimodal learning: An instructional practice that is designed to engage a learner in various modalities such as text and graphic as opposed to text alone.

Summary

Chapter 1 introduces the study and provides a purpose for an investigation. The benefit to education is detailed as providing information to better develop training, instruction and purchasing plans. Providing the specific training that teachers need for both operating and integrating interactive technology should establish a framework for effective lesson planning and development. The impact such technology training has on student learning may provide the catalyst for teacher acceptance and interactive technology as effective instructional tools.

Chapter 2: Literature Review

In chapter 1 the related legislation and funding for interactive technologies were described as an explanation of how schools attain technology and what their expectations are for its use in instruction. The rationale behind the implementation of these learning tools is the next logical consideration. Chapter 2 discusses (1) two foundational theories--considerations from classical teaching and learning, and socio-constructivist theory; (2) the history and evolution of interactive technologies in classrooms; (3) multimedia principles of application from educational research; (4) pedagogical practices for interactive teaching; and (5) professional development using IWBs relating to classroom technology, including interactive technologies.

Is it reasonable to assert that instruction with interactive technologies contributes to student achievement? Research on effective use of interactive technologies, though limited, supports such a claim. This potential benefit to learners prompts a methodological study to determine if the use of these technologies impacts student learning achievement by providing teachers with effectual training for planning and presentation, ICT skills modeling, and interactivity and participation.

Theoretical Literature

Classical teaching and learning. Two great influential teachers of the ancient world both used experience to relate new knowledge to learning**.** Aristotle's law of association is described as the mental connections of ideas and experiences gathered through the senses. When a person experienced an event, the stimuli within the event created a cause for understanding through association (Boeree, 2000). The circumstances in which the event and stimuli occur are recalled through four processes—contiguity, frequency, similarity, and contrast. The lasting impact of such experiences was termed *common sense* by Aristotle (Boeree, 2000).

Like Aristotle, Jesus taught from a basis of absolutes. God was Absolute Truth and Knowledge, the source for wisdom. He also used active learning experiences but related them to a walk of faith rather than the senses. His content, God's knowledge, was revealed on such topics as emotions, origin, matter, sin, motion, and creation--subjects that cannot be experienced through the senses but only by faith in understanding of His Truth. Unlike Aristotle, the challenge of Jesus' earthly ministry was to teach men to live by faith, those who hear with their eyes and think with their feelings; to look beyond what is seen and heard (Zacharias, 2002). Interestingly both of these teachers indicated that, whether from a physical or spiritual perspective, understanding a truth was linked to an interactive experience.

A socio-constructivist approach. More than 200 years ago, Jean-Jacques Rousseau proposed that students learn naturally from their environment where they construct their own knowledge from their experiences (Null, 2004). Rousseau's theory had relatively no effect on classroom pedagogy during his lifetime; however, his work did inspire others such as Friedrich Frobel--the father of Kindergarten, Lev Vygotsky, and John Dewey to conceptualize the ideas of individualized instruction, object teaching methods, learning by doing, inquiry-based learning, interpersonal communication, and mediation (Null, 2004). All of their ideas are based on the premise that students construct their understanding through experiences in the environment. Froebel emphasized the importance of play and interaction for the young child as methods of constructing a foundational knowledge base to build upon in later schooling (Null, 2004). Lev Vygotsky's *zone of proximal development* described a process within a constructivist framework where the child, or learner, was presented with a range of tasks posing a challenge to master alone and being better managed through the guidance of adults or peers (Vygotsky, 1978).

Other contemporary theorists such as Jean Piaget, Jerome Bruner, and Seymour Papert have also supported ideologies of cognitive construction, with minor differences. Piaget described a set of developmental stages that children move through assimilating and acquiring knowledge in their environment, while Bruner proposed that a child's cognitive development is based on events that move through three non-delineated stages– action-based, image-based, and language-based--that serve as prior knowledge translators to connect knowledge (Siemens, 2004). Papert, working with students and technology, concluded that students learn best when socially focused on a project as a group (Siemens, 2004). Contemporary theorists also distinguish constructivism, a guided learning experience, from maturationist views, which depict the learner as freely wandering without intervention or even behavioral guidelines (DeVries, Betty, Edmiaston, & Sales, 2002). Critics of constructivist theory often cite poorly implemented examples as pooled ignorance. While it is true that any child-centered teaching model will require more time and planning to implement, the degree of conceptual retention tends to be greater (DeVries et al., 2002).

The five tenets of modern constructivists. Some contemporary constructivists have adapted the theory into practice in the modern classroom. Alesandrini and

Larson (2002) employed five tenets of constructs for teachers as a way to develop constructivist-based lessons that traverse the void between prior knowledge and new learning. The first tenet states that learning results from exploration and discovery. Teachers are encouraged to act as facilitators who coach students in their endeavor to learn, not as imparters of knowledge. The act of learning is viewed as exploring new ideas and using prior knowledge and experience to make meaning of the new material.

Second, learning is a community activity facilitated by shared inquiry. Cooperative learning and collaborative activities have proven to be effective strategies in classrooms for learning. The constructivist classroom is by nature a collaborative atmosphere where students share insight as they cooperate and manipulate content to understand it better. Traditional methods of teaching occasionally attempt to utilize these strategies but create an artificial environment and assign roles to students to establish interdependence and relevance. The benefits of such strategies are that students accomplish shared goals and gain understanding from a variety of viewpoints and often attain a better understanding than through working alone. This impacts student-learning confidence, an important factor in enhancing a learning environment (Kernis, 1993).

A third tenet asserts that learning occurs during the constructivist process. Students work through the content in the constructivist classroom. The learner is actively engaged, and while traditional assignments focus only on the end product, an effective constructive classroom framework provides formative and ongoing assessment as well as self-assessment.

The fourth tenet states that learning results from participation in authentic activities. This is a major difference often observed when comparing the routine lessons in classrooms. It is a motivating factor for those who support a constructivist view to cognitive development as few learning theories provide for an authentic and complex learning environment that resembles real life (Alesandrini & Larson, 2002).

The final tenet, that outcomes of constructivist activities are unique and varied, describes how student background and experience will cause variation in the final product or outcome. This would seem to depend on the framework and level of guidance a teacher gives; however, differences will emerge even with younger students (Kernis, 1993). In contrast, most classroom practices are based on one subject or singled-out strands of knowledge. Students are presented with skills or facts in isolated activities for potential successful mastery which often leads to a singular purpose evidenced by counting the number of problems before they can say, “I’m finished.” In constructivist classrooms, to ensure authentic academic success, learners must be able to make sense of and build understanding; to interrelate concepts as they progress in a realistic environment (Alesandrini & Larson, 2002). Ironically, these tenets appear to describe very closely the environment found in our current culture, often referred to as the Information Age, where there is a vast and complex knowledge base with greater content demands even in younger grades.

Situated learning. Constructivist learning theory contains many various ideologies and approaches to teaching and learning that range from the loosely managed maturationist view to the more structured approach, as in an apprenticeship with continuous expert assistance for the learner (“Theories,” 2004). Regardless of the degree of guidance, the apparent primary tenet of constructivist theory pervades—an active learning environment. Whether it is Semour Papert and Jean Piaget defending the benefit of play for children or Vygotsky and his guided learning concept, the commonality among these theorists is that learners actively pursue answers as problem solvers, constructing *frameworks* of understanding and utilizing a social knowledge network to *scaffold* new ideas to old. It is from this active learning melting pot that the socio-constructivist learning concept emerged and the later theory known as situated learning (Lave & Wenger, 1990). The point of this theory is to address the need of an authentic context for the teaching objective while providing participation, collaboration, and interaction in the learning environment (Lave & Wenger, 1990; "Theories," 2004).

Situated learning would seem to promote communities of learning or practice, and it would appear to be best portrayed in activities such as student teaching, internships, and project work.

Knowledge is not independent but fundamentally a part of the activity, context, or culture (Brown, Collins, & Diguid, n.d.). The student benefits most from participating in the practice, applying the knowledge firsthand (Franzoni & Asser, 2009). In a classroom, manipulation can refer to any sort of interaction with content in discussion, searching for information, or working on a presentation. Some of the key terms used in situated learning describe processes that occur in learning groups. *Scaffolding*, storyboarding ideas, facilitating within a *content framework*, and monitoring for understanding—each describes a particular function of either members within the environment or the management of content as individual and group learners manage information (Lave & Wenger, 1990).

The History and Evolution of Interactive Technology

Interactive technologies for the classroom have a somewhat brief history as the first reported use in the literature began in the late 1970s with development of the remote response system first used in a classroom. This technology was considered as a limited purpose tool for voting or assessing, as this use of input was most familiar. It later came to stand on its own as an instructional tool to aggregate responses and provide immediate feedback within classroom lessons (Hill, Smith, & Horn, 2004). In 1992, interactive touch and wireless technologies were perfected, which led to the development of the interactive whiteboard. The industry initially targeted businesses as their primary market ("Smart," 2010).

Initial use of the interactive whiteboard in education began in the late 1990s. The University of Colorado experimented with an interactive whiteboard through their online math courses to provide a classroom-like environment (Abrams & Haefner, 1998). Widespread use of interactive whiteboards began with the British Primary Schools Whiteboard Expansion Project in 2003. The project involved 97 schools and included installation, training, and monitoring within the daily educational practice. (BECTA, 2003). The British government's BECTA (British Educational Communications and Technology Agency) project continued to fund large-scale installation and training projects and led the world in their deployment and in teacher training. Two years after their initial acquisition and funding efforts, the British government funded a study to document the impact of the interactive technologies on classrooms. These studies were qualitative in nature and, while detailed, were based primarily on student and teacher perceptions of the technology. Documented observations indicated mixed results on the impact on teaching and learning (Smith et al., 2004). Smaller scale independent qualitative studies indicated even less positive results although in nearly all studies, teachers and students highly praised the potential of the technology (Smith, Higgins, Wall, & Miller, 2005).

The interactive technologies have become a primary item of acquisition in school systems in recent years, especially in Western Europe, Turkey, Canada, Australia, and the United States. In 2007, the Sarasota County School District in Florida began installing IWBs in all of its 3,300 classrooms. It was then the largest American installation of interactive technology ("Sarasota," 2006). Then in 2008, the Fort Worth Independent School District unveiled their plan to install over 5,000 IWBs in their schools, topping the Florida installation and at a cost of around $594 million ("Fort Worth," 2008). The trend continues as districts across the United States and national school systems in those countries mentioned continue to fund local technology projects.

Multimodal presentation and planning. A great deal of research continues in the field of memory and on the effect that various modalities alone and in combination have on learning (Bransford & Cocking, 2000; Moreno & Valdez, 2005). Involving students with content in multiple activities is not new. It was a common practice in colonial America that fathers taught the children to read before beginning school. The Puritan schools not only introduced academics, but emphasized a social classroom environment that integrated Christian morality within the community setting (Marquand, 1997; Smith, 1973). The school was also a place where various intersections of subjects and content took place –especially in reading and writing. A great deal of learning occurred as a response to local community need--arguably a more effective curricular directive than a common curriculum for all colonies would have been (Ravitch, 1984). Local community members realized that a person needed to learn; those members made it their responsibility to guide the learners in understanding and applying the skill to the situation at hand. This often led to small group learning and mirrored the Puritan idea of community (Smith, 1973).

In the modern school, interactive technology in classrooms benefits from the claim that it is the catalyst for pedagogical change. Teachers gather a wider variety of related content to support lessons (Levy, 2002; Morrison, 2003). There are contrasting indications to this notion of change. Cuban (2001) noted that in spite of a district or school's commitment to technology, many teachers only use it to support their current teaching practices rather than retool their plan or philosophy of approach.

Some qualitative studies related to technology use reveal that students believe that their teachers do not plan for use of computers within lessons (Doherty and Orolfsky, 2001; Fuller, 2000).

Several supportive elements to the traditional didactic teaching model are expressed in the literature and considered to be indicative of pedagogical change. Boyle (2002) reported that teachers using interactive equipment considered the ability to store lessons a real incentive for use each year while Edwards, Hartnell, and Martin (2002) and Carson (2003) reported that lessons were enhanced by student randomizer selectors and game-like applications for the review of concepts.

ICT skills modeling. Information and communication technology skills are at the heart of the NCLB and the ISTE initiatives. In simplest terms, these skills are expressed as knowing how to use computers, related common applications, and how to communicate with technology. The literature indicates that one major benefit of interactive technologies is that instructors model ICT use in lessons. Goodison (2002) reported that teachers using applications during lessons provide direction on how to maneuver within a program to accomplish tasks. Other study groups reported similar findings, adding that students may no longer need explicitly taught ICT skill lessons due to extensive teacher modeling and large screen examples (Bell, 2002; Goodison, 2002; Lee & Boyle, 2003; Levy, 2002).

Certainly there is a benefit to exhibition. Teachers spend more time in front of the class teaching due to advance preparation of lesson materials (BECTA, 2004; Bell, 2001; Drage, 2002; Kelly, Underwood, Potter, Hunter, & Beveridge, 2007; Wood, 2001). Exhibition using interactive whiteboards and its benefits does not go unchallenged. There is potential for IWBs and related interactive technologies to be used to involve students in the lesson or merely as presentation tools like an overhead projector or regular whiteboard (Armstrong et al., 2005; Glover, Miller, Averis, & Door, 2007). If the teaching model is teacher focused, these interactive tools lose their primary purpose--increasing student-teacher interaction and engagement (Gillen, Staarman, Littleton, Mercer and Twiner, 2007). Recent considerations on the benefit of student participation have weakened support for the modeling aspect of ICT. Greiffenhagen (2002) reported that schools have started exploring the possibilities by outfitting classrooms with interlinking remote devices to a single projection, providing the teacher with the freedom to move through the classroom while input is witnessed as a collaborative effort visually. While modeling is important, the literature indicates that educators' need to realize that modeling ICT skills must include effective strategies for using technology and must take every opportunity to involve the learners in the learning process.

Interactivity and participation. Interactive technologies are designed to involve users in a tactile process. The IWB in particular offers the potential of images and video clips to support lessons. This active multimodal approach helps students remember (Becta, 2007; Damcott, Landato, Marsh, & Rainey, 2000). The act of input processing by touch makes learning more memorable (Higgins et al., 2005). Clickers or SRS provide a way to improve the quality of teaching. "These systems can not only provide valuable feedback to both instructor and students during class, but also facilitate changes in both student and instructor behavior that enhance teaching" (Wood, 2004). Clickers require a response from every student, so student responsibility becomes more prominent within the classroom group.

While interactive technologies may be used to support less effective didactic teaching or recitative script methodologies, the key objective must focus on not only greater student engagement tactically, but also on elaborate discussion (Hinchliffe, 2006; Hole, 2007; Martin, 2009). Nowhere is this idea better realized than in writing classes involving low-achieving and English as a second language students as they collaborate, discuss, and manipulate word selection and order interactively (Higgins, 2005).

Most studies on IWB classrooms have considered the teacher as the center of the instructional model. It is that factor that has led to conclusions that IWBs support traditional forms of instruction (Higgins, Wall, & Smith, 2005; Nordkvelle & Olsen, 2005). Some studies have noted that it is imperative that teachers be familiar with what the IWB and other interactive technologies offer to understand how it can be used to meet pedagogic intentions (John and Sutherland, 2005). Warwick and Kershner (2008) conducted a unique study working with teachers to develop socio-constructivist teaching methods as a prerequisite training activity for integrating a collaborative teaching model with IWB use, their work cited four interesting observations (Table 1) regarding the process of learning evidenced by researchers and educators.

Table 1

Warwick and Kershner's Teacher Observations of the Social Learning Process

• Active participation, focus and concentration learner behavior are influenced by: social structures, dynamics and skills (both social and technical) within groups experience and training in how to work as a group • Students working effectively in groups is observed through: direct interaction talk non-verbal communication • Individual and group information processing and metacognition occur by: reflection making connections evaluation, rethinking and reconsideration • The teacher role as facilitator and mediator is critical. Teachers must provide:

direct scaffolding of learning reference points –technological and human

***Age Factor*.** Student participation is initially increased with the use of interactive technologies (BECTA, 2003). Regular use was found to motivate students and keep them interested in lessons (Bush, Priest, & Coe, 2004; Cooper, 2003). The age of the student plays a role in participation using interactive technologies. Elementary students enjoyed going to the IWB to manipulate the screen (Virtual Learning, 2003) while the majority of teenagers were uncomfortable getting out of their seats (Thomas, 2003). Observations in primary classrooms showed that students were not able operate the IWB effectively or reach upper areas of the board during lessons (Smith, 2001). This leads to a rethinking of methodology—who will be at the board?

In another study in the United Kingdom, the researchers investigated the idea of how IWBs influence established pedagogic practices, communicative processes, and educational goals (Gillen et al., 2007). The study, conducted in primary classrooms, found that the IWB did provide teachers with a way to more easily move between planned activity and the spontaneous, thus benefitting educational goals. The findings regarding pedagogic practice and communication were not supported. Although teachers using IWBs may have provided a more visually interesting presentation, the ease of such a task had the tendency to speed up the lesson pace rather than to increase discussion time. Pedagogical practice was not changed as most lessons continued to center around a traditional initiation-response-feedback sequence of dialog focusing on closed questioning and cued responses. This outcome stands in contrast to one by Landis (2005), an informal study with the goal of finding what stimulated learners. The study outcome was a list of functional characteristics of the technology, descriptions of classes discussing homework review, and more contextual details in lessons.

Design and refinement. If the purpose of interactive technologies remains as a means to better involve students, will that be met effectively in a passive lecture-driven experience or in a different lesson design? It is this idea that led to a hybrid interactive technology known as the remote slate or chalkboard. The device fulfills the functionality of the IWB but allows the teacher or operator to be anywhere in the room (Walker, 2002). Walker (2002) also noted that use of such devices allows for teachers to be working within the student group rather than at the front of the room. Redesign, then, would seem to refer not only to equipment, but also to interactive lessons. The literature on participation indicates a conflict primarily involving the teaching style (Higgins et al., 2005; Nordkvelle & Olsen, 2005). To resolve this issue, it would seem that interactive teaching with technology requires more than what a traditional lesson format offers. Certainly this would seem to indicate more than mere discussion of content is necessary.

Group learning potentially adds depth to learning. Participation is a key element to that process. Students gain a broader understanding of concepts when working as a group focused on objective studies. Warwick and Kirshner (2008) further described this phenomenon during classroom observation as students making connections to their own prior knowledge, sharing their perspective knowledge, and rethinking and reconsidering their own understandings to better comprehend the assignment. The teacher may also act as a resource to scaffold the expressed background knowledge to the newer ideas in classrooms operating as a learning community.

Principles of Application

How interactive technology is made effective in instruction is another consideration. Research in the use of multimedia tools led to the development of several theories related to brain research and learning. These theories, tested through research studies, resulted in sets of guidelines under an umbrella of applied *principles* (Clark & Mayer, 2008).

The contiguity and multimedia principles. These closely related principles address both elements of sound and graphical representation used within lessons. The contiguity principle is defined as the use of words and/or speech relating directly to a graphical representation while the multimedia principle describes the effective use of graphics. Clarke and Mayer (2008) described the specifics of graphics use based on the type of lesson or learning objective and listed six possible research-based effective uses of graphics. They also identified contiguity as an effort to space text closely underneath a graphic with the word spoken only when shown to learners. In another study, the practice of having both spoken word and text with a graphic was shown to have a negative effect on learning. The findings indicated that students would too often compare the spoken word and text instead of making sense of any graphical concept (Mayer & Moreno, 2003).

The modality principle. Modality addresses the use of words with graphics; however, it considers the need to avoid the use of text with graphics whenever possible. The concept, based on cognitive load theory, describes how stimuli are mentally processed through visual and auditory channels. The consideration is that students may be overloaded visually if asked to both read words, and make sense of graphics simultaneously. Mayer (2005) identified 21 experimental studies identifying modality effect on learners.

Principle of practice. While practice is a universal term, a great deal of research has determined its effective use in the learning environment. One particular study found that the amount of study had no relationship to academic performance. It was concluded that practice was necessary but not sufficient to guarantee expertise (Plant, Ericsson, Hill, & Asberg, 2005). Clark and Mayer (2008) identified the following five factors that relate to practice: (1) target the practice to a specific task; (2) provide detailed explanation; (3) set a short timeframe for practice and establish practice intervals throughout lesson; (4) apply rules for visuals; and (5) identify the transitional steps from model to practice. The empirical principles are useful in any context; however, they specifically address teaching with interactive technologies.

Pedagogical Practices

In addition to the three principles, previous studies have indicated particularly effective activities during IWB involved lessons. Moss, Jewitt, Levacic, Armstrong, Cardini, and Castle (2007) reported that the use of teacher demonstration using subject-specific software for later student use, preloaded pages, drag or hide, color shading or highlighting, and downloaded images and sounds, were commonly observed effective lesson resources. Interestingly, the same study revealed that few teachers stored, shared, or annotated lessons--something that teachers later realized would have been beneficial. Levy (2002) observed that teachers confidently used presentation software to outline and present lesson content.

Warwick, Hennessy and Mercer (2011) reported on a case study investigating co-inquiry and classroom dialog related to the use of IWBs in classrooms. They concluded that the equipment alone did not transform teaching but what the teacher perceived what IWB provided as an added resource was of greater influence in lessons. Their final suggestion emphasized the need for an understanding of clearly defined effective pedagogical practices when using interactive technologies.

Stager (2011) offers criticism of IWBs in classrooms where the bulk of content in interactive lessons replicates flash cards, repetition, memorization and discrete skills without regard for promoting thinking or meaningful content. His contention considers the expenditure of such a capable instructional tool as being used for something just as easily accomplished by other more simplistic means while missing the opportunity for a more enriching learning experience.

In many classrooms the IWB is valued for the presentation and motivational benefits and may be a passing instructional feature of limited value in improving conceptual understanding (Glover et al., 2007; Hall & Higgins, 2005). There is need for greater attention to the pedagogy associated with interactive whiteboard use (Glover et al., 2007; Kennewell et al., 2008). This would seem to require professional development opportunities for teaching staff with an emphasis on both the content and approach to subject teaching and learning in the IWB-equipped classroom.

Project ACTIVate researchers (Terreni, 2009) found that IWBs could support children's learning in numerous ways. These included: (1) the provision of tactile 'hands-on' experiences suitable for kinesthetic learners; (2) encouraging group-learning activities by quickly capturing children's joint attention; (3) the ability to immediately respond to children's interests by accessing information relating to these from a variety of sources; (4) assisting teachers to model exploration and research skills; (5) Giving children easy physical access to the large screen; (6) encouraging children to engage in peer tutoring on how to use the board and the applications;(7) attracting shy and/or reluctant learners to the technology; (8) providing an effective vehicle for storing and then reviewing students' work.

Kennewell and Beauchamp (2007) conducted a detailed study in Great Britain on the functional features of the IWB and its effect on learning. They devised a method for identifying instructionally common activities, shown in Table 2, in the classroom that were cognitive influencers. Once identified, their list was compared against the known feature sets of IWB, both inherent and supplementary, and they used the data then to observe instruction using an IWB in different content areas. The conclusion was that 16 features related to IWB functionality were related to activities that influence learning

Table 2

Kennewell and Beauchamp's (2007) Identified Constructed IWB Features

Feature	**Meaning**
Timeliness	The information available is up to date.
Emphasis	Particular items are displayed in a format which highlights

	them
Multimodality	The facility to combine visual, aural and textual display
Accuracy	Items are constructed with greater precision that is realistic manually.
List	The facility to set out a choice of resources or actions
Template	The provision of a standard outline structure for individuals to add their own ideas
Acquisition	The entry of data into the ICT device and storage for subsequent processing and display
Dynamism	Processes and representations can be shown in motion
Simultaneity	Different processes or forms of display can be shown together.
Library	Data can be stored in an organized way for easy retrieval.
Linkage	Sets of information can be linked for easy access or processing.
Automation	Previously tedious or effortful processes happen automatically (other than changing the form of representation)
Capacity	Storage and retrieval of large amounts of material
Range	Access to materials in different forms and from a wider range of sources than textbooks or classroom sources
Editability/ Transformability	The facility to change content

Feedback	The ability to respond to user input contingently

It is important to point out that an initial set of seven intrinsic functions identified in previous British Government studies (BECTA, 2003; BECTA 2004 as IWB benefits, were used in combination to construct a more definitive set of features from observation during learning activities. Features were not chosen from a list of automated or isolated choices; thus, the critical educational factor was based upon the teachers understanding of how to use the IWB and plan for its use as an instructional tool. (Kennewell and Beauchamp (2007).

Professional Development in IWB Technology

In a Taiwanese study, Lai (2010) noted that teacher training is paramount to the success of the IWB. The study identified a set of basic and advanced skills and suggested a common support mechanism during and after training as a way to link a community of learners together. Holmes (2009) suggested teacher collaboration. He also observed teacher-users utilizing the following sequential four-phase lesson design: Review/Introduction (teacher led whole group IWB activity), Introduction of Concept (teacher led whole group activity), Group Work (student centered no IWB), and Review of Key Points (teacher led whole group activity).

Burden (2002) identified three stages (Table 3) of teacher use and learner involvement in the use of the IWB. The model's focus was based on teacher and student roles during instruction utilizing interactive whiteboards.

Table 3

Burden's (2002) Model from the Integration of IWB use

Stage	**Teacher Use**	**Student Involvement**
Stage 1: Infusion	•IWB used intermittently •IWB used mainly as a simple presentation tool- projection board •IWB used like a standard whiteboard	•Learners are mostly passive
Stage 2: Integration	•IWB is used to integrate software and devices •More than one ICT device is used in lessons •Teachers promote active learner participation •IWB activity supports learning goals	•IWB for learners is a focus activity point for part of a lesson
Stage 3: Transformation	•Teachers promote a learner-centered approach •Peripheral devices promote interactivity •Teacher and learner resources are produced and used in content lessons	•Learners are actively involved in lesson process •Learners construct knowledge using the IWB •Learner assessment includes the production of resources for the IWB that demonstrate deep understanding

Beauchamp (2004) developed a five-stage teacher and learner development model that specifically identifies an adoption level to IWB features and activities used within lessons as defined in Table 4. Beauchamp's more advanced fourth and fifth steps of teacher incorporation of the IWB consider classroom activity as non-linear in design, including hyperlinks, and a greater degree of student interaction in both high-level cognitive discussion and use of the equipment. His model focuses to a greater degree on particular skill-sets associated with the IWB and how they provide for instructional activity used by the teacher. Student involvement is understandably considered in each of the stages similar to Burden's model.

Table 4

Beauchamp's Five-Stage Model of IWB Use

Stage	Teacher	Learner
Whiteboard Substitute	•Basic operations--aligning, navigating, writing, and drawing •Only the teacher uses the IWB. •Lesson pace increases. •Information presentation may supersede questioning.	Observer
Apprentice User	•Self generated resources stored and used. •Lesson work is saved. •Limited external material is used.	•Learn to use IWB •Use IWB vocabulary
Initiate User	•Teacher uses several files or applications simultaneously. •Lesson pages are saved and sequenced. •Teacher uses multimedia effects with a purpose. •Teacher helps students with tools and input. •External resources outside of textbook series are prevalent.	•IWB tool experimentation
Advanced User	•Teacher uses video clips and scanned images. •Teacher facilitates spontaneous learner use of	•Learners confident in IWB use

	the IWB.	
Advanced User (continued)	•Other input devices are used. •Hyperlinks and hypertext facilitate non-linear thinking. •Previous lessons are revised, improved, and re-used. •Emphasis is on learning rather than the technology	
Synergistic User	•Teacher is competent in the use of the IWB. •Teacher's interaction with the IWB and other integrated technology provides for a fluid lesson structure. •Lessons are such that allow for a construction of meaning with both teacher and students on a quest for understanding.	•Learners highly competent in IWB use •Learners construct meaning and determine pace and direction of lesson with teacher.

Summary

The rationale behind the implementation of interactive technologies appears to involve the three themes most noted in research (Higgins, Wall, & Miller, 2005). The most notable observation of the first theme, ICT skill modeling, has a greater degree of opposition in its impact on student achievement. Though it has significant benefits for interactive technologies, interactivity participation emerges from the literature relating closely to student achievement and pedagogical change; however, it is noteworthy that the interaction described is tied closely to a student-centered pedagogical approach in which students primarily interact with the technology. This type of classroom environment is descriptive of teachers in more advanced stages of IWB integration

(Beauchamp, 2004). Logically then, it is critical that teachers first be trained to work with the technology and plan and develop lessons that engage student participation with interactive technology for the latter utilization stages to occur. Interactivity may prompt opposition in cases where interaction is mostly between the technology and the teacher presenter (Higgins et al., 2005; Nordkvelle & Olsen, 2005). A recent article resounded with strong accusations that "such a device locks teachers into a 19th century lecture style of instruction." "Whiteboards are popular precisely because companies designed them to suit an older instructional style to which teachers are most comfortable" (McCrummen, 2010).

The recent professional development experience in the study in Taiwan by Lai (2010) emphasizes the need for a personal approach, a mentored support with shared resources, opportunities for collaboration and interaction among adult learners.

The reviewed literature in this chapter describes effective interactive activities that relate specifically to learning and indicates that higher engagement occurs when teachers and students construct meaning of content and share in the interactivity and high-order thinking discussion. Several studies reported that professional development is a critical element in the process toward interactive lessons in classrooms (Glover et al., 2007; Hall & Higgins, 2005; Holmes, 2009; Torff & Tirotta, 2010). While ICT skills modeling may not be considered as important as once was thought, it is crucial that instructors be familiar with the technology. Recent trends in technology are focusing on interactive technologies and their benefit in classroom instruction.

Is it reasonable to assert that interactive technologies contribute to student achievement? The research does support such a claim; however, there is need of a quantifiable determination on how teachers trained in effective interactive technology use impact learning achievement to better understand its true benefit in the classroom environment and for widespread adoption of best practices when integrating interactive tools during instruction.

Chapter 3: Methodology

This chapter describes the research design, the study environment, the data collection and the data analysis procedures used in this study. It is divided into seven parts: introduction, design of the study, participants, setting, research methods, data gathering procedure, and summary.

Introduction

The research within the study began by a review of the instructional use of technology and the legislation impacting educational reform including current trends in instructional technology application. A theoretical connection was drawn historically and procedurally to socio-constructivist methods and potential benefits that interactive technologies may offer.

The purpose for investigation was based upon the concern that, while classrooms may be equipped with the latest technology, teachers are unfamiliar with how to use it effectively for instruction. Such an issue led to a secondary factor, the effect of such instructional unfamiliarity on the learning achievement of students.

Design of the Study

The design of this quasi-experimental study examined questions from the literature, namely the need for effective use of interactive technology, lack of a supportive training component and the potential benefit such training may have on student achievement. It also built upon previous research by Dr. Steve Kennewell and Dr. Gary Beachamps in the United Kingdom through the use of an identified set of

IWB features they observed to influence learning and by Dr. Horng-Ji Lai of the National Chi Nan University in Taiwan, recommending that teacher professional development studies using IWBs implement key supportive methods to meet learner need (Kennewell & Beauchamp, 2007; Lai, 2010). As a result, the feature-trained participants were provided professional development with a campus mentor model for support and the incorporation of the Kirkpatrick four-level training evaluation model (Kirkpatrick and Kirkpatrick, 2010). The model examined teacher satisfaction, learning, behavior, and the degree to which targeted outcomes occurred as a result of the training event at various times during the training process. The review of the literature indicated that the teacher was the critical element in the classroom. Thus, it was apparent that a supportive experimental approach was needed to provide an opportunity to gain a better understanding of the effect of teacher training on technology interactivity and on learning achievement. The research questions for this study were as follows:

RQ_1. How will professional development in interactive technologies best practice, supported through a mentor model, transfer to classroom instructional practice?

RQ_2. What effect will lessons utilizing mentored best practices for interactive technology have on student achievement?

The statistical design followed a quasi-experimental mixed design as it best fit the framework of the study by comparing two variables and their interaction effect.

Based on a review of the literature, hypotheses were developed relating to the research questions.

Null Hypotheses RQ_1.

$H_0$1 There will be no statistically significant mean difference between the two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to pre and post intervention scores on the observation rubric.

$H_0$2 There will be no statistically significant median difference between the two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to scores on the observation checklist.

Null Hypotheses RQ_2.

$H_0$3 No statistically significant mean difference will be found between interactive whiteboard kindergarten feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Stanford Achievement Test Series 10 (SAT 10).

$H_0$4 No statistically significant mean difference will be found between interactive whiteboard first-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

$H_0$5 No statistically significant mean difference will be found between interactive whiteboard fourth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

$H_0$6 No statistically significant mean difference will be found between interactive whiteboard fifth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

Independent variables. The independent variables of the study will include the interactive white board (IWB) professional development training, the interactive feature-trained instruction, and the mentor modeling support

Dependent variables. The study consists of six dependent variables, (1) The teacher participant observation rubric, (2) the teacher participant observation checklist, (3) Pre/post resulting Stanford Achievement Test Series 10 Math subtest for Kindergarten, (4) the Pre/post resulting Standardized Test for the Assessment of Math (STAR Math) achievement scores for First Grade, (5) the Pre/post resulting Standardized Test for the Assessment of Math (STAR Math) achievement scores for Fourth Grade, and (6) the Pre/post resulting Standardized Test for the Assessment of Math (STAR Math) achievement scores for Fifth Grade.

Participants

The researcher introduced the plan for study to certified faculty at the target school during a meeting and by a detailed email. Interested teachers expressed their intention to participate and attended an orientation meeting describing the study expectations and duration. Participants were divided into feature-trained and non-feature-trained groups to provide some degree of randomization in teacher groups. Participants were asked to solicit their grade level for interested partnership and group participation if necessary. As an elimination exercise, a list of all target school math teachers was made and presented to the target school principal, asking if there would be any reason that any teacher on the list would not be a good candidate for the study–

identifying effectiveness and any unknown concerns. If an interested participant was identified, he or she was to be eliminated from participation due to a lack of "match to study." No study candidates were eliminated.

The participant teachers comprised 18 target school staff members who volunteered for the study, shown in Table 5. The study participants represented kindergarten, first, fourth and fifth grades. Kindergarten and first grade teachers were self-contained with teachers teaching all subjects to their students while fourth and fifth-grade teachers were departmentalized, with teachers specializing in teaching subjects on a rotational schedule. The departmentalized approach further minimized teacher effect between classes, considering the same teachers taught mathematics to more than one class. The fourth grade had one pair of classes that taught math together. The fifth-grade treatment group consisted of three classes. One class was self-contained while the other two classes taught math as a team similar to the fourth grade. The three control group fifth-grade math classes were taught by the same teacher. Teacher participants had an average of 19 years of teaching experience. Of participant teachers, 75% had a Bachelor of Science degree, while 18% held a Master of Education and 11% an Education Specialist degree. These percentages closely matched the target school district teacher-by-degree percentages.

Table 5

Teacher Participant Study Data

Teachers (N=18) by Grade and Code	Treatment Setting(1);N=11 Control Setting (0); N=9	Number of students in Math Classes (N=311)	Number of Math Classes Taught
Kindergarten (N=5)		Kindergarten (N=74)	

Teacher I	0	6	1
Teacher H	0	18	1
Teacher E	1	18	1
Teacher F	1	17	1
Teacher G	1	15	1
First (N=4)		First (N=67)	
Teacher D	0	16	1
Teacher B	0	17	1
Teacher A	1	17	1
Teacher C	1	17	1
Fourth (N=4)		Fourth (N=66)	
Teacher L	1	16	1
Teacher J	1	14	1*
Teacher K	1	18	1*
Teacher Q	0	18	1
Fifth (N=5)		Fifth (N=104)	
Teacher P	1	18	1
Teacher R	1	18	1*
Teacher N	1	16	1*
Teacher O	0	45	3
Teacher M	0	7	1

* Denotes team teaching of subject with both teachers teaching math

The participant math classes consisted of 20 non-randomized classes of math in four grade levels. The student demographic data is shown in Table 6.

Setting

The target school was located in southwest Florida, with a population of approximately 620 students, an urban school built in the mid-1950s and located within an older neighborhood. The school student population consisted of 42% Caucasian, 38% African-American, and 18% Hispanic, and 2% Asian. The target school district used a school choice assignment procedure allowing parents to choose their child's school from within large areas or zones.

Table 6

Demographic Data for Student Study Population

Student Study Population	Students in Treatment Classes	Students in Control Classes
N of Students	184	127
% male	55	42
% female	45	58
% Asian	2	2
% black	34	45
% Hispanic	16	24
% white	48	28
% economically disadvantaged	63	78

Of the students, 74% receive free or reduced lunch. The school has an average attendance rate of 95.6%. The average school-wide student-teacher ratio is 15:1 (Lee County Schools, 2011). The school also utilizes inclusion of students with special needs into the regular classroom.

There are 33 regular and 4 intensive academics/intensive language classroom teachers. Each classroom is equipped with computers and a projector, document camera, and interactive whiteboard. Other interactive technologies such as SRS and interactive tablets are shared among teachers.

Research Methods

After approval from the Institutional Review Board, (IRB) the treatment teachers in the target school began a 17-hour, 9-week professional development training program on the effective use of IWB and interactive technologies in instruction based on three application principles and 16 identified features of the IWB associated with learning activities (Clarke & Mayer, 2008; Kennewell & Beauchamp, 2007; Mayer & Moreno, 2003). The independent variables implemented with the treatment group are described in the subheadings (1) professional development, (2) feature set, (3) mentor support, and (4) the feature-trained instruction.

The feature-trained teachers. The 11 treatment teachers were asked to make a commitment to attend each training session with an understanding that the term of study would incorporate a school quarter term of 9-weeks. They were to begin implementing their newfound skills as soon as possible within their math lessons.

Professional development. Weekly workshop trainings lasted 5 weeks. The core of the training was designed as an orientation to the basics of IWB operation. Some of the teachers were familiar with IWB use and some were not. Each week a different aspect of basic operation was provided by example or by video. Participants were provided sample activities with emphasis on classroom management when using interactive technology. During the training, teachers were also given a review of using SRS and interactive tablets.

Feature set. At the first session each teacher was given a binder including a list of the feature set. During each week’s session, any IWB feature that was identified as a learning influencer was emphasized as important to incorporate in any lesson that would accommodate it. The list was referred to several times each session. The feature set categories of schematic, inventive and constructive helped teachers to understand when to consider their inclusion in lessons. Additionally these categories provided a stepped sequence of lesson development and pedagogical practices that endeavored to attain higher levels of student interaction and learning potential (Beauchamp, 2004). The three application principles from Clark and Mayer (2008); contiguity/multimedia, modality and practice combined with the 16 identified features were assigned a leveled category that most closely matched their instructional usage instruction to teacher IWB and interactive technology expertise level.

Mentor support. Support was planned through the use of suggested considerations described in the Lai study (2010). The training workshops included activity components such as the reactive survey from the Kirkpatrick and Kirkpatrick (2010) training development model to address learning needs from each session; a common shared resource area for participants on SharePoint (Lai 2010; Holmes, 2009); team/grade level grouping during training; interaction time during training and most importantly, in-class mentoring support during implementation as they learned to design lesson plans and instruct with the IWB. learning partners from the same grade-level team and identified basic, intermediate and advanced skills required for operation of the IWB for lessons described by the researcher categorically as schematic, inventive and constructive influencers. Additionally it provided a stepped sequence of lesson development and pedagogical practices that endeavored to attain higher levels of student interaction and learning potential (Beauchamp, 2004) by assigning the application principles and sixteen identified features were assigned a leveled category that most closely matched their instructional usage instruction to teacher IWB and interactive technology expertise level. The researcher's named categorical levels schematic, inventive and constructive also provided the needed differentiation of teacher skill level described by (Lai 2010) with the application principles and 16 identified features of the IWB associated learning activities (Clarke and Mayer, 2008; Mayer and Moreno, 2003; Kennewell and Beauchamp, 2007). Teachers were observed twice using the researcher-developed instrument mirroring the training model based upon the application principles and sixteen IWB features, outlined in the literature, providing opportunity for suggested improvement and as an accountability measure in the utilization of best practices. Student test scores before and after implementation were used to determine learning gain through a comparison analysis with same grade non-feature-trained classes.

The feature-trained instruction. Teachers taught lessons using their IWB as lessons were developed. The impact of such use varied with teacher confidence with the equipment and also reference to feature set; however, each week the implementation improved and students were introduced to the learning influencers.

The non-feature-trained teachers. The 7 participant control group teachers were teachers of the same grade levels as those in the treatment group. Like the treatment classrooms, all control classrooms were equipped with IWBs. Control teachers received their training following the customary method during regular faculty training meetings highlighting various functions and operation of the equipment including some examples of application in core curriculum subjects. The training format followed a demonstration question-answer design with accompanying handouts. Teachers were given the opportunity to request personal assistance if they had any specific questions or issues in their rooms. It is important to note that the non-feature-trained teachers were provided the usual method of training and support provided. No change was made with regard to support or assistance.

The Dependent Variables. The teacher instrumentation was based on observations from the 5^{th} and 8^{th} weeks of the study. An observation checklist was used to focus primarily on the interoperable role of teacher, student and interactive equipment within a lesson. The second instrument, a checklist, noted what features were used within a lesson and how they were used-schematically, inventively or constructively.

Student instrumentation was based on pre/post math tests given the first week and last week of implementation. kindergarten was given the SAT 10 math subtest and first, fourth and fifth were given the STAR Math test.

Data Gathering and Analysis

This investigation required two types of data to be obtained—student achievement before and after the treatment interval and teacher observations accounting for the implementation of best practices. Teacher data was collected on the observation rubric and checklist forms. Observations were scheduled with teachers the fifth and eighth week. The observer entered data on the forms during observed lessons. The forms were coded with the assigned teacher code at each observation and entered into SPSS then filed other data.

The informal data, the reactive survey and the teacher interactive technology confidence survey, were made available to participant teachers as individual forms for written entry. The reactive survey was given only to feature-trained teachers after each week's training session and collected by one teacher and given to the researcher for data entry into SPSS. The interactive confidence survey form, a Likert-type scale survey, was given to all participant teachers in the feature-trained and non-feature-trained groups the last week of the study. Teachers were instructed to return the form to the researcher's mailbox by the end of week nine. The Likert scale tabulation was set up in SPSS and data was entered accordingly. This procedure was used to gather data to address the following research question:

RQ_1. How will professional development in interactive technologies best practice, supported through a mentor model, transfer to classroom instructional practice?

The second set of data comprised the pre/post scores of students on either the STAR Math or the Stanford Achievement Early School Achievement Test (SESAT) Series 10. The researcher used the target school computer lab as a testing facility to administer the STAR Math pretest and posttest to first, fourth and fifth graders the first and last week of the study interval. STAR Math is a computer-based program that also includes built-in reporting of scores. Teacher assigned letter codes were used to organize Report data. Reports were printed and filed for each test administration after score entry into SPSS for analysis.

The kindergarten SAT 10 Math subtest was administered as a paper-pencil test by each kindergarten teacher the first and last week of the study. Teachers returned completed tests for scoring to the researcher. Raw scores were used to enter into the and Excel spreadsheet that converted raw scores creating a Scaled Scores report for entry into SPSS.

These tests provided scores for students in feature-trained and non-feature-trained classes as comparison data and addressed the second research question:

RQ$_2$. What effect will lessons utilizing mentored best practices for interactive technology have on student achievement?

Using a mentor model, the teachers received suggestive feedback from observations on lesson planning and implementation related to the training components.

Teacher input on the supporting mentor model was gathered through a weekly reactive survey and a final confidence survey and was included in the study discussion as it related only to the professional development training.

Student Instruments. The two instruments used to determine student math achievement in participant math classes and assigned to groups as shown in Table 7. The Stanford Achievement Test Series 10 Mathematics subtest for Kindergarten and the Standardized Test for the Assessment of Math (STAR Math) for grades one through five. The resulting Scaled Scores (SS) were used in the analyses

Table 7

Test to Test Group

Stanford Achievement Test Series 10 Mathematics subtest for Kindergarten (SESAT)	The Standardized Test for the Assessment of Math (STAR Math) for grades 1, 4, and 5
Participant Kindergarten Students(N=	Participant First, Fourth and Fifth

	Grade Students

The Stanford Achievement Early School Achievement Test (SESAT) Series 10 is designed specifically to measure achievement in a given subject area for students from the first half of kindergarten or grade one. The SESAT 10 Kindergarten math subtest consists of forty questions with script narration from the teacher. The test is not timed, and students are allowed to take as much time as needed given that they are working on test answers. The 10th edition was normed in 2002 by 360,000 participating students. A 9-member panel checked the test for any type of bias. The SAT 10 subtests measure math content and processes identified by the National Council of Teachers of Mathematics, which includes number sense and operations, patterns, relationships, and measurement. The kindergarten test required at least 30 minutes and was administered in participating classrooms. Again, the scaled scores were gathered as in the other test instrument.

Teacher Instruments. The researcher developed the teacher observation rubric, checklist of skills, informal confidence survey and weekly reactive survey. No type of instrument was found to gather data effective use relating to research on interactive whiteboard activities found to influence learning or the selected multimedia principles of Kennewell and Beauchamp (2007) or Clark and Mayer (2008).

The observation rubric identified the interoperable role of teacher, student and interactive equipment within a lesson. The 4-point rubric scale identified the degree of interaction from little or no observed interactive element to a more spontaneous use by teacher or student. The total rubric score ranged from 5 to 20 points. The 5-item rubric was based on an incrementally increasing scale.

The observation checklist provided a quantitative list of learning influencer features observed during the lesson, divided into three skill-level categories of schematic, inventive, or constructive. Some of the features were duplicated in the skill level categories created on the list due to the nature of their use but differing potential application. An example of such an occurrence was the use of *range* of lesson. A teacher might plan to extend the range of the lesson beforehand by adding a hyperlink to a lesson page–a use of range in the schematic category. A spontaneous use of range might be done due to a student idea (unplanned) or an impromptu action of the teacher--an inventive use of the same feature. The total sum of features provided a score for learning influencers used within the lesson. A reliability analysis was completed on the checklist, resulting in an overall alpha value reliability of .79.

The informal Teacher Interactive Technology Confidence Survey provided a final review for the participating teachers regarding their comfort level in using interactive technologies when teaching. The survey consisted of 20 sentences asking teachers to identify their confidence level. The survey used a Likert 5-point ordinal scale that ranged from *strongly disagree* to *strongly agree*.

Finally, as part of the mentor model and the Kirkpatrick and Kirkpatrick plan for staff development, a reactive anonymous survey was given after every training event (Kirkpatrick and Kirkpatrick, 2010). The short participant feedback survey was used to gauge learner reaction to new content and allow for feedback on future needs. Like the confidence survey, a weekly reactive survey was used within the study; however, it, too, was not used to gather data for the research questions. Training modifications due to reaction were reported in chapter 5.

Instrument validity and reliability. It was the intent of the researcher to develop a set of instruments with reliable and valid measures. The Observation Checklist and Observation Rubric were developed by the researcher to gather observed teacher utilization of trained features and teacher-student interaction. The instruments was used by a single individual for all observations; therefore, no reliability data were reported to compare results between any additional research observer. Both observation instruments were reviewed by a panel of nine peers for content error.

The Weekly Reactive Training Survey and the Interactive Technology Confidence Survey, also researcher developed, were self-reporting instruments targeting participant reaction to the day's training or confidence in using interactive technologies. The surveys were short, based on teachers' recent experience during the study interval. The brevity reduced the possibility for unreliability due to fatigue. Also, only participant teachers were asked to complete the surveys, making the group heterogeneous. The researcher-developed instruments were peer-reviewed by a panel of nine educators familiar with technology, for clarity and accuracy in content. Any noted concerns were addressed by the researcher.

The SAT-10 Kindergarten mathematics subtest validity received an alpha reliability rating of .86 for fall test administrations ("Stanford Achievement," 2004).

The STAR Math version 2.0 standardized norm-referenced achievement overall reliability testing was done in three forms: Generic reliability coefficient tests indicating a reliability range from .79 to .88, split half reliability coefficient testing ranging resulting in coefficients from .78 to .88, and alternate form reliability with a coefficient range from .72 to .80. Construct validity was supported by correlation with 30 other standardized tests and teacher rating from 17,326 students. Table 8 indicates specific reliability by grade level and indicates reliability coefficients by test type in both norming and alternate-forms testing methods ("STAR," nd). Correlations for each test ranged from .58 to .70 with the thirty tests and a correlation range from .38 to .58 on the teacher rating with an overall correlation of .85.

Table 8

STAR Math Reliability by Grade

	Norming			Alternate - Forms	
Grade	Sample Size	Split-Half Reliability	Generic Reliability	Sample Size	Reliability
1	3,076	0.82	0.83	745	0.73
2	3,193	0.78	0.79	866	0.75
3	2,972	0.78	0.80	853	0.74
4	2,981	0.79	0.81	840	0.73
5	3,266	0.80	0.83	813	0.79
6	2,555	0.84	0.84	729	0.73
7	2,896	0.86	0.86	698	0.72
8	2,598	0.88	0.88	714	0.74
9	1,771	0.86	0.86	381	0.79
10	1,556	0.87	0.88	304	0.80
11	1,419	0.87	0.87	255	0.76
12	945	0.88	0.87	191	0.72

Overall	**29,228**	**0.94**	**0.95**	**7,389**	**0.91**

Note. There were 29,228 cases in the norms sample; 43 outlier scores were not included in the norms calculations, but were included in the reliability calculations.

Summary

For the purpose of the mixed factorial study design, Table 9, student test score data was recorded to be used together to serve as a within-subjects factor. Student score data was then divided with teacher data into the respective instructional classes as treatment and control, thus forming a between-groups factor adding the teacher feature-trained treatment and non-feature-trained control group data.

Table 9

Graphical Representation of Study Design

	Student Pretest	Teacher Observations	Student Post test
Feature-trained Teachers	Treated Student Pretest	Observation 1 Observation 2	Treated Class Student Post test
Non-Feature-trained-Teachers	Non-Feature-trained Class Student Pretest	Observation 1 Observation 2	Non-Feature - trained Class Student Post test

This chapter described the method for a quantitative study to find what effect teacher professional development has on instructional practice and student achievement. Chapter 4 will provide a summary of data and explore the statistical implications. Chapter 5 will provide a discussion of the findings and consider possible uses for the research

Chapter 4: Results

Introduction

In chapter 4, the results of this study are presented in a descriptive format as well as with tables. The results are divided into three sections: (a) population and descriptive findings, (b) investigation of assumptions as they relate to inferential analysis, and (c) tests of hypotheses. The chapter concludes with a summary of the results. SPSS v15.0 was used for all descriptive and inferential analyses.

This quasi-experimental quantitative study examined the need for effective use of interactive technology, the lack of a supportive training component, and the potential benefit such training in interactive technology may have on student achievement. The research questions for this study asked:

RQ_1. How will professional development in interactive technologies best practices, supported through a mentor model, transfer to classroom instructional practice?

RQ_2. What effect will lessons utilizing best practices for interactive technology have on student achievement?

The statistical design followed a quasi-experimental design, and included six statistical hypotheses to answer the two research questions of study.

Null hypotheses 1 and 2 will address Research Question 1. A 2X2 mixed factorial analysis of variance (ANOVA) with a between-groups independent variable of teacher group (control vs. experimental), and a dependent variable outcome of observation rubric score will be used to investigate Null Hypothesis 1.

A Mann-Whitney U test with the independent variable of teacher group (control vs. experimental) and the dependent variable of observation checklist score will address Null Hypothesis 2.

Null Hypotheses 3 through 6 will address Research Question 2 and will be investigated via a 2x4X2 mixed factorial between and within groups design. The three independent variables include (a) teacher group (control vs. experimental; between groups variable), (b) a between groups variable of grade level with four groups of kindergarten, 1st grade, 4th grade, and 5th grade, and (c) a within groups independent variable of pre-test time vs. post-test time. The mixed ANOVA will investigate effects of the individual variables as well as their interaction effects on the dependent variable outcome of student assessment score. Finally, A series of four analyses of covariance (ANCOVA) tests will be performed to further address the between groups interactions to better address hypotheses 3 through 6.

Based on a review of the literature, statistical hypotheses were developed relating to the research questions:

Null Hypotheses RQ$_1$.

> ***$H_0$1*** There will be no statistically significant mean difference between the two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to pre and post intervention scores on the observation rubric.
>
> ***$H_0$2*** There will be no statistically significant median difference between the

two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to scores on the observation checklist.

Null Hypotheses RQ_2.

$H_0$3 No statistically significant mean difference will be found between interactive whiteboard kindergarten feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Stanford Achievement Test Series 10 (SAT 10).

$H_0$4 No statistically significant mean difference will be found between interactive whiteboard first-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

$H_0$5 No statistically significant mean difference will be found between interactive whiteboard fourth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

$H_0$6 No statistically significant mean difference will be found between interactive whiteboard fifth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

Population and Demographics of Study

The dataset used in this study included a convenience sample of 18 teachers from one urban primary school located in southwest Florida with a population of approximately 620 students. The teacher participants represented Kindergarten, first, fourth, and fifth grades. Kindergarten and first-grade teachers were self-contained with these teachers teaching all subjects to their students while fourth and fifth-grade teachers were departmentalized with teachers specializing in teaching subjects on a rotational schedule. In addition to the repeated measures nature of analysis for this study, this departmentalized teaching approach further controlled for teacher effect between classes, considering the same teachers taught mathematics to more than one class. The fifth grade had one self-contained class in the treatment group, with the other two classes taught by the same teacher. Teacher participants had an average of 19 years of teaching experience. Of participant teachers, 75% had a Bachelor of Science degree, while 18% held a Master of Education and 11% an Education Specialist degree. These percentages closely matched the target school district teacher-by-degree percentages. The participant math classes comprised 20 non-randomized classes of math in four grade levels.

The target school was located in southwest Florida, with a population of approximately 620 students, an urban school built in the mid-1950s, located within an older neighborhood. The school student population consisted of 42% Caucasian, 38% African-American, and 18% Hispanic, and 2% Asian. The target school district used a school choice assignment procedure allowing parents to choose their child's school from within large areas or zones.

In the target school, 73% of the students receive free or reduced lunch. The school has an average attendance rate of 95.6%. The average school-wide student teacher ratio is 17:1. The school has also utilized inclusion of students with special needs into the regular classroom.

Instrumentation and Related Descriptive Statistics

A teacher observation rubric was developed by the researcher (Appendix G). The rubric identified five key areas of interactive learning, focusing on how the technology was used in the lesson--the role of the teacher and learner within the lesson design listed in a 5-item format. The 4-point rubric point scale identified little or no observed interactive element (1) to a more spontaneous use by teacher or student (4). The total rubric score ranged from 5 to 20 points. A total of two observations were made for each teacher in the study; the first observation was performed at 5 weeks and the second observation was performed at 8 weeks. The two observation scores were summed and divided by two in order to obtain a mean score for each teacher. Feature-trained teachers had higher mean teacher observation rubric scores (N=11, *M* = 12.18, *SD* = 1.94) than the non-feature-trained teachers (N=7, *M* = 6.14, *SD* = 1.14). The feature-trained teachers also had higher mean scores on the observation rubric for both observation times. Table 10 presents the teacher observation rubric scores for each of the two observations for each individual teacher, the mean score for each teacher, and observation and mean scores according to teacher group.

Table 10

Observation and Mean Scores of Teacher Observation Rubric According to Individual Teacher and Teacher Group (Feature-Trained vs. Non-Feature-Trained)

Teacher	Group	Grade Level	Score		
			Obs.1	Obs. 2	Mean
A	1	1	14	14	14.0
B	0	1	8	6	7.0
C	1	1	9	12	10.5
D	0	1	5	5	5.0
E	1	k	12	15	13.5
F	1	k	12	13	12.5
G	1	k	10	11	10.5
H	0	k	7	8	7.5
I	0	k	5	6	5.5
J	1	4	7	9	8.0
K	1	4	14	15	14.5
L	1	4	12	13	12.5
M	0	5	7	8	7.5
N	1	5	12	13	12.5
O	0	5	5	6	5.5
P	1	5	13	15	14.0
Q	0	4	5	5	5.0
R	1	5	9	14	11.5
Mean scores feature-trained group	---	---	11.27	13.09	12.18
Mean scores non-feature-trained group	---	---	6.0	6.29	6.15

Note. Group 1 = Feature-Trained; Group 2 = Non-Feature-Trained; Obs. = Observation.

A teacher observation checklist (Appendix F) was also developed by the researcher to provide a quantitative list of learning influencer features observed during the lesson. The observation checklist was divided into three skill categories of (a) schematic, (b) inventive, and (c) constructive. Each of the items on the checklist was scored as 0 = not observed or 1 = observed. Each teacher was observed two times in this study, at 5 weeks and again at 8 weeks. Table 11 presents the counts on the teacher observation checklist for each teacher according to each of the three skill categories. The total sum of features provided a count score for learning influencers used within the observed lesson for each of the three skill categories.

Table 11

Influencer Scores of Teacher Observation Checklist According to Individual Teacher

			Count of Influencers					
		Grade	Schematic[a]		Inventive[b]		Constructive[c]	
Teacher	Group	Level	Obs 1	Obs 2	Obs 1	Obs 2	Obs1	Obs2
A	1	1	4	6	2	2	0	0
B	0	1	3	3	0	0	0	0
C	1	1	3	5	1	1	0	0
D	0	1	0	0	0	0	0	0
E	1	k	4	6	2	2	1	2
F	1	k	5	6	1	2	0	1
G	1	k	4	6	0	1	1	1
H	0	k	3	4	0	0	0	0
I	0	k	0	0	0	0	0	0
J	1	4	2	4	0	2	0	0
K	1	4	6	6	3	5	1	2
L	1	4	5	5	3	3	1	1
M	0	5	1	1	0	0	0	0
N	1	5	4	5	2	3	2	2
O	0	5	0	0	0	0	0	0
P	1	5	6	6	0	3	1	1
Q	1	4	0	0	0	0	0	0
R	1	5	5	5	0	3	0	0

[a] Count range of schematic influencers = 0 – 10.
[b] Count range of inventive influencers = 0 – 7.
[c] Count range of constructive influencers = 0 – 4.

The study included student outcomes of the Stanford Achievement Test Series 10 (SAT 10) Mathematics Subtest for kindergarten or the Standardized Test for the

Assessment of Math (STAR), referenced according to each of the 18 teachers, with scores obtained at two times: (a) pre-feature-based teacher training intervention, and (b) post-feature-based teacher training intervention. Scores on the SAT 10 were scaled differently than for the STAR assessment; however, the repeated measures element of this study controlled for differences in score metrics by providing a baseline (pre-intervention scores) for each of the eighteen teachers' student groups. Table 12 presents the measures of central tendency for the student pretest scores while Table 13 represents the measures of central tendency for the student posttest scores according to teacher group (non-feature-trained vs. feature-trained).

Finally, as part of the mentor model and the Kirkpatrick and Kirkpatrick (2010) plan for staff development, two types of informal anonymous surveys were given, a Weekly Reactive Survey after every training event, and (2) the Interactive Technology Confidence Survey. Although these were used within the study, they were not used to gather data for the research questions and the results reported in chapter 5 discussion.

The Interactive Technology Confidence Survey provided a final review for the participating teachers regarding their comfort level in using interactive technologies when teaching. The survey consisted of 20 sentences asking teachers to identify their confidence level. The survey used a Likert 5-point ordinal scale, ranging from *strongly disagree* to *strongly agree*.

Validity and reliability information for all instrumentation is described in Chapter 3, Methods.

Table 12

Measures of Central Tendency for Combined SAT 10 and STAR Mathematics Student Assessment Scores for Pre Intervention Scores According to Grade Level and Teacher Training Group

Grade Level (Test) / Group (N)	# Obs. Group	Student Assessment Scores Pre-Intervention *M*	*SD*	*Mdn*	Range
Kindergarten (SAT 10)					
Non-feature-trained (N = 2)	22	452.68	34.69	450.0	378 - 534
Feature-trained (N = 3)	50	438.20	35.37	439.0	356 – 515
All teachers in grade level (N=5)	72	442.63	35.56	443.0	356 - 534
1st Grade (STAR)					
Non-feature-trained (N = 2)	33	354.58	97.93	369.0	181 - 623
Feature-trained (N = 2)	34	369.00	96.00	377.0	171 - 537
All teachers in grade level (N=4)	67	361.90	96.49	370.0	171 - 623
4th Grade (STAR)					
Non-feature-trained (N = 4)	20	689.35	136.97	726.5	294 - 808
Feature-trained (N = 3)	48	621.21	107.46	607.0	429 - 835
All teachers in grade level (N=7)	68	641.25	120.00	655.0	294 - 835
5th Grade (STAR)					
Non-feature-trained (N = 2)	52	672.81	114.48	690.0	422 - 841
Feature-trained (N = 2)	52	750.08	85.32	769.0	549 - 868
All teachers in grade level (N=4)	104	711.44	107.71	738.5	422 - 868

Note. SAT 10 = Stanford Early School Achievement Test Series 10; STAR = Standardized Test for the Assessment of Math; M = Mean; SD = Standard Deviation; Mdn = Median

Table 13

Measures of Central Tendency for Combined SAT 10 and STAR Mathematics Student Assessment Scores for Post Intervention Scores According to Grade Level and Teacher Training Group

Grade Level (Test) / Group (N)	# Obs. Group	Student Assessment Scores Post-Intervention *M*	*SD*	*Mdn*	Range
Kindergarten (SAT 10)					
Non-feature-trained (N = 2)	22	459.91	30.59	462.0	420 - 534
Feature-trained (N = 3)	50	474.00	48.64	472.0	378 – 613
All teachers in grade level (N=5)	72	469.69	44.05	469.5	378 – 613
1st Grade (STAR)					
Non-feature-trained (N = 2)	33	379.55	91.26	366.0	174 - 605
Feature-trained (N = 2)	34	407.24	93.08	393.5	200 – 575
All teachers in grade level (N=4)	67	393.60	92.55	388.0	174 – 605
4th Grade (STAR)					
Non-feature-trained (N = 4)	20	709.30	149.76	742.5	313 - 851
Feature-trained (N = 3)	48	649.04	103.95	644.5	474 – 851
All teachers in grade level (N=7)	68	666.76	121.26	661.5	313 - 851
5th Grade (STAR)					
Non-feature-trained (N = 2)	52	667.04	111.44	691.0	445 – 851
Feature-trained (N = 2)	52	779.50	89.60	806.0	492 - 899
All teachers in grade level (N=4)	104	723.27	155.40	750.5	445 - 899

Note. SAT 10 = Stanford Early School Achievement Test Series 10; STAR = Standardized Test for the Assessment of Math; M = Mean; SD = Standard Deviation; Mdn = Median

Assumptions for Inferential Analysis

Inferential analyses involved mixed methods (between/within groups) analysis of variance (mixed-ANOVA) and the Mann Whitney U test (MWU). The MWU test is a non-parametric technique that only requires independence of observations between groups, and at least ordinal or ranked outcomes. These assumptions were met.

Assumptions for the parametric ANOVA test included absence of missing values and outliers, normality, homogeneity of variances, and sphericity. None of the records were missing data.

Outliers have the potential to distort results of statistical tests. The data was investigated for the presence of outliers on the ANOVA dependent variable outcomes of pre and post intervention student test scores. No outliers were indicated, and therefore the outlier assumption was not violated.

Normality for the dependent variable outcomes of pre and post intervention student test scores was investigated via Kolmogorov-Smirnov Tests (KS Test) and a visual inspection of histograms and normal Q-Q plots of the variable distributions. The KS Test returned significance ($p < .0005$) for both pre and post intervention student scores; however, the KS Test is very sensitive to larger sample sizes (Tabachnick and Fidell, 2007). The histograms did not indicate skew, and the Normal Q-Q plots indicated a nice fit of the data with a normal curve. ANOVA analysis is quite robust to deviations from normality if other assumptions hold. Therefore, it was determined that the assumption of normality was not violated.

Homogeneity of variances was investigated via Levene’s Test. Results were not statistically significant at the $p = .05$ level for the 2X2 mixed-ANOVA of Hypothesis 1.

Therefore the assumption of equal variances was not violated for Hypothesis 1. The assumption of equal variances was not met for the 2X4X2 mixed-ANOVA according to Levene's Test ($p < .0005$). A variance ratio test was performed for each of the three independent variables of (a) teacher group, (b) grade level, and (c) time of assessment. For each of the three groups, the highest variance was divided by the lowest variance. All variance ratios were below the cut-off value of 2, and therefore it could be assumed that the equal variance assumption was met for the test of Hypotheses 3 through 6 (Field, 2005, p. 371).

Sphericity, requirement for mixed ANOVA analysis, is assumed because there are only two levels of the repeated-measures independent variable (pre vs. post-test); therefore sphericity cannot be violated.

Effect sizes of significant inferential results from ANOVA analyses were determined using Partial eta squared. According to Cohen, (1988) classifications of effect size as small, medium, and large effects are .01, .06, and .14, respectively. These are generally accepted criteria for Partial eta squared effect size ranges (Pallant, 2007, p. 260).

Tests of Hypotheses and Inferential Findings

Statistical hypotheses for inferential analysis as relates to the research questions are as follows:

RQ_1. How will professional development in interactive technologies best practice, supported through a mentor model, transfer to classroom instructional practice?

$H_0 1$ There will be no statistically significant mean difference between the two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to pre and post intervention scores on the observation rubric.

$H_0$2 There will be no statistically significant median difference between the two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to scores on the observation checklist.

RQ_2. What effect will lessons utilizing best practices for interactive technology have on student achievement?

$H_0$3 No statistically significant mean difference will be found between interactive whiteboard kindergarten feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Stanford Achievement Test Series 10 (SAT 10)

$H_0$4 No statistically significant mean difference will be found between interactive whiteboard first-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

$H_0$5 No statistically significant mean difference will be found between interactive whiteboard fourth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

$H_0$6 No statistically significant mean difference will be found between interactive whiteboard fifth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

Inferential Findings as Relates to Hypothesis 1

$H_0$1 There will be no statistically significant mean difference between the two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to pre and post intervention scores on the observation rubric.

H_a1. There will be a statistically significant mean difference between the two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to pre and post intervention scores on the observation rubric. A two-way (2 X 2) mixed-ANOVA was performed to address statistical hypothesis 1. The analysis included one repeated measures (within-groups) independent variable of time with two levels (before intervention and after intervention), and one between-group independent variable of teacher group (feature-trained vs. non-feature-trained). The dependent variable was the observation rubric score, which was computed by summing the five rubric items for each teacher before intervention, and then again post intervention.

There was a statistically significant interaction effect between teacher group and pre and post observation rubric scores, indicating there was a significant change in the teacher observation rubric scores over pre intervention vs. post intervention times for the two teacher groups, F (1, 16) = 5.94, p = .027, partial η^2 = .271. Comparisons of the estimated marginal means of the two teacher groups showed that for the non-feature-trained teachers, the mean observation rubric score at post intervention was greater (M = 6.29, SE = 0.63) than the pre intervention score (M = 6.00, SE = 0.73). The feature-trained teachers also increased in mean observation rubric scores from pre intervention (M = 11.27, SE = 0.56) to post intervention (M = 13.09, SE = 0.50).

The variable of pre intervention observation rubric score vs. post intervention observation rubric score indicated a significant within-subject main effect for the mean difference in scores, F (1, 16) = 11.19, p = .004, partial η^2 = .412. Comparison of the estimated marginal means for pre vs. post test mean observation rubric scores indicated that the mean observation rubric scores were significantly higher for post intervention scores (M = 9.69, SE = 0.40) than for pre intervention scores (M = 8.64, SE = 0.47).

The between group variable of teacher group was also significant, F (1, 16) = 54.87, p < .0005, partial η^2 = .774, indicating that the mean observation rubric scores were significantly higher for the feature-trained teachers (M = 12.18, SE = 0.51) than for the non-feature-trained teachers (M = 6.14, SE = 0.64).

Conclusion as Relates to Hypothesis 1. Statistical significance was found for the interaction effect of teacher groups and observation rubric scores, the within-groups difference in mean scores pre intervention to post intervention, and also for the mean observation rubric scores between the teacher groups of non-feature-trained vs. feature-trained. Therefore, reject null hypothesis 1; there are statistically significant differences between participant trained and participant non-trained instructional practices as measured by the Observation Rubric.

Inferential Findings as Relates to Hypothesis 2

$H_0$2 There will be no statistically significant median difference between the two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to scores on the observation checklist.

H_a2. There will be a statistically significant median difference between the two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to scores on the observation checklist.

A series of three Mann Whitney U tests was performed to test hypothesis 2. One test was performed for each of the three checklist categories: (a) schematic influencers, (b) inventive influencers, and (c) constructive influencers. Teachers were observed at 5 weeks and 8 weeks in the study. A checklist of items the teacher used in their lessons was completed at each of the two observation times. The counts from observation time 1 and observation time 2 for each of the three checklist categories were totaled and divided by 2 to comprise a mean count score for use as the dependent variable in analysis. The checklist counts were counts and not continuous in nature. Parametric tests, such as a mixed ANOVA (which would make use of the time and also teacher group classification as independent variables) and an independent samples t-test on the mean checklist scores were considered; however, the data was not distributed normally, and the variances were not equal between groups. It is standard practice to convert count scores for parametric analysis using a square root transformation. This was attempted, but the normality and variance did not improve. There is not a non-parametric alternative for the mixed ANOVA. Therefore, it was decided that the non-parametric Mann Whitney U test would be performed in lieu of the independent samples t-test on the mean checklist counts for each of the three checklist classifications (dependent variable) with independent variable of teacher group (non-feature-trained vs. feature-trained).

Results of the Mann Whitney U test on the dependent variable outcome of schematic influencer mean count was statistically significant. $Z = -3.41$, $p < .0005$. The feature-trained teacher group had a higher mean rank of 12.86 vs. 4.21 for the non-feature-trained group.

Results of the Mann Whitney U test on the dependent variable outcome of inventive influencer mean count was statistically significant. $Z = -3.60$, $p < .0005$. The feature-trained teacher group had a higher mean rank of 13.00 vs. 4.00 for the non-feature-trained group.

Results of the Mann Whitney U test on the dependent variable outcome of constructive influencer mean count was statistically significant. $Z = -2.53$, $p = .027$. The feature-trained teacher group had a higher mean rank of 11.73 vs. 6.00 for the non-feature-trained group.

Conclusion as Related to Hypothesis 2. The Mann Whitney U tests were statistically significant for all three observation checklist categories. Therefore, reject null hypothesis 2; there were statistically significant differences between participant trained and participant non-trained instructional practices as measured by the Observation Checklist.

Inferential Findings as Relates to Hypotheses 3-6

A three way (2X4X2) mixed-ANOVA was performed to address statistical hypotheses 3 through 6. The analysis included one repeated measures (within-groups) independent variable of time with two levels (before intervention and after intervention), and two between-groups independent variables of (a) teacher group (feature-trained vs. non-feature-trained), and (b) grade level (four grade levels; kindergarten, 1st grade, 4th grade, and 5th grade). The dependent variable was the student assessment score. Kindergarten student assessment scores were scaled differently than the first, fourth, and fifth-grade scores; however, the kindergarten teachers were represented in both teacher groups, and the repeated measures nature of the time variable allowed for baseline control student score measurements for each individual teacher. The student assessment scores were kept in their original scaled form for analysis. Table 3 presents measures of central tendency for each of the teacher groups, by grade level, for each student assessment time.

A within subjects effect returned a statistically significant interaction between time and teacher group, indicating there was a significant change in the student test scores over pre intervention vs. post intervention times for the two teacher groups: F (1, 303) = 8.96, p = .003, partial η^2 = .029. Comparisons of the estimated marginal means of the two teacher groups showed that for the non-feature-trained teachers, the mean student test score at post intervention was greater (*M* = 553.95, *SE* = 8.93) than the pre intervention score (*M* = 542.35, *SE* = 8.88). The feature-trained teachers also increased in mean student test scores from pre intervention (*M* = 544.62, *SE* = 6.98) to post intervention (*M* = 577.44, *SE* = 7.01).

The group of time (pre vs. post intervention) also returned a statistically significant within subject effect, $F(1,303) = 39.22$, $p < .0005$, partial η^2 = .12. Comparison of the estimated marginal means for pre vs. post test mean student test scores indicated that the mean student test score was greater for post intervention test scores (*M* = 565.70, *SE* = 5.68) than for pre intervention test scores (*M* = 543.49, *SE* = 5.65).

There was a statistically significant between group interaction effect between teacher group (feature-trained vs. non-feature-trained) and grade level, $F(3,303) = 10.52$, $p < .0005$, partial η^2 = .09. A significant between subject effect for grade level F(3,303) = 256.08, p < .0005, indicated that mean overall student assessment scores (both pre and post test assessment score combined) differed according to grade level.

Figures 1 through 4 present plots of the mean student assessment scores for the two teacher groups, and pre and posttests, for each grade level. Tables 12 and 13 present means and standard deviations of the pre and post intervention student assessment scores according to grade level.

A series of four analyses of covariance (ANCOVA) tests was performed to further address the significant between groups interactions to better address hypotheses 3 through 6. Each of the four ANCOVA analyses used the student assessment scores for time 1 as the covariate, the student assessment at time two as the dependent variable, and the teacher group (feature-trained vs. non-feature-trained) as the independent variable. Individual ANCOVA results are presented according to the related statistical hypothesis.

$H_0$3 No statistically significant mean difference will be found between interactive whiteboard kindergarten feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Stanford Achievement Test Series 10 (SAT 10)

A one-way between groups ANCOVA was conducted to compare two teacher groups as relates to kindergarten student performance outcomes. The independent variable was teacher group [feature-trained (N = 50) vs. non-feature-trained (N = 22)], and the dependent variable was post-intervention student SAT 10 score. Pre-intervention student assessment scores on the SAT 10 were used as the covariate. After adjusting for the pre-intervention scores, there was a statistically significant difference between the two teacher groups in the post-intervention SAT 10 scores [$F(1,69) = 11.66$, $p = .001$. partial $\eta^2 = .145$]. The covariate of pre-intervention SAT 10 was also statistically significant, [$F(1,69) = 75.63$, $p < .0005$], with a large effect size (partial eta squared =

.523). The effect size of .523 indicates that, while controlling for the independent variable of teacher group, 52.3% of the variance in the dependent variable outcome of post-intervention SAT 10 score can be explained by the pre-intervention SAT 10 score. Figure 1 shows that SAT 10 scores for the students of non-feature-trained teachers were greater at time 1 (*M* = 452.68, *SE* = 19.88) than for the students of feature-trained teachers (*M* = 438.20, *SE* = 13.19); however, at time 2, the students of feature-trained teachers had higher mean SAT 10 scores (*M* = 474.00, *SE* = 13.26) than the students of non-feature-trained teachers (*M* = 459.91, *SE* = 19.99).

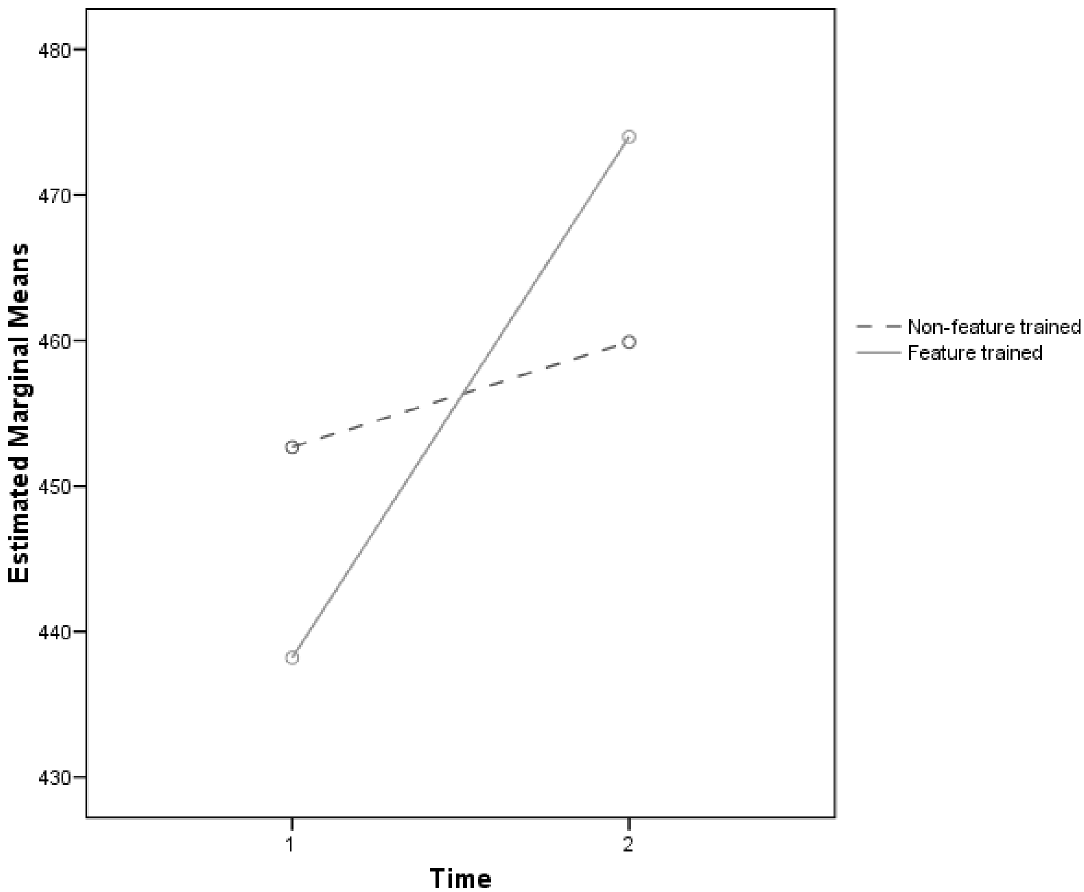

Figure 1. Estimated marginal means of student assessment scores at time 1 and time 2 for teacher groups of (a) non-feature-trained vs. (b) feature-trained, for the grade level of kindergarten.

Conclusion as Relates to Hypothesis 3. There was a statistically significant main effect involving the teacher groups of feature-trained vs. non-feature-trained. Therefore, reject Null Hypothesis 3. There is sufficient evidence to indicate a statistically significant difference in mean SAT 10 student assessment scores between the two teacher groups.

$H_0$4 No statistically significant mean difference will be found between interactive whiteboard first-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

A one-way between groups ANCOVA was conducted to compare two teacher groups as relates to first-grade student performance outcomes. The independent variable was teacher group [feature-trained (N = 34) vs. non-feature-trained (N = 34)], and the dependent variable was post-intervention student STAR score. Pre-intervention student assessment scores on the STAR were used as the covariate. After adjusting for the pre-intervention scores, there was not a statistically significant difference between the two teacher groups in the post-intervention STAR scores [$F(1,64) = 1.24$, $p = .270$, partial $\eta^2 = .019$]. The covariate of pre-intervention STAR was statistically significant, [$F(1,64) = 61.23$, $p < .0005$], with a large effect size (partial eta squared = .489). The effect size of .489 indicates that, while controlling for the independent variable of teacher group, 48.9% of the variance in the dependent variable outcome of post-intervention STAR score can be explained by the pre-intervention STAR score. Figure 2 shows that STAR scores for the students of non-feature-trained teachers were lower at time 1 (M = 354.58, SE = 16.24) than for the students of feature-trained teachers (M = 369.00, SE = 16.00). The outcomes were similar at time 2, with the students of feature-trained teachers having a higher mean STAR score (M = 407.24, SE = 16.08) than the students of non-feature-trained teachers (M = 379.55, SE = 16.32).

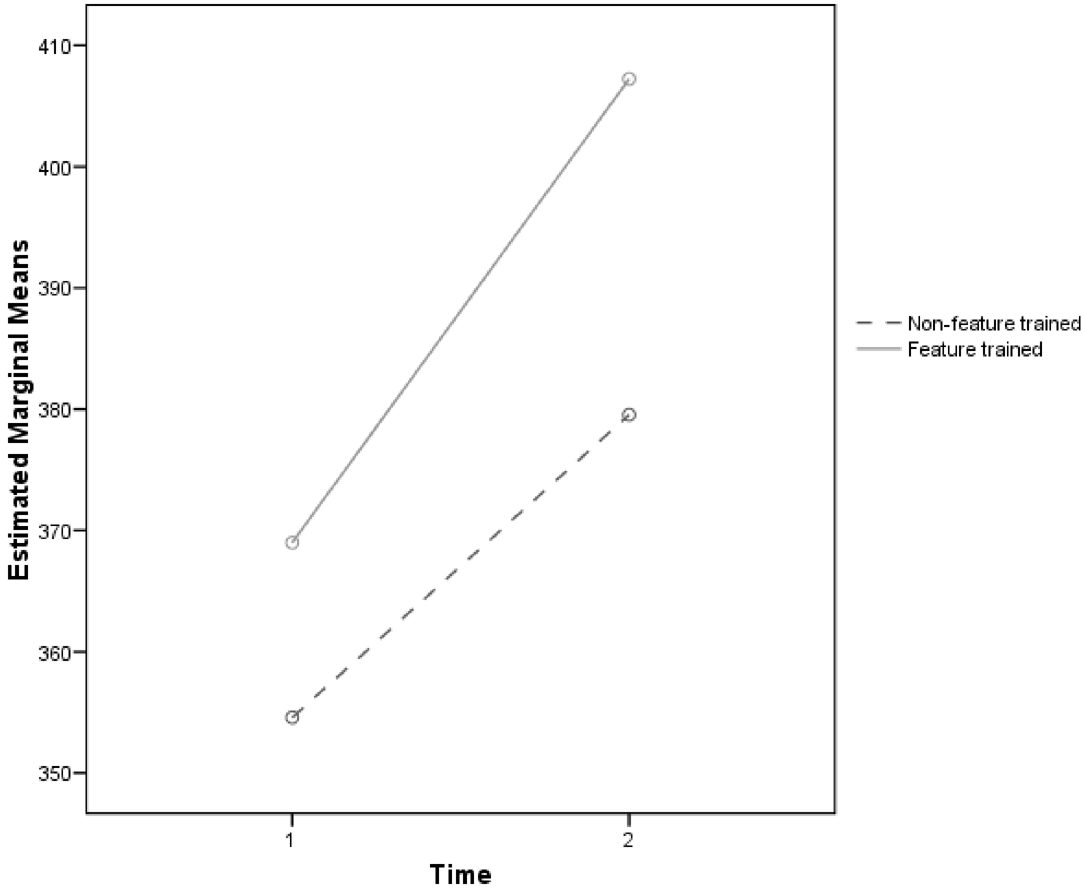

Figure 2. Estimated marginal means of student assessment scores at time 1 and time 2 for teacher groups of (a) non-feature-trained vs. (b) feature-trained, for the grade level of first grade.

Conclusion as Relates to Hypothesis 4. There was a not statistically significant main effect involving the teacher groups of feature-trained vs. non-feature-trained. Therefore, do not reject Null Hypothesis 4. There is not sufficient evidence to indicate a statistically significant difference in mean STAR student assessment scores between the two teacher groups.

H₀5 No statistically significant mean difference will be found between interactive whiteboard fourth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

A one-way between groups ANCOVA was conducted to compare two teacher groups as relates to fourth-grade student performance outcomes. The independent variable was teacher group [feature-trained (N = 48) vs. non-feature-trained (N = 20)], and the dependent variable was post-intervention student STAR score. Pre-intervention student assessment scores on the STAR were used as the covariate. After adjusting for the pre-intervention scores, there was not a statistically significant difference between the two teacher groups in the post-intervention STAR scores [$F(1,65) = 0.03$, $p = .866$, partial $\eta^2 < .0005$]. The covariate of pre-intervention STAR was statistically significant, [$F(1,65) = 285.10$, $p < .0005$], with a large effect size (partial eta squared = .814). The effect size of .814 indicates that, while controlling for the independent variable of teacher group, 81.4% of the variance in the dependent variable outcome of post-intervention STAR score can be explained by the pre-intervention STAR score. Figure 3 shows that STAR scores for the students of non-feature-trained teachers were higher at time 1 (M = 689.35, SE = 20.86) than for the students of feature-trained teachers (M = 621.21, SE = 13.46). The outcomes were similar at time 2, with the students of non-feature-trained teachers having a higher mean STAR score (M = 709.30, SE = 20.97) than the students of non-feature-trained teachers (M = 649.04, SE = 13.53).

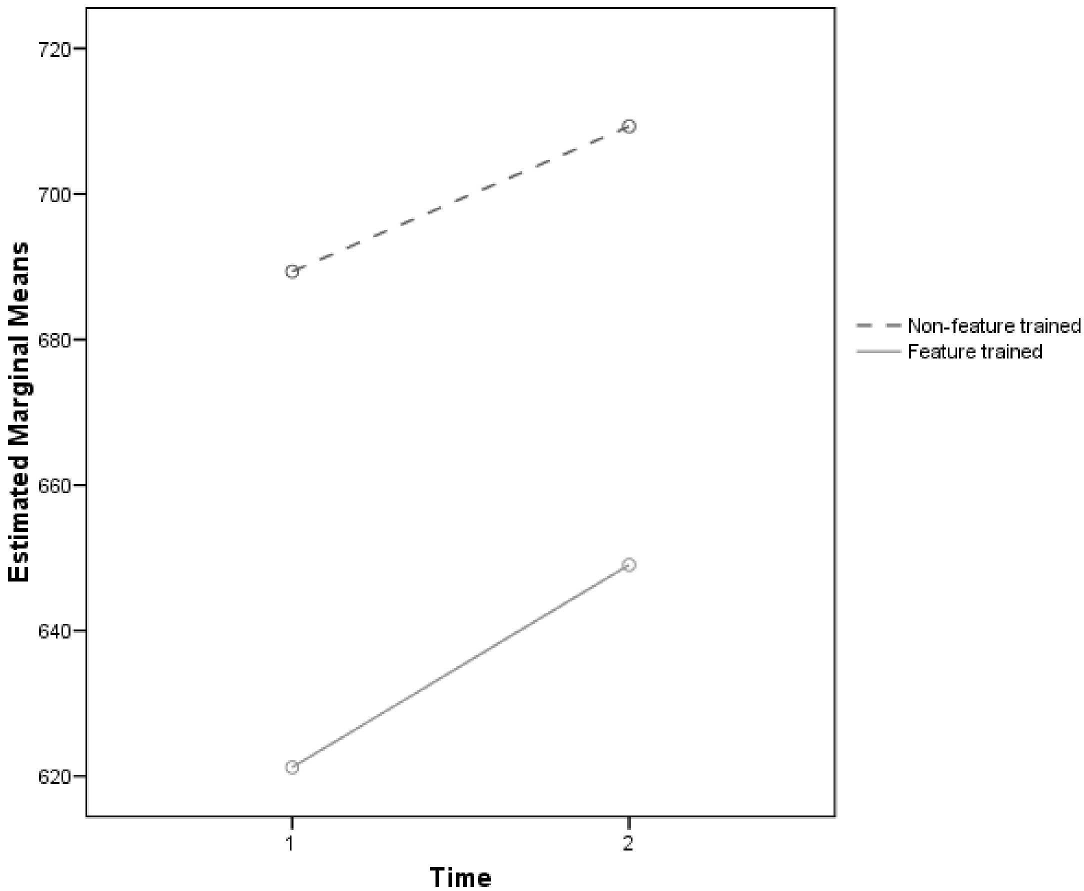

Figure 3. Estimated marginal means of student assessment scores at time 1 and time 2 for teacher groups of (a) non-feature-trained vs. (b) feature-trained, for the grade level of fourth grade.

Conclusion as Relates to Hypothesis 5. There was a not statistically significant main effect involving the teacher groups of feature-trained vs. non-feature-trained. Therefore, do not reject Null Hypothesis 5. There is not sufficient evidence to indicate a statistically significant difference in mean STAR student assessment scores between the two teacher groups.

$H_0$6 No statistically significant mean difference will be found between interactive whiteboard fifth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement, as measured by the Standardized Test for the Assessment of Math (STAR).

A one-way between groups ANCOVA was conducted to compare two teacher groups as relates to fourth-grade student performance outcomes. The independent variable was teacher group [feature-trained (N = 52) vs. non-feature-trained (N = 52)], and the dependent variable was post-intervention student STAR score. Pre-intervention student assessment scores on the STAR were used as the covariate. After adjusting for the pre-intervention scores, there was a statistically significant difference between the two teacher groups in the post-intervention STAR scores [$F(1,101) = 15.29$, $p < .0005$, partial $\eta^2 < .131$]. The covariate of pre-intervention STAR was also statistically significant, [$F(1,101) = 163.71$, $p < .0005$], with a large effect size (partial eta squared = .618). The effect size of .618 indicates that, while controlling for the independent variable of teacher group, 61.8% of the variance in the dependent variable outcome of post-intervention STAR score can be explained by the pre-intervention STAR score. Figure 4 shows that STAR scores for the students of non-feature-trained teachers were lower at time 1 (M = 672.81, SE = 12.94) than for the students of feature-trained teachers (M = 750.08, SE = 12.94). The outcomes were similar at time 2, with the students of feature-trained teachers having a higher mean STAR score (M = 779.50, SE = 13.03) than the students of non-feature-trained teachers (M = 6667.04, SE = 13.00).

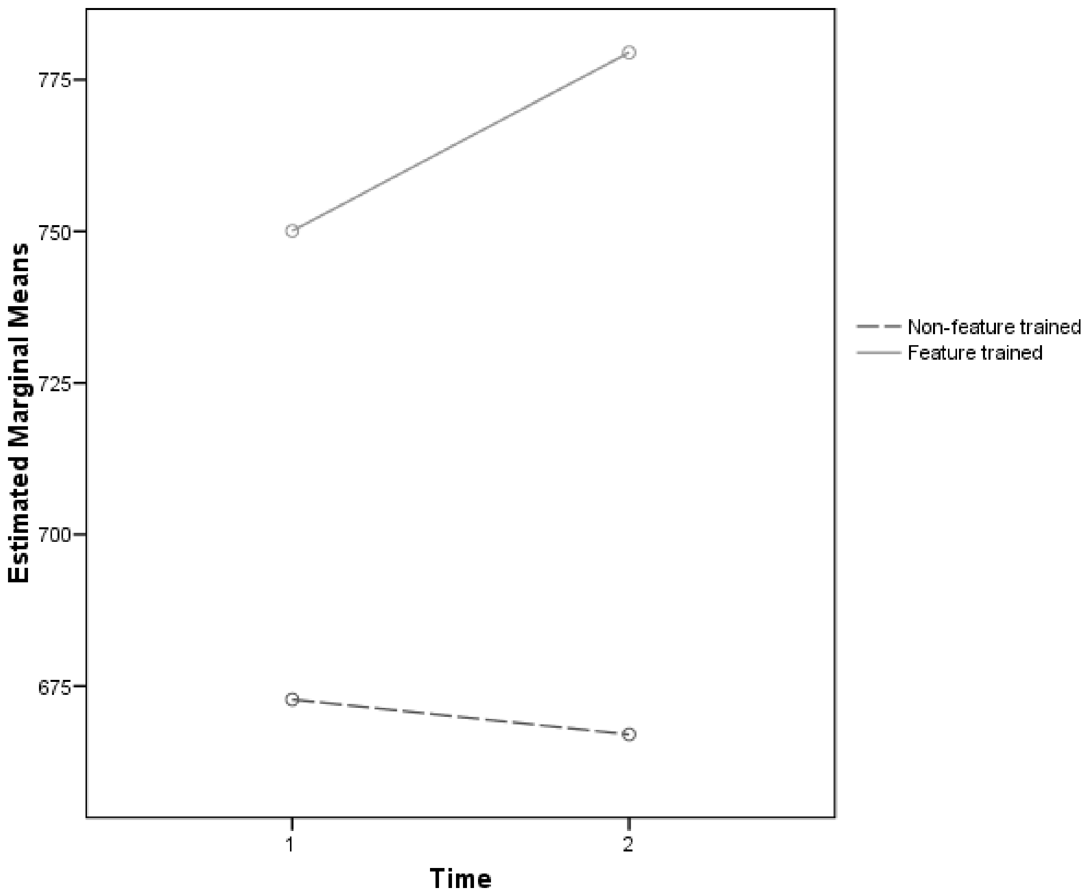

Figure 4. Estimated marginal means of student assessment scores at time 1 and time 2 for teacher groups of (a) non-feature-trained vs. (b) feature-trained, for the grade level of fifth grade.

Conclusion as Relates to Hypothesis 6. There was a statistically significant main effect involving the teacher groups of feature-trained vs. non-feature-trained. Therefore, reject Null Hypothesis 6. There is sufficient evidence to indicate a statistically significant difference in mean STAR student assessment scores between the two teacher groups.

Summary

Chapter 4 began with a description of the demographics of the participants in the study. Following the report of demographics, the instrumentation and inferential analysis variable constructs were briefly defined. Information pertaining to required assumptions for the inferential analyses were presented and discussed.

Following the demographic and assumption sections, inferential analyses were performed using mixed ANOVA and MWU tests to address the three statistical hypotheses of this study. For hypotheses 3 through 6, one-way between groups ANCOVA analyses were utilized to further investigate the interactions between teacher group and grade level. Research Hypothesis 1 stated that there would be a statistically significant mean difference between participant feature-trained teachers' and participant non-feature-trained teachers' interactive role with students during lessons incorporating the elements of design, as measured by the observation rubric. Research Hypothesis 1 was supported.

Research Hypothesis 2 stated that there would be a statistically significant median difference between teacher participant feature-trained and teacher participant non-feature-trained application of learning influencers as measured by the observation checklist. Research Hypothesis 2 was supported.

Research Hypothesis 3 stated that a statistically significant mean difference would be found between interactive whiteboard kindergarten feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Stanford Achievement Test Series 10 (SAT 10). Research Hypothesis 3 was supported.

Research Hypothesis 4 stated that a statistically significant mean difference would be found between interactive whiteboard first-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement, as measured by the Standardized Test for the Assessment of Math (STAR). Research Hypothesis 4 was not supported.

Research Hypothesis 5 stated that a statistically significant mean difference would be found between interactive whiteboard fourth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement, as measured by the Standardized Test for the Assessment of Math (STAR). Research Hypothesis 5 was not supported.

Research Hypothesis 6 stated that a statistically significant mean difference would be found between interactive whiteboard fifth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR). Research Hypothesis 6 was supported.

Chapter 5: Summary, Conclusions, and Recommendations

Chapter 5 briefly summarized the research study presented in previous chapters. It is divided into the following sections: (a) the purpose of the study; (b) the restatement of the problem; (c) a review of the methodology; (d) a discussion of the results; (e) implications; (f) limitations; (g) recommendations for future practice and (h) recommendations for future research.

Purpose

The purpose of the study was to examine the effect that teacher professional development in interactive whiteboard training, utilizing an identified set of learner influencing features, had on student achievement in mathematics. The research questions that guided this study and the null hypotheses were as follows:

RQ_1. How will professional development in interactive technologies best practice, supported through a mentor model, transfer to classroom instructional practice?

RQ_2. What effect will lessons utilizing mentored best practices for interactive technology have on student achievement?

The statistical design followed a quasi-experimental mixed factorial between and within groups design as it best fit the framework of the study by comparing two variables and their interaction effect.

Based on a review of the literature, hypotheses were developed relating to the research questions.

Null Hypotheses RQ_1.

$H_0$1 There will be no statistically significant mean difference between the two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to pre and post intervention scores on the observation rubric.

$H_0$2 There will be no statistically significant median difference between the two independent teacher groups of (a) feature-trained, vs. (b) non-feature-trained as relates to scores on the observation checklist.

Null Hypotheses RQ_2.

$H_0$3 No significant difference will be found between interactive whiteboard kindergarten feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Stanford Achievement Test Series 10 (SAT 10)

$H_0$4 No significant difference will be found between interactive whiteboard first-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

$H_0$5 No significant difference will be found between interactive whiteboard fourth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

$H_0$6 No significant difference will be found between interactive whiteboard fifth-grade feature-trained and interactive whiteboard non-feature-trained teacher participant student achievement as measured by the Standardized Test for the Assessment of Math (STAR).

School reform initiatives challenge schools to provide better opportunities for learning. NCLB and Race to the Top address technology as a competitive measure in an increasingly global marketplace. Both programs provide funding for an infrastructure of technology.

Restatement of the Problem

This study focused on the use of current IWB and supporting interactive technologies that districts strive to provide in classrooms and how teachers use such equipment to enhance the learning experience. There were few studies within educational research literature of the effective use of such technologies on student learning. The majority of previous studies presented a qualitative approach identifying student and teacher perceptions toward learning with IWBs; however, quantitative studies on the topic were limited. Of greater importance was the issue of teacher training. The fact remained that although a teacher might work within a 21st century classroom, there was no guarantee that instruction would be implemented in an effective manner when using the technology. Thus, the problem at the heart of this study was that, while classrooms may be equipped with the latest technology, teachers are unfamiliar with how to use it effectively for instruction.

Review of Methodology

Chapter 3 described mixed factorial within and between pre post control design to investigate an interactive effect within student subject scores and between voluntary randomized teacher feature-trained and non-feature-trained subjects. The trained teacher subjects received instruction in the utilization of 16 IWB features that had been found to influence learning in a previous study, noted in research literature and in chapter 3.

Additionally, three principles of multimedia teaching, also noted in cognitive research, were provided to the trained group.

Discussion of the Results

The teacher mentor model teacher training certainly supported teachers with the implementation of the IWB feature set and the resulting significance in improved student achievement for at least two of the student groups. This was unexpected, particularly considering the study's implementation interval. Since the study was quasi-experimental, no direct correlation can be made between the teacher training and student achievement; however, that there was some significant difference in general math achievement within and between student groups and between teacher groups warrants thoughtful consideration.

The results in grades 1 and 4 were not surprising. During the study, teacher C of the first-grade group missed two training sessions. During the teacher C observations, a minimal usage of learning influencers were noted. The teacher had personal reasons for the absences. The results were included to provide a realistic perspective to the study-the human element. The fourth-grade student control group was a high achieving group. They began with higher mean scores and maintained their higher scores. It would have been beneficial to have a larger control group for the grade level. These two considerations most likely influenced the outcome of the results in those grades.

The fact there was no statistical significance between group teacher student scores in grades 1 and 4 may also be caused by the relatively brief nine-week time interval. The greater point of interest describes the main effect – the intersection of both teacher training and student score. The average student within group score was greater in most teachers' classes that implemented the influencer feature set.

The feature-trained subjects in the study found their experience to be beneficial to their teaching. The school administration commented several times on how participant teachers were excited and trying new ideas out in the classroom. They, too, observed several strategies used within their visits to classrooms.

The feature-trained subjects shared their weekly reaction to training through the survey. As the weeks progressed, the responses became more specific to need. The third reactive survey results included for the following suggestions:

• "We need to have small group meetings."

• "More examples of videotaped lessons would be helpful."

• "Provide some more time for computer work as a group."

• "Demonstrate more than once per feature."

Feedback was addressed within the week or during the next training. An unplanned event occurred when some of the teachers decided to meet during the school day and work together. A second group decided to meet after school to help one another design lessons and help with equipment operation. These meetings happened spontaneously and in addition to the mentoring plan. By the final week, the reactive survey comments included statements such as "more, more" and "I cannot think of anything to improve what is already happening."

The kindergarten teachers were most at home with the IWB as a focal point within the lesson, as lessons in those classes were presented at the front of the room. The kinder students were very interested in the teacher's ability to manipulate objects, and in two classrooms they had the opportunity to work with the IWB themselves. The kindergarten teachers continued to express their appreciation for their students' greater level of attention in lessons using the IWB.

It was unexpected that teachers would take on more advanced interactive devices so quickly. In two fourth-grade classrooms, the teachers transitioned their IWB skills seamlessly to an interactive tablet and primarily worked with their classes using a more remote approach. Both teachers commented on the need to move around the classroom while teaching, not wanting to be stuck in the front of the room. During observations in both rooms, students were handed the tablet to respond without getting out of their seat. The same result was observed in two observations in fifth grade regarding the preference for the tablet, although not to the same degree. One particular teacher commented that the use of the tablet seemed to be more natural. Considering the need to learn an additional software component, the comfort of using the tablet by a majority of teacher subjects was a surprise.

Students overwhelmingly enjoyed the clickers or SRS remotes. This was a logical outcome since it provided a way for them to actively respond in the classroom. In more than one room students were seen rubbing the remotes anticipating their next use. The teachers were not as comfortable using the remotes. This seemed to be due to the need to learn a third software application and the fact that it was shared equipment not always available for use. All of the teachers in the trained group saw the benefit of the clickers but they needed more time to understand the software. The quick move to experimentation with the clickers was not expected. Teachers at the target school had exposure to them in previous years but the interest level did not seem to warrant taking the time to learn about them. That changed during this study.

The mentoring model provided a secondary advantage of assisting trained teacher subjects to implement the trained feature set within lessons.

The Teacher Confidence Survey. The results of the Teacher Confidence Survey are indicated on Tables I-14, J-15 and K-16. Statistical significance was indicated by using < .05 as a measure. The survey questions were divided into three specific groups: (1) generalized tasks relating to the instruction of mathematics, (2) basic operations and use of the IWB and related interactive technologies, and (3) advanced application of interactive tools within instruction. The first category, while not specifically targeting interactive tools, may describe the teacher's disposition regarding adaptation during the teaching process without consideration of equipment operation. The second category covers instruction that is common to lessons incorporating IWBs and interactive tools. The third group considers more specific elements of design and implementation of the interactive lesson. The survey results in this study should only be considered descriptive in nature.

Within the first group of generalized mathematics teaching confidence, there was a significant difference in the mean scores between the feature-trained and non-feature-trained teacher groups. The second cluster of questions found a higher statistically significant difference between groups. The third question group continued to show a statistical significance in the confidence of teachers. It would seem that the teachers were energized to teach more dynamically when supported by the mentor model. Their willingness to try out new ideas and respond to students' related tangents of thought, as indicated by survey, led to a more comfortable situation.

Implications of Relevant Literature

The primary research used to carry out this study was based upon the Kennewell & Beauchamp (2007) research by using their 16 learning influencers as an integral part of what constitutes effective instruction; that is to say, what influences learning. The inclusion of only three of the principles of learning from Clark and Mayer (2008) were also important considerations as part of what it means to teach with multimedia-rich resources effectively. If teachers are to partner technology standards with content as prescribed by ISTE to address NCLB student literacy goals, it is imperative they be given training on effective instructional techniques designed to impact learning. The call for such need was echoed in past studies (BECTA, 2003; Holmes, 2009).

Another consideration important to the success of IWB and technology use in classrooms relates to the instructional model. The observations during the study found that teachers less familiar with IWB teaching style tended to stay at the front of the room using the IWB as an illustrative device while those more comfortable quickly were at home teaching with remote slates and SRS response systems. Teachers need to be familiar with instructional practices that promote problem solving, group activity and interactive technologies. It is just as important that teacher professional development staff, look beyond what is operational know-how and focus on effective teaching and learning that is research based. Training sessions in this study were only a part of the necessary support offered to implement effective IWB lessons. Mentoring one on one with grade level or team support helped teachers to apply training content.

Teaching models of this type are most closely related to socio-constructivist methods opposed to the more common behaviorist approach. DeVries et al (2002) describe the greatest difference of socio-constructivist teaching requiring more time and planning but with the added benefit of increased conceptual retention. Participation and collaboration occurs when students have learned to how to engage in lessons. Didactic forms of teaching do not promote interactive behaviors. Students are held captive, occasionally prodded to respond in a passive learning environment. The classic teaching examples in the literature ascribe to the notion that there are some things explained and some things best experienced (Boeree, 2000).

The lessons from the Lai study (2010) and the Kirkpatrick and Kirkpatrick (2010) training model were effective in providing recommendations for training. The Lai study pointed out the importance of particular strengths and weaknesses in their study on teacher IWB training and provided considerations that future studies consider the Kirkpatrick model for training, a common shared resource and time for discussion all of which this researcher utilized.

The Kirkpatrick training called for a reactive instrument be designed to gather adult learner responses immediately after each training session, the learning and behavior; steps 2 and 3 of the Kirkpatrick process were easily integrated within the mentor model as both were parts of a process for teachers with the mentoring providing the assistance needed in reaching the goal. The final stage of the Kirkpatrick model, results, was addressed by the student outcome in the study.

Limitations

The results of the study were based on a limited population. The participants were from one school, and the study was limited to one subject area. The results may differ in another subject area or school. Although participant teachers were voluntary, group randomized, and observed to confirm the application of treatment, there is still a potential for teacher effect or nested variables with different teachers involved. In addition, the observation component in the study was conducted by the researcher. Blind observations conducted by a separate researcher or members of a research team in a larger scale study would improve the methodology. Such limitations should be considered when generalizing the study results.

The teacher rubric and confidence survey were peer evaluated; however, it would be beneficial to do a follow-up study on these observation instruments to increase reliability and validity. There is a need for tools designed to identify effective use of IWBs during lessons.

Recommendations for future practice Teachers need training and support in effective use of interactive classroom technologies; however, it is not enough to assume that training alone will insure that classroom practice will change. First, there must be a clearly identified and established best practice research-based model for instruction, using the IWB and other interactive technologies, that is based upon student achievement. The challenge posed in the research literature describes the importance of the active learning environment that engages learners in tasks that involve participation. A related analogy might be offered as a journey where teacher and students work as co-inquirers clearing a path to understanding, rather than a teacher directing students down a predetermined hallway. Teachers acting professionally must apply resources provided within the curriculum but also employ inventive and constructive elements at every given opportunity to invoke interest, engagement, and learning. This would assume a degree of creativity in teaching beyond that of textbook offerings and foster a personal touch within the social classroom setting. Working within an established content framework and allowing students to work with that content will potentially provide the best learning opportunity. Such practice describes effective teaching, and it also describes how interactive technologies foster such practice, assisting teachers to illustrate, animate, and extend the range of lessons far beyond the walls of the classroom or the pages of the textbook. They also provide a simplified way to elicit a response from each student effectively and tabulate the responses within any lesson. Student engagement is increased as students realize they have a voice and are accountable for their responses.

Secondly, the need for a supportive model during and after training, providing teachers with assistance in aligning curricular goals, materials, and technology methodology together, is critical to this type of instructional reform. The teacher's day is spent managing and instructing. A redesign of instruction will require not only additional initial planning, but also practice on the part of the teacher. An instructional mentor model can offer the needed support and increase the potential for instructional change. Additionally, grade level or department teams can provide a secondary source of support through the sharing of lesson resources and ideas to better help refine instructional practice. Once teachers are confident and regularly utilizing IWBs and other interactive technologies, student use will increase through modeling and useful application. The learners will want to use the tools they have observed being used.

Finally, regarding school staffing needs, it is important that teachers be willing participants quick to learn, open to suggestions, and flexible in trying new instructional methods. There is a current conception claiming that younger teachers, often generationally referred to as digital natives, are more comfortable using technology on a personal level; however, teaching with technology and time management of an interactive classroom of learners are a new experience. It must not be assumed that newer teachers come from college fully versed in the latest methods and skills for effectively teaching with interactive technologies. They, too, will need the support and guidance offered to veteran teachers as all members of a school learn to collaborate and work together as an educational team to improve achievement.

Recommendations for future research

There is need for further research in effective support for teachers implementing IWB strategies in classrooms. Professional staff development is a first step. The Kirkpatrick model for training merits consideration as the focus identifies the training element then follows it from initial trainee reaction to practice. This is important as it may indicate where the training falters in reaching its goal. The professional development model was new to the researcher, and the reactive survey was considered to be the most helpful element in the training process. It provided the ability to tailor the training to the learner group.

A suggestion for future study would be to expand the study to include a year-long or a longitudinal study involving a multi-school implementation of the feature set targeting a subject using national achievement scores to provide pre and post data on student achievement. This study was conducted in an elementary setting. Future studies implemented in middle and high schools and even universities would almost certainly provide an interesting perspective in instructional methodology using interactive technologies. Secondly, it would be of particular interest to schools at every level to consider the effects of various interactive technologies on student learning. During this study, teachers remarked how students enjoyed using clickers to respond during discussion and asked for clicker tests. This would imply that students enjoyed the personalized action a remote offered in the learning process.

The teacher confidence survey is another aspect of this study that should be further developed. It is not enough to put an IWB in a classroom, allow teachers to experiment and take a staff development course on how to operate the board. Teachers need the benefit of research to provide practices that are incorporated into lessons using the technology.

It is this researcher’s opinion that interactive tools for teaching are in a state of transition. What started primarily as a revolutionary teaching apparatus for the front of the room--an electronic touch board--has become a mobile interactive slate. Now other mobile devices such as cell phones and iPods have the ability to work with slates and clickers to potentially provide multi-group input and dynamic conversation within and between people and classrooms, providing opportunities for learning never before possible. Students were greatly interested in being a part of lessons in this study, as indicated by the teachers and observed by the researcher. The interest in these devices is reflective of the societal trend toward pods, phones, and pads. Such a phenomenon would seem to indicate that people want information but that they also want to touch and manipulate it in a way that makes sense to them. The school experience necessitates that same privilege.

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Appendix A

IRB Approval

Appendix A

IRB Approval

IRB Approval 1011.111010: Investigating the Impact of Interactive Whiteboard Professional Development on Lesson Planning and Student Math Achievement

Hartin, Tiffany Erin

Sent: Wednesday, November 10, 2010 3:39 PM
To: Winkler, Rodney Lee
Cc: Holder, David E; IRB, IRB; Garzon, Fernando
Attachments: Annual Review Form.doc (31 KB) ; Change in Protocol.doc (29 KB)

Good Afternoon Rodney,

We are pleased to inform you that your above study has been approved by the Liberty IRB. This approval is extended to you for one year. If data collection proceeds past one year, or if you make changes in the methodology as it pertains to human subjects, you must submit an appropriate update form to the IRB. Attached you'll find the forms for those cases.

Thank you for your cooperation with the IRB and we wish you well with your research project. We will be glad to send you a written memo from the Liberty IRB, as needed, upon request.

Sincerely,

Fernando Garzon, Psy.D.
IRB Chair
Associate Professor
Liberty University
1971 University Blvd.
Lynchburg, VA 24502
(434) 592-4054

Appendix B

District Research Approval

Appendix B

District Research Approval

Winkler, Rodney

To: Itzen, Richard
Subject: RE: Research Study

From: Itzen, Richard
Sent: Thursday, October 14, 2010 4:26 PM
To: Winkler, Rodney
Cc: Pescatrice, Michelle
Subject: Research Study

Rodney,

The District Research Committee has reviewed your study, "Investigating the Impact of Interactive Whiteboard Professional Development on Lesson Planning and Student Math Achievement", and approved its implementation at Target Elementary School. I understand that you have already addressed the areas below, but please review our requirements and suggestions below.

You study should be conducted with the following in mind:

1) Please follow the direction of the school principal, Ms. Pescatrice, concerning study activities at the school.
2) Please make it clear to teachers that participation is voluntary and secure their consent to participate in writing.
3) If time is spent conducting research activities during your school day, you should take personal or vacation time to do so.
4) If it is not already built into your study, consider comparing results from the group you are working with a control group at the school.
5) Please plan to forward a copy of the results of your study to the Dept. of Accountability when it is completed.

Thank you for your interest in conducting research in the Target School District.

Richard Itzen, Director
Dept. of Accountability, Research, and Continuous Improvement

Appendix C

Orientation Agenda

Appendix C

Orientation Agenda

Orientation Agenda

3:45-4:45pm

Investigating the Impact of Interactive Whiteboard Professional Development on Lesson Planning and Student Math Achievement

I. Welcome

II. The Purpose of the Study

- **A. The Investigative Aspect**
- **B. Benefits to Teaching Practice**
- **C. Benefits to Learners**

III. The Benefit of Confidentiality

- **A. To You**
- **B. For the Study**

IV. The Association of Risk

- **A. Risk Within this Study**

V. Who May be Contacted

- **A. Researcher – Rodney Winkler**
- **B. University – Liberty (see consent form)**

VI. Consent for Study

- **A. Expectations**
  - **1. Attendance**
  - **2. Implementation**
  - **3. Confidentiality Reminder**
- **B. Signing**

VII. The Collaborative Element

- **A. Sharepoint for Participant Sharing**
- **B. Mimio Connect**

Appendix D

Participant Consent Form

Appendix D

Participant Consent Form

Investigating THE IMPACT of INTERACTIVE WHITE BOARD Professional Development on Lesson Planning and Student Math Achievement

Rodney Winkler

Liberty University

College of Education

You are invited to be in a research study on instructional technology in schools. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by: Rodney Winkler, teacher in Target School County and student of Liberty University, Department of Education Doctoral Studies

Background Information

The purpose of this study is: To improve the learning opportunity for students in classes where interactive whiteboards are present focusing on teacher lesson planning and development using interactive technology. Specific features identified in research for lessons utilizing Interactive Whiteboard instructional best practices designed for learning gain will be introduced and used within study implementation during mathematics lessons.

Procedures:

If you agree to a part of this study, we would ask you to do the following things:

Participant teachers will instruct mathematics classes using Interactive White Board (IWB) experimental lessons. Students would continue using adopted lesson materials as usual. The idea is to gather information that relates to the impact that IWB lesson planning has on student learning.

Risks and Benefits of being in the Study

Since this particular research is instructionally based, there is minimal risk involved to participants or their classes. The benefits to participation are that the intent of the data gathered will benefit the greater educational community to better understand the effect technology has on instruction.

Confidentiality:

The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a participant. Research records will be stored securely and only the researcher will have access to the records.

No Names will be shared in the data acquired including names of the district, school or any participants. Information will be coded as Teacher A or student B on all documentation.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the Liberty University or with the participant, Lee County Schools. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:

The researcher conducting this study is: Rodney Winkler. You may ask any questions you have now. If you have questions later, you are encouraged to contact him at Target Elementary, 239.298.9898, rlwinkler@liberty.edu.

You will be given a copy of any information given as a participant to keep for your records.

Statement of Consent:

I have read the above information. I have asked questions and have received answers. I consent to participate in the study.

Signature: ____Date: ___________

Signature of Investigator: _____________________________ Date: _____________

Appendix E

Weekly Teacher Training Reactive Survey

Appendix E

Weekly Teacher Training Reactive Survey

Weekly Session Survey-------------

Please provide your frank reactions and comments in the following questions.

Strongly Agree Strongly

	disagree							agree
1. The material covered in the session was relevant to by job.	1	2	3	4	5	6	7	8
2. The material was presented in an interesting way.	1	2	3	4	5	6	7	8
3. The session handouts or resources will be helpful to me.	1	2	3	4	5	6	7	8
4. The schedule was suitable.	1	2	3	4	5	6	7	8

5. How pertinent was the session content to your instructional needs and interests?

_____ Not at all _____ To some extent _____ Very much

6. Was the content covered in the session thorough enough for you to employ the ideas in the classroom?

_____ Not at all _____ To some extent _____ Very much

7. How was the ratio of presentation to discussion?

_____ Too much presentation _____ Ok _____ Too much discussion

8. Is the classroom mentoring support beneficial to you as a teacher?

_____ Not at all _____ To some extent _____ Very much

9. How can support be improved for your needs?

10. What would make our sessions better suited to meet your goals for learning?

Don’t forget to access the SharePoint IWB project and the online teacher resources!

Appendix F

Observation Checklist

Appendix F

Observation Checklist

Schematic Influencers (Mapped/Planned)

_____Template

_____Acquisition (evidence of saved lesson)

_____Library (evidence of "created" items in the gallery)

_____Capacity* (evidence of stored/retrieved related content)

_____Range* (evidence of content from external resources other than text publishers)

_____Principles of Modality (evidence of multimedia/modal principles in design of lesson)

_____Principle of practice (evidence by segmented lesson format)

_____Linkage (planned visual links to source materials)

_____Dynamism* (animation in lesson, learners manipulation of objects)

_____Automation* (lesson flow has minimum delays-clearing board, organizing materials, etc.)

Inventive Influencers (During Lesson)

_____Capacity*(related content used to differentiate learning/repeating and progressive steps)

_____Range* (lesson is extended-unplanned)

_____Accuracy (tools of drawing/text recognition are used during lesson)

_____Dynamism*/ Simultaneity (use of hide/reveal/things in motion/alternative views)

_____Emphasis (highlighting, circling, annotating, clipping items/objects in content)

_____Modality Principles (evidenced narration w/text or graphics or video alone)

_____Timeliness* (content planned and unplanned)

Constructive Influencers (Promoting Lesson Interactivity and Dialog)

_____Template* (student generated or for impromptu practice)

_____Listing (closure matching or any group problem solving leading to a choice of resources)

_____Edit ability/Transformability (evidence of adapting content or provide for tangents of thought)

_____Feedback (evidence of responding to user input contingently (discussion with activity or annotated save/use of clickers and/or tablets)

*Indicates the feature can be used in the lesson design or inclusive during lesson activities as an adaptive strategy

Observed Lesson Notes:

Appendix G

Teacher Observation Rubric

Appendix G

Teacher Observation Rubric

Teacher Observation Rubric

Observed Interaction	1	2	3	4	Score 1-4
IWB facilitation and Lesson Pedagogy	IWB is a visual aid used for navigation and illustration by teacher - lesson is didactic, remote controlled	IWB content is limited to readily available content. Student participation is encouraged - lesson is graphic	IWB supports learning goals evidenced by non-linear thinking and a wide range of saved resources incorporated - lesson is thought provoking	IWB is fully integrated in learning activity by teacher and/or students. The lesson would require the technology - lesson is adaptive	
Student Role	Students are passive observers- no interactive element included	Students participate in basic questioning and directed IWB functions	Students use the IWB spontaneously and confidently as a learning tool during the lesson	Students are participants in the construction of knowledge and lesson resources (examples)	
Schematic Influencers	Little or no evidence of planned use of an interactive lesson	Some schematic influencers are present in planned lesson	Multiple features are present with linked resources/apps that extend the lesson range.	Lesson is designed specifically for student use without teacher intervention	
Inventive Influencers	No inventive learning influencers are observed in the lesson	Teacher uses an inventive feature in an illustrative lesson	Teacher or students use two particular inventive influencers within a lesson	Teacher or students use three or more inventive influencer features	
Constructive Influencers	No evidence of constructive influencers are included	Teacher works with students in a directed engagement activity as group review/assessment or multi-group input	Teachers and students work together to learn by adding content providing related tangents of thought	Teacher facilitates as students work with content. Student assessment is resource creation-synthesis	

R Winkler

Appendix H

Teacher Interactive Technologies Confidence Scale

Appendix H

Teacher Interactive Technologies Confidence Scale

Teacher Interactive Technologies Confidence Scale

INSTRUCTIONS: Please indicate your opinion about each statement by circling the appropriate response to the right of the statement. Your answers will be kept confidential. The purpose is to determine your level of confidence in carrying out the actions of each statement based upon your current level of experience. Note that Interactive Whiteboard is abbreviated as IWB.

KEY: 1 = Strongly Disagree; 2 = Moderately Disagree; 3 = Neither Disagree or Agree ; 4 = Agree; 5 = Strongly Agree

<u>**I am confident in my ability to**</u>	**Disagree--→--Agree**
use interactive technologies	1 2 3 4 5
construct a notebook or flipchart lesson	1 2 3 4 5
apply the contiguity principle to text and graphics	1 2 3 4 5
facilitate class discussions using an IWB	1 2 3 4 5
Locate external resources for preparing math lessons	1 2 3 4 5
teach math as a co-inquirer of knowledge with students	1 2 3 4 5
use a variety of assessment techniques using clickers or an IWB	1 2 3 4 5
evaluate students using interactive tools	1 2 3 4 5
facilitate class discussions using an interactive tablet	1 2 3 4 5
design IWB lessons to target the academic needs of my students	1 2 3 4 5
adapt the activity during a lesson to facilitate discussion	1 2 3 4 5
select appropriate graphics for interactive teaching	1 2 3 4 5
create integrated interactive lessons and units	1 2 3 4 5
construct student-centered (learning center) activities using an interactive board or tablets	1 2 3 4 5

teach a lesson on place value or basic fractions using an IWB	1	2	3	4	5
manage an interactive lesson led by students	1	2	3	4	5
use cooperative learning approaches using interactive tablets or clickers	1	2	3	4	5
build learning in math on children's intuitive understanding or prevailing current-day examples	1	2	3	4	5
use media to support teaching and learning	1	2	3	4	5
apply multimedia principles in teaching to increase coherence	1	2	3	4	5

Appendix I

Generalized Teaching Confidence Questions

Appendix I

Generalized Teaching Confidence Questions

Table 14

Generalized Teaching Confidence Questions

Generalized Teaching Confidence Questions						
I am confident in my ability to:		Sum of Squares	df	Mean Square	F	Sig.
locate external resources for preparing math lessons	Between Groups	13.174	1	13.174	12.600	.002
	Within Groups	17.774	17	1.046		
	Total	30.947	18			
teach math as a co-inquirer of knowledge with students	Between Groups	10.917	1	10.917	8.547	.009
	Within Groups	21.714	17	1.277		
	Total	32.632	18			
adapt activities during a lesson to facilitate discussion	Between Groups	6.018	1	6.018	4.721	.044
	Within Groups	21.667	17	1.275		
	Total	27.684	18			
build learning in math on children's intuitive understanding with current day examples	Between Groups	9.023	1	9.023	9.761	.006
	Within Groups	15.714	17	.924		
	Total	24.737	18			

Appendix J

Basic Skills Confidence Questions

Appendix J

Basic Skills Confidence Questions

Table 15

Basic Skills Confidence Questions

Basic Skills Confidence Questions						
I am confident in my ability to:		Sum of Squares	df	Mean Square	F	Sig.
use interactive technologies	Between Groups	14.667	1	14.667	15.619	.001
	Within Groups	15.964	17	.939		
	Total	30.632	18			
construct a flipchart lesson	Between Groups	17.684	1	17.684	25.053	.000
	Within Groups	12.000	17	.706		
	Total	29.684	18			
facilitate class discussions using an IWB	Between Groups	8.724	1	8.724	9.643	.006
	Within Groups	15.381	17	.905		
	Total	24.105	18			
facilitate class discussion using an interactive slate	Between Groups	16.647	1	16.647	17.941	.001
	Within Groups	15.774	17	.928		
	Total	32.421	18			
create integrated interactive lessons and units	Between Groups	8.001	1	8.001	9.296	.007
	Within Groups	14.631	17	.861		
	Total	22.632	18			
teach a lesson on place value or basic fractions using an IWB	Between Groups	10.753	1	10.753	11.588	.003
	Within Groups	15.774	17	.928		
	Total	26.526	18			

Appendix K

Advanced Application Confidence Questions

Appendix K

Advanced Application Confidence Questions

Table 16

Advanced Application Confidence Questions

Advanced Application Confidence Questions						
I am confident in my ability to:		Sum of Squares	df	Mean Square	F	Sig.
apply the contiguity principle to text and graphics	Between Groups	15.642	1	15.642	17.615	.001
	Within Groups	15.095	17	.888		
	Total	30.737	18			
use variety of assessment techniques using clickers or IWB	Between Groups	3.812	1	3.812	2.426	.138
	Within Groups	26.714	17	1.571		
	Total	30.526	18			
evaluate students using interactive tools	Between Groups	8.001	1	8.001	8.178	.011
	Within Groups	16.631	17	.978		
	Total	24.632	18			
design IWB lessons to target the academic needs of students	Between Groups	5.303	1	5.303	4.424	.051
	Within Groups	20.381	17	1.199		
	Total	25.684	18			
select appropriate graphics for interactive teaching	Between Groups	5.774	1	5.774	5.206	.036
	Within Groups	18.857	17	1.109		
	Total	24.632	18			
construct student-centered activities using an IWB or slate	Between Groups	12.281	1	12.281	12.526	.003
	Within Groups	16.667	17	.980		
	Total	28.947	18			

manage an interactive lesson led by students	Between Groups	3.524	1	3.524	2.386	.141
	Within Groups	25.107	17	1.477		
	Total	28.632	18			
use cooperative learning approaches using interactive technologies	Between Groups	8.001	1	8.001	7.300	.015
	Within Groups	18.631	17	1.096		
	Total	26.632	18			
use media to support teaching and learning	Between Groups	6.018	1	6.018	5.202	.036
	Within Groups	19.667	17	1.157		
	Total	25.684	18			
apply multimedia principles in teaching to increase coherence	Between Groups	13.356	1	13.356	11.715	.003
	Within Groups	19.381	17	1.140		
	Total	32.737	18			