A STUDY OF THE EFFECT OF INTERACTIVE WHITEBOARDS ON STUDENT ACHIEVEMENT AND TEACHER INSTRUCTIONAL METHODS

by

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ABSTRACT

CHERYL LEE LUTZ. A study of the effect of Interactive Whiteboards on student achievement and Teacher Instructional Methods. (Under the direction of DR. JOHN GRETES)

Students today are digital natives. They grow up immersed in technology long before they set foot in the classroom. They are connected to the entire world through television, the internet, and a myriad of personal devices in electronic and digital format. Classrooms equipped for the 21st Century demand curriculums that integrate technology resulting in high standards, high expectations, and high results. With this in mind, teachers must acknowledge how students learn today and find every possible way to teach children and improve learning.

Using mixed method design investigation, the researcher examined the effect of interactive technologies, specifically interactive whiteboards (IWBs), on student scale scores in the classroom and on the instructional methods of teachers. The sources of data included large-scale standardized test scores for 13861 students in grades three, four, and five, covering two academic years, were analyzed to investigate whether the interactive whiteboard made a difference on student achievement in math and reading. Teacher focus groups were used to gather information from 44 teachers on whether interactive whiteboards had an effect on their instructional methods.

Results of the analysis of covariance indicated statistically significant differences in Math and Reading in grades three and five in classrooms that used IWBs for instruction. There was not a significant difference in either subject in grade four. From these results, the researcher concluded classrooms that used an IWB may have improved

the achievement levels of students in Reading and Math. In addition, teachers in classrooms that regularly used an interactive whiteboard for instruction participated in focus groups to determine whether interactive whiteboards influenced their instructional methods. Focus group summaries indicated teachers unanimously agreed that use of the IWB made a difference in their instructional methods. IWBs allow for increased student engagement and make instruction more exciting. The results of the study will lay the groundwork for standardized technology integration in academic classrooms for 21st Century instruction in a rural county school system in the Southeast.

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"A hundred years from now, it will not matter what kind of car I drove,
what kind of house I lived in, how much money I had in the bank...
but the world may be a better place because I made a difference
in the life of a child." (1987, Witcraft)

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CHAPTER 1: INTRODUCTION

Children in today's elementary schools do not know a world without cell phones, computers, and the internet. Technology has revolutionized our society and made every corner of the world accessible for students and teachers. It has the capability of transforming the learning process in the classroom through educators who can integrate it effectively and efficiently within their curricula. Knowlton states "Today's students expect to experience their lessons, and it is perhaps their preferred mode of learning" (Knowlton, 2006, p.1). Students in classrooms today have different expectations than previous generations. Students need to be prepared for a future that requires a different set of skills and technology has to be assimilated.

As technology drives the workforce in the 21st Century, all phases and stages of education must adjust. Children are growing up immersed in technology long before they set foot in the classroom. They are connected to the entire world through television, computers, and a myriad of personal devices in electronic and digital form (Prensky, 2008). The North Carolina State Board of Education has addressed the need for preparing students for the technology focused job market by affirming that every public school student will graduate from high school, globally competitive for work and postsecondary education and prepared for life in the 21st Century (NCDPI, 2002). With this information in mind, one could surmise that teachers acknowledge today's students grow up differently and learn differently and that we must find every way possible to teach

children and improve learning. While chalkboards, whiteboards, and overhead projectors still exist in numerous classrooms, they are losing their status as the classroom focal point. School districts are investing hundreds of thousands of dollars in technology in order to modernize classrooms and utilize every means available to advance student achievement. From interactive whiteboards (IWBs) to handheld tablets, from student response systems to mini video cameras, the most successful of these technology products are those that can grab student attention and capture learning in new and productive ways in order to service all types of learning. Classrooms preparing for the 21st Century must become innovative, interactive, and equipped with technology that offers numerous avenues for instructional methodologies. Technology can help provide an enriched environment that allows the teacher to better facilitate learning and instruction (Kennedy, 2008).

Need for Research

The National Academy of Sciences states that 26% of US teenagers spend between one and two hours online every day. Statistics also indicate that children prefer to learn in a visual classroom and like to have information available at their fingertips (Villano, 2006). Prensky adds "thanks to technology, kids in developed countries grow up knowing about, or being able to find out about, pretty much anything from the past or present that interests them. Google, Wikipedia, youtube, and millions of reference sites stand at their beck and call" (Prensky, 2008, p. 41).

Teachers are turning to technologies, specifically IWBs, which can provide a variety of tools and do multiple things. The more a student participates in classroom instruction, the more likely that student is to absorb and internalize the material being

taught. When teachers teach in ways that students learn in today's digital age, students are much more engaged in the lesson content and are more interested in the information. There is much excitement concerning IWBs and their ability to engage children. "Educators say it's important to incorporate technology into the lower grades because most children entering school today are "Internet natives" - they have always had technology at home and have come to expect it wherever they go. Schools need to adapt and give students a multimedia experience" (Wong, 2010).

Purpose of the Study

This study used mixed methods design investigation involving both quantitative and qualitative components. It was designed to examine the effect of interactive technologies, specifically interactive whiteboards (IWBs), on student End-of-Grade (EOG) scale test scores in the classroom and on the instructional methods of teachers. Data analysis was done sequentially and examined the effect of IWBs on two outcomes, student scale scores (EOG) and teacher instruction. The results of the study will lay the groundwork for standardized technology integration in academic classrooms for 21st Century instruction in a rural county school system in the Southeast. Mixed methods research is becoming more popular and may be considered as justifiable research (Creswell, 2002, 2003). It can be defined as "the collection or analysis of both quantitative and qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of the data at one or more stages in the process of research" (Creswell, Plano Clark, Gutnam, & Hanson, 2003, p. 212).

The quantitative section of this study investigates the effects of IWBs on student scale scores in grades three, four, and five through comparisons of Math and Reading End-of-Grade (EOG) standardized test scores as published by the North Carolina Department of Public Instruction. North Carolina EOG Tests are curriculum based multiple choice assessments for grades three through eight in the areas of Math and Reading. These tests are specifically aligned to the North Carolina Standard Course of Study and measure the achievement level of North Carolina students. Standardized EOG scale scores fall within four levels of achievement. Achievement levels relate a common meaning as to what is expected at various levels of competence in each subject area. EOG assessments are given during the last three weeks of school and are administered to all students at the same time on the same days. The North Carolina EOG scale scores are used to assess a student's knowledge of subject content including the student's mastery of the content material as stated in the goals, objectives, and grade level competencies of the North Carolina Standard Course of Study (NCDPI, 1999).

The school system used for this study has 16 elementary schools and two intermediate schools that house third, fourth, and fifth graders. The Accountability Department of this rural county in the North Carolina used the ten categories of "No Child Left Behind" to demographically compare all 18 schools End-of-Grade (EOG) test scores. Three categories emerged that resulted in similar demographics among this county's elementary and intermediate schools and those categories were African-American enrollment, socio-economic status reflected in free and reduced lunch percentage, and Exceptional Children enrollment.

The qualitative section of this study investigates how interactive whiteboards influence the instructional methods of teachers through a series of focus groups. The purpose of a focus group is to not only listen but to gather information, gather opinions, interview, and share perceptions of the topic at hand (Lutenbacher, Cooper, and Faccia, 2002). Focus groups develop and create information on attitudes and values, and can provide relevant substance on a particular experience or program. It is a collection of qualitative data from people who share a common interest involved in a group focused discussion (Krueger, 2009).

The teacher population for the qualitative part of the study included 44 third, fourth, and fifth grade teachers that had used the IWB for at least one academic year. The focal point of the focus groups was instructional methodology and how the IWB made instruction different in the classroom. The 44 teachers' student test scores ranged from the highest to the lowest in the school system. Focus group sessions were recorded and digitized for later analysis.

For analyzing focus group data, this researcher used the process of coding responses through the common themes of instructional methodologies. The first and second rounds of coding the digitized transcripts occurred through a comparison of reoccurring themes. Subsequently, codes that were not consistent throughout the focus group sessions were removed. This process provided the researcher with a master list of codes on which to base analysis.

Statement of the Research Problem

The focus of this research was an analysis of the use of IWBs in elementary schools. Achievement is a student's level on EOG scale scores as defined by the state of North Carolina. The researcher addressed the following questions:

1. Are there differences between classrooms that use IWBs and those that do not use IWBs in third, fourth, and fifth grade students' Math and Reading scale scores?
2. How has instruction in the classroom changed by using an IWB?

One such technology making its way into classrooms all across the nation is an interactive white board (IWB), a touch sensitive screen that works in conjunction with a computer and projector to allow digitizing media through the use of a stylus or even the finger of a child. IWBs can be portable or permanently affixed in the classroom. A typical setup includes the touch sensitive board, computer, LCD projector, and interactive software. The first interactive whiteboard was manufactured by SMART Technologies, Inc. in 1991 (Knowlton, 2006).

The IWB offers several features which make it particularly useful for classroom instruction: (1) The IWB enables teachers the flexibility of projecting a computer image onto a screen and making additions or corrections to the projected image and to save for future reference, enhancing the achievement opportunity for students, or the opportunity for remediation. A positive attribute of an IWB is the ability to control a computer from a touch of the board (Smith, et al., 2005). The teacher has the ability to flip from one screen to another, one document to another, and/or one software application to another. As one

teacher puts it, “I can see much more evidence of learning carried from one lesson to the next because of the ability for reinforcement on the fly” (Smith, et al., 2005, p. 92).

(2) The second avenue for teacher instructional methods and IWBs is efficiency. Students who find it difficult to manipulate a mouse and keyboard find it much easier to work with an IWB. Smith reports that students who lack some fine motor skills find working with the IWB to be much more forgiving and easier to work with lessons and activities (Smith, et al., 2005). Teachers have the capability to develop lessons integrated with multiple types of resources and save those lessons complete with notations, on their computer for reference later on during the day, week, month, or year. Teachers can use IWBs to adapt materials for students of all learning needs through numerous ways such as resizing text and graphics, converting handwriting to text, adjusting brightness and darkness and using the board to integrate videos, enlarging any image that is viewed on the screen of a computer (Knowlton, 2006). Teachers and students can use the stylus or a finger to click on the board and interact as one would on a touch screen. This type of interactivity lends an instructional opportunity not offered by any other presentation device.

Further support for IWBs comes from research conducted by Dr. Mary Ann Bell in which she explains how IWB users can control software from either the IWB or a computer and through the use of a finger or stylus; the teacher can use the IWB for presentations, demonstrations, highlights, and notations to any number of applications (Bell, 2002). Thousands of interactive whiteboards have been installed in K-12 classrooms, colleges and universities throughout the United States (Kennedy, 2008).

When IWBs were first introduced, one was placed in a classroom in Ontario, Canada. A technology consultant wrote “Hello, class” on the board and converted his handwriting to text and the class fell silent, awed by this introduction (Starkman, 2006). According to Futuresource Consulting, about 20% of K-12 classrooms have an IWB with 300,000 IWBs sold in 2008 (T&L Editors, 2009).

Many research projects with IWBs have reported positive results with regard to student achievement. IWBs assist learning in ways that raise levels of student engagement, motivate learning, and promote enthusiasm for learning, and, they can effectively be used to reach students with all levels of learning styles (Hall, 2005). One such IWB is the SmartBoard, an interactive whiteboard developed by SMART Technologies in 1991. The system is comprised of an interactive whiteboard, a computer and a projector connected wirelessly or via cables. Use of the projector allows the computer desktop to be projected onto the board and then acts as a monitor and an input device. The board reacts to touch from a finger or stylus and converts that information into a mouse click or digital information (Knowlton, 2006).

IWB and Student Achievement

Anything that can be viewed on the screen of a computer can be displayed using an IWB. Teachers that use IWBs during instruction have the potential to enable the learning needs of all students by keeping them engaged throughout the learning process. This type of instruction can allow for the entire class or small groups to see what is being displayed and interact with the presentation. Much of the popularity comes from the idea that using an IWB in the classroom levels the playing field for students and teachers. It allows both sides to use technology in a way that is equally comfortable to them

(O'Hanlon, 2007). Three broad categories emerged from research regarding IWB and student achievement that can be categorized into types of learning needs. The first avenue for student achievement and IWBs is visual learning. Visual learners can easily see colors, objects that are in motion, diagrams, charts, and anything else that can be displayed on the computer can be displayed on an IWB (Knowlton, 2006). Students who learn better visually can have their learning process improved through the use of an IWB by enabling them to become better organized and process information easier. Visuals can also be utilized to challenge students to think on levels that require higher order thinking skills (Beeland, 2002).

Students with these types of learning needs can see what is taking place as it develops during instruction. IWBs make it easy for teachers to integrate their instruction by using all kinds of resources in a lesson. Pictures from the internet, graphs from a spreadsheet, presentations from any lesson, and videos are all available at the resourcefulness of the teacher's imagination. Even with all these resources available, students and/or teachers can make notations on top of any display and that information can be saved and referred to as often as needed. Using a bright, colorful device in the classroom provides greater opportunities for maintaining attention and engagement between students and the curriculum (Tanner, 2007). All children can improve their learning but especially children with poor concentration particularly benefit from the extra visual stimulation.

The second avenue of learning that presents itself as a benefit of the IWB are those children who learn better with auditory instruction. The IWB offers multimedia experiences through resources that engage the student in verbal reinforcement, group

activities, and class discussions. IWBs can utilize activities that promote auditory leaning by involving sound effects, speeches, videos, poetry, and even music to help encourage group interaction (Bell, 2002). All these activities support the student that learns best by hearing and participating in whole class or small group activities. The student receives immediate feedback and frees the student up from note-taking.

The third avenue of learning that presents itself as a benefit of IWBs is kinesthetic. Students can interact with the board and explore instruction by moving letters, numbers, words, graphs, pictures, and objects with just the touch of a finger. This type of instruction works best for students who need hands-on activities for facilitation of learning (Bell, 2002). Instruction becomes active and interactive and can hold the attention of students who learn best by participating in the lesson. When teachers give their students opportunities to get away from their desks and touch or write on the IWB, the opportunity for retention is greater (Knowlton, 2006).

From these three areas, IWBs can help stimulate visually, auditorily, and kinesthetically to reach different levels of student learning. The IWB has the flexibility to engage students of different learning needs.

IWB and teacher's instructional methods

Technologies like the IWB allow teachers to start integrating technology into their instructional methods as a way of adding flexibility and efficiency to their instructional practices. Typically, teachers will utilize this technology standing at the board and using it with technologies previously learned such as Interactive whiteboard software, PowerPoint, or an internet website, until a comfort level is reached. As they become more comfortable with the IWB they begin to place emphasis on the interactivity and allow students to come to the board and manipulate the information. Being able to involve the

entire class enables the teacher to capture students' interests and makes information more visually understandable (Blanton, 2008).

British Educational Communications and Technology Agency (Becta, 2003), found students are more motivated in classrooms where IWBs are because of the high level of interaction the board presents through manipulation of text and graphics. They also say that the board offers more opportunities for integration and discussion among students of all learning needs. Finally, the most widely mentioned advantage of the IWB and teachers attitudes of student learning can be related to the motivation of students because the lessons are more enjoyable and interesting resulting in better attention and behavior (Beeland, 2002).

Now, more than ever, technology, specifically IWBs, can be integrated into the curriculum and used easily by teachers that have been hesitant to try new forms of interactive teaching. In addition, teachers suggest that the benefits of IWBs include more time on task for students, clearer lesson presentations, and better organization of instructional materials, wide variety of resources, and the ability to modify lessons with ease (Bell, 2002).

Significance of the Study

Many students entering our classrooms today must "power-down" and revert to learning the same way their parents did many years ago (Kennedy, 2008). Chalkboards, overhead projectors, and lectures are instructional methods still being used in schools all across our state and nation. The findings of this study will add to what is already known about the extent to which IWBs result in increased student scale scores as well as improved teacher instructional models that address all types of learning needs. The

findings should be useful to parents, school administrators, Boards of Education, and classroom teachers as they lay the foundation for implementation of technology within 21st Century classrooms.

Delimitations and Limitations

The study was completed in a single rural school district in western North Carolina.

- Third, fourth, and fifth grade Math and Reading EOG scale scores on statewide assessments, and teacher focus groups were included in statistical comparisons.
- EOG scale scores fall within four levels of achievement as described by North Carolina Department of Public Instruction (NCDPI, 1999).
- The educational background and professional preparation of the teachers will not be included in statistical comparisons.
- The number of years and types of teaching experience will not be included in statistical comparisons.

The study used extant data and will not include a randomly assigned treatment. The following additional limitations are acknowledged:

- The research data collection was limited to 16 elementary and two intermediate schools in one rural county school system in North Carolina.
- The quantitative data collection included 13861 End-of-Grade (EOG) standardized test scores.
- The qualitative data collection included 44 teachers in one school district that used IWBs for instruction and had used the IWBs at least one academic year.

- The focus group responses of the teacher participants involving technology integration of instruction, specifically IWBs, was digitized, coded, and conducted by the researcher.

Assumptions

The research is a quasi-experimental comparison of existing conditions in a single school district. The researcher has made the following assumptions:

- A series of focus groups were used to collect information on the instructional methods of teachers and how they address student learning.
- The researcher acknowledges differences in the preparation of teachers instructional methods based on number of years of teaching experience.
- The researcher acknowledges differences in the amount of professional development teachers have received in use of the IWB.
- The researcher acknowledges a difference in the amount of time teachers have been using the IWB during instruction, however, all participants have used the IWB for at least one academic school year.

Definition of Key Terms

ActiveBoard: A brand of interactive white board.

End-of-Grade (EOG) Standardized Tests: Scale score assessments administered at the conclusion of each academic school year in grades three through eight that are designed to measure student performance on the goals, objectives, and grade-level competencies specified in the *North Carolina Standard Course of Study* (NCDPI, 1999).

End-of-Grade (EOG) Achievement Levels: Four levels that EOG standardized tests fall within as specified by North Carolina Department of Public Instruction (NCDPI, 1999). score ranges (Levels I, II, III, or IV) reported for EOG student performance, with III and IV used to reflect proficient or above, that a student is prepared for school work at the next grade level (NCDPI, 1999).

Interactive white board: An electronic touch-sensitive display that connects a computer and digital projector and allows users to control applications, write notes in digital ink and save work for sharing later (Knowlton, 2008).

Mimio: A brand of interactive white board.

Proficient: Term used to indicate EOG composite Reading and/or Mathematics combined scores for grades three through eight at or above Achievement Level III (NCDPI, 1999).

Promethean Board: A brand of interactive white board.

Standardized Scores: Scale student scores on EOG assessments (NCDPI, 1999).

SmartBoard: A brand of interactive white board.

Student Achievement: Performance on EOG assessments (NCDPI, 1999).

Technology Integration: Using computers and technology tools in conjunction with educational resources and curriculum objectives to actively engage students in the process of learning (NCDPI, 1999).

Summary

In summarizing the influence of IWBs on students and teachers, technology has the capability of transforming the learning process in the classroom through educators who can integrate it effectively and efficiently within their curricula. Knowlton states

"Today's students expect to experience their lessons, and it is perhaps their preferred mode of learning" (Knowlton, 2006, p.1). The following questions guided the data collection and analysis of both the quantitative and qualitative sections of this research:

1. Has student scale scores changed by using an IWB for instruction?
2. How has instruction in the classroom changed by using an IWB?

The effective use of technology affects performance from students by allowing them to access and analyze information, problem solve, communicate and collaborate their thoughts and ideas with others. Through the integration of technology students emerge as self-directed, self-motivated, lifelong learners, productive members of society, and contributing citizens (Florida Department, 2000).

The dissertation representing this work is organized and reported in five chapters. Chapter One introduces the topic that will investigate the use of IWBs on the math and reading scale scores of students as evidenced by Math and Reading EOG scale scores in classrooms in which teachers use IWBs for instruction. Local data was used from the 2007-2008 and 2008-2009 academic years of EOG scale scores in grades three, four, and five. Data from focus groups involving 44 teachers were examined to determine the difference in the technology integrated instructional methods of teachers in classrooms that use IWBs. Finally, Chapter One also includes support for the need for the study, a statement of the problem, a description of the purpose of the study, the significance of the study, and research questions as well as the delimitations, limitations, assumptions, and definitions of terms.

Chapter Two provides a comprehensive review of the literature pertaining to IWBs and how they have been used in educational settings and studies around the world.

The literature review examines the classroom practices of teachers who have been provided an IWB for instruction and how the IWB has affected scale scores in reading and math. The review is divided into six concepts: Interactive Whiteboards and Learning Styles, Children and Technology Today, History of Classroom Boards, Interactive Whiteboards, Interactive Whiteboard and Student Achievement, and Interactive Whiteboard and Teacher's Instructional Methods.

CHAPTER 2: REVIEW OF RELATED LITERATURE

The purpose of this chapter is to examine literature relevant to IWBs and the effect on students' math and reading scale scores along with teacher's instructional methods in classrooms that have IWBs. These two concepts are broken down into six categories: Interactive Whiteboards and Learning Styles, Children and Technology Today, History of Classroom Boards, Interactive Whiteboards, Interactive Whiteboard and Student Achievement, and Interactive Whiteboard and Teacher's Instructional Methods.

With today's rapid advancements in technology, classrooms need to evolve into the 21st Century to meet the challenges of students' needs and learning styles. Technology is now seen as a means of effective communication and a way in which teachers and students can take control of instruction and learning. The Horizon Report (2009) states "technology skills are critical to success in almost every arena, and those who are more facile with technology will advance while those without access or skills will not. The digital divide, once seen as a factor of wealth, is now seen as a factor of education: those who have the opportunity to learn technology skills are in a better position to obtain and make use of technology than those who do not" (The Horizon Report, 2009, p. 6). With over a million IWBs being used in classrooms all over the world, the interactive whiteboard is here to stay (Knowlton, 2008). IWBs have many advantages for both students and teachers. They provide an avenue for activities that are

highly visual and engaging for today's technology savvy student and offer the ability for integration of multimedia in the instructional methods of teachers (Knowlton, 2008).

Interactive Whiteboards and Learning Styles

The Visual-Auditory-Kinesthetic learning styles model, commonly called VAK (Chapman, 2005) was first developed by Fernald, Keller, Orton, Gillingham, Stillman, and Montessori, in the 1920's. It has become popular with learning communities as a perspective for explaining how students understand and learn. Carbo, et al., (1986) documented that approximately 20 to 30 percent of the school-aged population remembers what is heard; 40 percent recalls well visually the things that are seen or read; and many must write or use their fingers in some manipulative way to help them remember basic facts. During the 1960s, Edgar Dale theorized that learners retain more information through a "direct purposeful experience" as opposed to listening, reading, or observing. His research led to the development of the "Cone of Experience" (Dale, 1969). Dale suggests that involving students in the instructional method strengthens their knowledge retention and provides activities that build on real-life experiences.

Everyone has their own "style" for learning information and converting it into useful knowledge. With this in mind, teachers should design instruction that addresses the different styles of learning in order to provide the opportunity of achievement for all students (Illinois Online Network, 2009).

Of the many resources of technology available to teachers today, IWBs may provide a significant potential for meeting the needs of all students. Farwell (2009) found that auditory learners tend to learn best using traditional teaching methods. These students experience achievement when they can hear directions or when information is

presented verbally using back and forth conversation. Voice tone, inflection, and body language are all ways a teacher can make sure auditory learners have opportunities to experience success in the classroom. Visual learners tend to learn best by seeing representations of the lesson. Diagrams, charts, pictures, video, written directions, homework trackers, and presentations are ways a teacher can make sure visual learners are most successful. Kinesthetic learners tend to learn best by experiencing, touching, or feeling classroom instruction. These students are most successful when they can engage in their learning activity and have hands-on opportunities (Farwell, 2009).

While most students use parts of all three styles for receiving information, one or two of these styles is dominant. This dominant style is the best way for students to retain new information. Stanford University professor Eliot Eisner (Walling, 2006) states that teachers who are successful during instruction are those that can adapt their teaching strategies to teach all students. When teachers understand how their students learn best, their instruction will bring out the best efforts of students (Walling, 2006). Scientific theorists believe the human brain differentiates stimuli well enough to understand the best way a student learns. If teachers want students to learn, it is necessary for them to develop instructional strategies that will match students' learning styles (Farwell, 2009). According to Glover and Miller (2002), there are three elements in effective teaching: verbal, visual, and kinesthetic learning styles and using an IWB supports all three of these elements. Technology, specifically IWBs, is one avenue that can assist teachers with instruction and can satisfy all learning styles. When students have opportunities to learn in classrooms that use technology, specifically IWBs, students are more engaged in the lesson content and comprehend more information.

Interactive resources are in demand for teachers who want to involve all students with technology. Bell (2002) endorses the use of the IWB as a means of providing an instructional tool in the classroom to accommodate different learning needs with research that indicates students respond to the color and interaction the board provides. Students who learn from touching can benefit from marking at the board. Audio learners benefit from the class discussions the board can initiate, and visual learners see what is taking place during the lesson. According to Bell (2002) the IWB is a powerful instructional tool that can be implemented within a wide range of subjects and is advantageous for students of all ages. As teachers continuously strive to develop instructional strategies and tools, IWBs enable teachers to draw from whichever resource is needed for any particular student's learning style (Glover & Miller, 2002; Bell 2002).

Children and Technology Today

Technology has revolutionized our society and made every corner of the world accessible for students and teachers. Children can be connected to technology round the clock and are seldom far from personal devices such as cell phones and mp3 players. With the availability of the internet, children can get the answers to anything they want to know or are interested in. Google, Wikipedia, and millions of resources are within their reach anytime and anyplace (Prensky, 2008).

In 2005, 94% of public school classrooms were connected to the Internet, according to the National Center for Education Statistics (NCES, 2000). Of the schools connected, 97% had fast access through broadband connections (Kennedy, 2008). Reasoning behind the push for technology advancements was the availability of educational improvement and student achievement. It gave students and teachers access

to an unlimited amount of information and research. With the availability of new resources of information, teachers wanted a way to display it and the solution of the IWB was founded (Knowlton, 2006).

Students today have grown up with various media devices which they rely upon as their source of information. By the time they reach school age, they have seen a great deal of the world through television, the Internet, online discussions, and social networking (Prensky, 2008). The world is not unknown and unreachable to them and they come to school ready to broaden their thoughts, ideas, and opinions of the world around them.

Some people still harbor the belief that what worked for their education should be good enough to educate our students today. Zevenbergen (2008) states the IWB will further distance children's education from their parent's education. The problem with this line of thinking is that the world has changed dramatically and students today have different expectations and different challenges than what parents faced as children. Students today consider themselves to be a technology generation and are more motivated by technology resources that make the instruction modern and entertaining (Tanner et al., 2007). Classrooms need to focus on developing 21st Century skills that allow students to interact with learning and utilize the skills they have developed throughout their young life, that offer collaboration and multi-tasking opportunities (Knowlton, 2006).

According to the National Academy of Sciences, children prefer to learn through a myriad of visual venues especially those available on the Internet (NAS, 2007). However, schools have not completely bridged the divide between instruction and the

21st Century. “Whenever I go to school, I have to power down” says one student (Prensky, 2008, p. 42). Students are becoming bored with learning the way their parents learned. Schools are lagging behind in technology integration. We have to do a better job preparing classrooms and teachers for instruction that reaches all levels of student learners. As part of the National Education Goals and America 2000, the US Department of Education believes all children deserve an equal opportunity to learn and that we must work to improve these opportunities for all children (Knowlton, 2006).

Teachers need to find ways to make education relevant to students. According to Marc Prensky (2008), four important practices can help.

(1) *Give students the opportunity to use technology in school*. Allow students to use tools and resources that will enable them to find information and create products that enhance the technology skills they already possess. When students are allowed these skills, students are more engaged and produce better results.

(2) *Find out how students want to be taught.* This means getting to know your students and engaging in dialog with each one. Students like having goals they can reach. Allowing them to be involved with setting goals rather than being told what to do gets them listening and contributing.

(3) *Connect students to the world*. Provide opportunities for communication to other parts of the world through video, research, and text messaging.

(4) *Understand kids are preparing for the 21st Century*. Students are being educated today for jobs and technologies that don’t yet exist, in order to solve problems we don’t know are even problems yet (Fisch, 2007). Covering the

material and preparing students for the test is not preparing them for the future. Educators have to integrate classrooms with technologies that work.

History of Classroom Boards

During the past 20 years, technology has begun to create major changes in classrooms all across our Nation. It has been most instrumental in converting classrooms from visions of straight rows of desks and chairs into clusters or pods of tables and chairs. Looking back to the early classroom, James Pilliams is credited with the invention of the blackboard to teach geometry in Scotland (Ergo In Demand, 2008). In 1801 George Baron introduced the blackboard to his students at West Point Military Academy and by the middle of the century blackboards were a staple in almost every school classroom. Slate gave way to boards manufactured with steel and covered with porcelain enamel in the 1960s and green colored Chalkboards were the single most instrumental educational tool a teacher had in the classroom (Ergo in Demand, 2008). In the mid 1990s, chalkboards evolved into whiteboards and classrooms have not been the same since (CNN, 2002).

For almost 200 years, classrooms remained unchanged and instruction was centered on the chalkboard. With more and more information becoming readily available from the Internet, more and more teachers want the ability to display that information. Then in 1991, David Martin, founder of Smart Technologies introduced the first interactive whiteboards, called the SmartBoard, (Knowlton, 2006). An interactive whiteboard (IWB) enables the user to project the image from a computer onto a screen and use a stylus, a pen, or the finger of a child, to add information to the projected image (Kennedy, 2008).

Interactive Whiteboards

The previous categories have concentrated on technology and children today along with how technology can assist in meeting the needs of students with different learning needs. The remaining categories of this review will focus on the specific use of the IWB for student achievement and for assisting in teacher instruction. This section will describe the IWB and how it made its way into 21st Century education.

Classrooms must be innovative, interactive, and equipped with technology that offers numerous avenues for the learning needs of all students. One such technology making its way into classrooms all across our schools is the interactive whiteboard. An interactive whiteboard (IWB) is a touch-sensitive board that controls a computer and shows the image from the computer onto a board. An IWB allows a teacher or student the ability to interact with images, highlight, edit, modify, write notes, add sound, add video, and save files for continual usage (Ansell, 2003).

The basic setup for an IWB requires three components: a computer, a data projector and the IWB. Operation includes simply touching the board and students have access to any computer application, the Internet, or any multimedia platform from CDs or DVDs. Teachers and students can write over, edit, print, and save any changes made to the document or application for remediation or for future reference. Children are immediately engaged and are offered the opportunity to experiment and explore a newer level of instruction (Knowlton, 2008). Using bright and colorful dynamics, IWBs provide the opportunity for increased attention levels and sustained engagement that not only motivates the student but motivates the teacher as well. The result offers the potential for greater interaction, more student involvement, and a higher degree of understanding by

all students in the classroom (Tanner, 2007). Gerard and Widener (1999) report that IWBs support interaction, stimulates conversation in the classroom, and helps with the presentation of new cultural elements.

IWBs enable teachers to deliver instructional lessons that are streamlined, correlated to the curriculum, and integrated with multimedia and Internet resources. Teachers are not using the old school style of chalkboard and chalk but instead are using lessons that engage learning and offer lessons that are more interesting, more motivating, and provide solutions for all students regardless of their learning style, visual, auditory, or kinesthetic. Some students are visual learners while some students are auditory learners. IWBs can provide instructional lessons that are visually engaging and can also provide the ability to integrate pictures, videos, images, and diagrams along with a variety of multimedia resources that enriches the learning opportunity for students (Knowlton, 2008).

Even though IWBs have been around for several years, the United States lags behind when compared to the United Kingdom. Approximately 75 percent of all classrooms in the United Kingdom have IWBs and they have been utilizing this technology almost since the production of the boards. Former Secretary of State for Education and Skills in the UK, Charles Clarke, is quoted as saying “every school of the future will have an interactive whiteboard in every classroom, technology has already revolutionized learning” (Smith, 2005, p. 91). Between 2003 and 2004, Secretary Clark provided £50 for the purchase of IWBs in the schools of England.

Decision Tree Consulting (DTC) has been tracking the interactive whiteboard market worldwide since 2001. The company's senior consultant, Colin Messenger,

predicted interactive whiteboards would be a $1 billion market by 2008. According to DTC, there are over 1.2 million boards installed, and that number is expected to grow to 5.3 million by 2011 (Ankeney, 2007). The reason for this low percentage, according to David Martin, executive chairman of SMART Technologies, is due to the localized spending of education dollars in the United States. Education is financed based more on what schools need from a local vision rather than from the federal government or state level (Ankeney, 2007).

Interactive Whiteboards and Student Achievement

Anything that can be viewed on the screen of a computer can be displayed using an IWB. A study conducted by Zevenbergen and Lerman (2008) investigated IWBs and other computer technologies. The goal of the study was to present ways in which pedagogies were used to support IWBs in classes compared to classes that were using other computer technologies. Forty-five classrooms using computer technologies and 15 classrooms using IWBs participated in the study over a three year period. Data collection was through video recordings of the lessons and by analyzing the lessons in terms of the pedagogies being used by the teachers. There were four dimensions within the framework: Intellectual quality, relevance, supportive school environment, and recognition of difference. Findings from the study revealed that the use of IWBs in the way in which the classrooms were using them, may inhibit learning. Zevenbergen and Lerman (2008) offered considerable potential for IWBs to enable new forms of learning however teachers need to identify the pedagogies being used with the IWB. Additional training in the use of IWBs was highly recommended.

Use of the IWB can provide a productive learning environment that motivates students. Oleksiw (2007) conducted an IWB experiment in an Ohio charter school to investigate the effects of IWBs on third grade math knowledge and skills. The goal of the study was to use the IWB for one year during math instruction. Nineteen students were given one or two math problems daily on the IWB. These math problems were developed similar to what a student might see on the state achievement test. A total of six areas of mathematics were studied: operations, measurement, geometry and spatial sense, patterns, functions and algebra, and data analysis and probability. The IWB was also incorporated into Center time each day for increased math practice. Data collection for the study occurred throughout the year of research. Weekly written assessments; remediation activities; individual, small group and whole group activities; a pre-test at the beginning of the year, a post-test at the conclusion of the year; and finally, the state achievement test rounded out the means of data collection for third grade math. The results indicated students significantly improved their math knowledge and skills, and all students met proficiency expectations on their state achievement test. Oleksiw concluded that the IWB enhanced motivation, stimulation, and understanding in the math curriculum for third graders.

Dill (2008) conducted a study to determine whether IWBs were positively associated with student's achievement on the Ohio Math Achievement Test in grades three through five. The goal of the study was to use IWBs during math instruction from October until the end of the school year, and then measure student achievement on the state test. Data collection for this study was based on one school as the experimental group and another school as the control group. The experimental group used an IWB

from the first week in October until the end of school and the control group conducted class as usual. The results indicated the mean was statistically significant on the fifth grade Ohio Achievement Math test for the groups of students that used the IWB. However, grades three and four failed to reject the null hypotheses. The research that was conducted at these schools did not support nor reject the concept that IWBs improve student achievement in grades three through five on the Ohio Math Achievement Tests however it does lay the groundwork for future study.

Actively engaging students in the learning process has become an interest in the theories of instruction. Swan, Schenker, and Kratcoski (2008) investigated whether the use of interactive whiteboards in language arts and mathematics lessons improved student achievement as measured by scores on state achievement tests. The goal of the study was to examine reading and math achievement scores on students in grades three through eight to compare students whose teachers used IWBs for instruction and those whose teachers did not. The study was conducted in an urban school district in Ohio and involved 11 elementary schools, three junior high schools, and one alternative school. Data collection was in the form of mathematics and reading scores of third through eighth grade students on the Ohio Achievement Test for the 2006-2007 academic year. Test scores of students whose teachers used the IWB during instruction in math and/or language arts were compared with the scores of students whose teachers did not use an IWB during instruction. Results showed a slightly higher performance score among students in the IWB math classes, with students in grades four and five having the greatest advantage. Swan also noted that when the students were grouped by teachers,

students in the IWB classrooms scored above the mean more frequently than students in the non IWB classrooms.

Students often report the enhancement IWBs bring to the classroom. Schut (2007) investigated student perceptions of IWBs and their use in a secondary biology classroom. The goal of the study was to explore the use of IWBs as compared to the overhead projector in two biology classrooms for four weeks on ABAB and BABA alternate day design. Thirty-six students participated in journal entries and interviews giving their perceptions on the benefits, limitations, and improvements of the overhead projector as compared to IWBs. The results of the study did not show a substantial improvement in student grades as compared to other biology classes however Schut (2007) found that students preferred the IWB in lieu of the overhead because it was more engaging and offered more multimedia aspects. Students felt the IWB provided visuals that were more pleasing to the eye and the information presented was bright and colorful. The interactive components of the board increased attention and interest and held engagement for longer periods. She also reported the IWB improved instruction through the use of visuals and note taking capabilities in the secondary biology classroom.

With regard to IWBs and student achievement, Reaume (2007) studied the effects of IWBs and their potential to enhance boys' interest in literacy lessons, enhance their attitudes toward writing, and improve their writing achievement. Research was conducted in 13 elementary classrooms in the York Region of Ontario, Canada. The goal of the study was to use the IWB during instruction for third months to teach lessons in writing. Data was collected from 104 boys in grades one, three, six, seven, and eight that participated in the study by writing responses to the text that was presented to them daily.

The results indicated the boys were significantly engaged when using the IWB and their attitudes toward writing also showed significant improvement. However, performance scores in writing showed little improvement when writing was broken down into scoring categories. The study's length of time was a possible limitation of the results and pointed toward the need for future research.

Schmid (2008) conducted an interactive experiment at Lancaster University in the United Kingdom to investigate the use of IWB technology in the teaching of English to international students. The goal of the study was to uncover the challenges of integrating multimedia into language classrooms in order to identify possible pedagogical implications of the research. The study took place during the summers of 2003 and 2004 over an eight week program. Twenty-nine students participated in Study One and 33 students participated in Study Two. These students were from all over the world but the majority tended to come from mainland China and Taiwan. The experiment included video recordings of each of the lessons taught by the researcher as well as notes and questionnaires completed by colleagues who observed the lessons. Data collection for the study was comprised of interviews with students and the teacher's field notes. The results indicated that 100% of students in Study One and 93% of students in Study Two agreed that the use of the IWB made lessons more effective than had the board not been used. Students justified their answers by stating the board made multimedia access more readily available, allowed more participation during class, which translated into more time for group discussions. Schmid concluded that although much research has taken place in regards to IWB technology, more studies need to occur in regards to the use of the board in language classrooms.

Interactive whiteboards have been present in classrooms in the United Kingdom almost since they first arrived in the business market. Moss, Jewitt, Levaaic, Armstrong, Cardini, & Castle (2007) conducted a study to evaluate the educational and operational effectiveness of the London Challenge component of the Schools interactive Whiteboard Expansion project (SWE). The intent of the project was to place an IWB in at least one core subject department in every secondary school in London during the 2003-2004 school years. The study had three main goals: (1) assess the differences of the IWB on teaching and learning; (2) teacher/pupil motivation, and pupil attendance and behavior; and (3) standards in core subjects. Data collection was in the form of case studies, surveys of department usage, and statistical analysis of pupil performance data. The findings concluded that IWBs adapt well to whole class teaching and that correlates well in secondary classrooms. The IWB implementation was successful as long as it supported the teachers' explorations of their current pedagogy and integrated into their instructional practices. Finally, Moss et al., (2007) showed no statistical difference on student performance standards in the first year in which departments were equipped with the technology. Moss noted that "The IWB does not transform existing pedagogies; instead the main emphasis needs to rest on the appropriateness of the pedagogy and not the technology."

Listening to students could help teachers develop learning strategies. Tanner and Jones (2007) examined the use of video-stimulated reflective dialogue to encourage students to reflect on their learning situations through the use of technology, specifically IWBs. The goal of the study was to recognize the extent that students are able to identify ways that are most effective in enabling them to learn. Specifically, the researchers were

interested in student perceptions about pedagogies associated with using IWBs during instruction. Thirty-two teachers from 18 schools in Wales worked in pairs to plan instruction. During the first phase, one of the teachers in each pair used the IWB during instruction while the other teacher in the pair taught the class without using the IWB. During the second phase, both teachers in each pair used the IWB along with other resources to teach class. Data collection was in the form of pre- and post-tests, interviews with teachers and students, and lesson observations. A key form of data was the use of video-stimulated reflective dialogue (VSRD) (Hargreaves et al., 2003). Video clips of lessons were shown to focus groups of students to probe their perceptions about pedagogies and use of the IWB in their learning. Students were invited to dialogue on the features of each clip and discuss what enabled or inhibited their learning. The results of the study found that students preferred the use of the IWB during class over older technologies such as an overhead projector. They commented on the bright colors, active displays, and neatness of type, which held their attention better. They consider themselves to be a technology generation and are aware of a classroom that strives to integrate technology rather than continue to use outdated resources. Although there were no significant differences in student attainment between the classes that used IWBs and those that did not, students were much more aware of the teacher-student interactions that improved their learning.

Dhindsa (2006) conducted a study in Brunei to compare student performance between a traditional teaching classroom and a constructivist, technology-rich classroom equipped with an interactive whiteboard. The goal of the study was to find and compare both types of learning environments and determine if gender had any effect on

performance in the same types of classrooms. The traditional approach group had a membership of 58 students and the constructivist group had a membership of 57 students. Data collection was in the form of a chemistry achievement test given at the beginning of the study and again at the conclusion of the study. Research occurred over a six week period. Findings revealed a significantly higher mean gain in the constructivist classroom largely due to the visual and tactile nature the IWB presents.

Finding ways to increase student performance on test scores is always the emphasis in education. Fisher (2006) studied the influence of technology, specifically IWBs and laptops, during science lessons in order to prepare fourth grade students for the Kansas State Science Assessment. The goal of the study was to evaluate the effects of technology integration during science instruction. Sixty-one fourth graders participated in the study and were divided into three classes, A, B and C. Each class received six, 50 minute science review sessions over a two week period. The review days alternated between direct instruction and inquiry based learning. Class A received direct instruction and inquiry based learning using an IWB, Class B received direct instruction and inquiry based learning using laptops, and Class C was the control group in which no technology was used. Class sessions taught during direct instruction were reading and interpreting nutrition labels; categorizing man-made and naturally made objects; comparing research to investigations. Class sessions taught during inquiry based learning were identifying 23 types and permeability of soils; comparing needs of organisms; investigating magnets and simple circuits. Data collection for the study included a researcher-generated technology survey, a pre- and post-test measuring science knowledge, and the Kansas State Reading, Math, and Science test scores. The results did not show significant

differences between groups, with or without technology interventions. Fisher did note that although there were no significant statistical differences between groups in the results, the students in the interactive whiteboard group were the highest ranked at the conclusion of the study.

Wall, Higgins, and Smith (2005) conducted a review of literature regarding the IWB and its bearing on teaching and learning from a student's point of view. The purpose of the review was to evaluate the implementation of the boards in six Local Education Authorities, 12 schools in each LEA throughout England, and from students in Years Five and Six in primary schools. Data collection involved using a template for interviewing 80 pupils, 46 boys and 34 girls, in small focus groups of four to six children. Statements were categorized as to whether they were positive, negative, or neutral. Results concluded a positive difference for IWBs on teaching and learning. Students found the boards effective especially when used for pupil participation and interaction. Students felt the boards improved their learning because of the color and movement that motivated and reinforced their concentration and attention. Wall et al., (2005) concluded that IWBs were received positively by the majority of students in their study.

In a study among eighth graders, Bell (2002) explored the effect of the IWB on writing achievement, writing attitudes, and computer attitudes. This study was conducted at a junior high school in Texas, over a six week period. Participation involved 90 students under the instruction of one classroom teacher that were divided between experimental and control groups. The experimental group participated in instruction with the daily use of an IWB while the control group received the same instruction without the use of an IWB. Compiled data consisted of the TAAS (Texas Assessment of Academic

Skills), the Knudson Writing Attitude Survey, and five categories of the BELCAT (Blomberg-Erickson-Lowery Computer Attitude Task). The results indicated no statistical difference in the writing achievement gains of the experimental group over the control group as reported on the Texas Assessment of Academic Skill. However there were significant differences in the results of the Knudson Writing Attitude Survey among all subgroups. Finally, the Blomberg-Erickson-Lowery Computer Attitude compiled significant gains in half of the subgroups in regards of mean scores. Bell concluded that IWBs have value as an instructional tool that proves its worth through students that are difficult to motivate.

Beeland (2002) found that the IWB did have an effect on student engagement. Ten middle school teachers and 197 students participated in the study. Lessons were presented using the IWB and after the lesson, students and teachers completed surveys regarding the IWB and lessons learned. All teachers believed that the interactive whiteboard increased attention and all but one student felt that they learned better with the interactive whiteboard. Beeland's results showed that the use of an interactive whiteboard does affect student engagement. Primarily, the reason can be attributed to the visual capabilities an IWB can provide engaging students and therefore improving learning.

Gerard and Widener (1999) researched the use of an IWB in foreign language classrooms. The goal of the study was to determine how the IWB could be used to facilitate teaching from the teacher’s perspective and how it could be used to facilitate learning from the student perspective. The study took place in foreign language classrooms in an independent 6-12 school, in North Carolina. Gerard and Widener (1999)

concluded that the IWB supports teaching in three ways: interaction and conversation in the classroom; helps in presenting new and linguistic components; and enables the teacher to be more organized. The IWB also supports the learning process in three ways: provides opportunities to support oral skills; supports the cognitive process; and increases motivation and emulation. Finally, the IWB brings the Internet into the classroom and makes information available to all students without having the need for a computer for every student.

Interactive Whiteboards and Teacher's Instructional Methods

With the inception of the No Child Left Behind Act of 2001, most states now require that 25 percent of federal technology dollars be used for staff development (Ansell, 2003). Many states have made great strides in providing standards for teachers and students in the use of technology. In North Carolina prior to 2010, eighth grade students had to pass a Computer Competency Test, written and practical, as part of their graduation requirements. In addition to the previous student requirement, new teachers must obtain 30 hours of technology training in order to become initially certified. Most experts agree that improving the technology skills of teachers depends largely on their professional development. When districts were implementing technology into the classroom, most of that technology came in the form of hardware and software, which didn't leave a lot of funding for training. As Ansell states, "Market Data Retrieval reports that almost 66 percent of school technology spending is projected to go to hardware and a little more than 19 percent to software. Staff development is expected to capture 15 percent of most schools' technology budgets" (Ansell, 2003, p. 44). Based on the U. S. Department of Education's 1999-2000 Schools and Staffing Survey, only 42 percent of

first year teachers felt well prepared to use computers and technology in their instruction their beginning year of teaching (NCES, 2000). Following up that statistic is more data from across the nation that declares at least half of our teaching force considers themselves to be beginners in the integration of technology within the curriculum (NCES, 2000).

There is a significant amount of literature that discusses the ways in which IWBs can be used to influence teacher instruction. Glover, Miller, Averis, and Door (2007) conducted research in the United Kingdom to investigate the use of IWB technology in their schools and whether IWBs had positive effects on teaching and learning. The goal of the study was to determine the way teachers who were comfortable using technology, specifically IWBs, changed their pedagogy to enhance instruction and student learning through the use of the IWB. During 2003 and 2004, Keele University identified 36 teachers (24 math and 12 foreign language) that regularly used IWBs for instruction. These teachers agreed to video 50 lessons, 14 agreed to second recordings, during which they used the IWB for instruction. Teachers had between two and 27 years of teaching experience and all observed lessons were taught to students aged 11 through 14. Structured interviews were conducted with all recorded teachers using questions that ranged from equipment installs, training, identification of problems, confidence in using the IWB, classroom management, and student achievement while using the IWB for instruction. The results produced three evidences by the researchers through which they classified IWB use by the participating teachers. The first use of the IWB supported didactic instruction whereby the teachers used the IWB for visual support and not for conceptual development. The second use of the IWB was a progression from didactic and

evolved into interactive. Teachers used the IWB to challenge pupils using visual, verbal, and kinesthetic methods. The third use of the IWB marked a pinnacle in usage from those teachers that had made the IWB part of their everyday instructional practices through using the interactive capabilities of the board for cognitive development. Glover concluded that teachers need adequate time to prepare lessons, become comfortable using the IWB, and have time to implement the technology into their teaching. Finally, Glover states the clear issue with use of the IWB is that the board does not ensure progress but good quality teaching does.

Wood and Ashfield (2008) conducted a case study to investigate how IWBs can provide opportunities for creativity in teaching and learning, by drawing upon observations of and discussions with, classroom practitioners and students. A grounded theory approach, or an analytical induction process was implemented as opposed to a hypthetico-deductive system, to develop theory from collected data (Glaser & Strauss, 1967). Ten observations of whole-class lessons were conducted that included five in literacy and five in numeracy, within five primary schools. Interviews with the class teachers and focus group discussions with students provided qualitative data regarding perceptions towards, and use of IWB technology. The data was placed under four broad headings: Maintaining Attention, Enhanced Learning Experience, Nature of Interaction and Distinct Characteristics of the Technology. The findings indicate a teacher's preferred style of whole-class interactive teaching can by supported by an IWB. All of the participants felt that the IWB enhanced whole-class teaching and learning due to speed of operation, quality of media accessed, and teacher position at front of the classroom. "In many ways the functionality of the IWB could be viewed as a modern

technological version of the traditional blackboard" (Wood& Ashfield, 2008, p. 94). The study found that if a teacher used the IWB creatively, as with any resource, the most influential factors with regard to developing children's learning is the context and the purpose. The study showed that teachers should have a clear understanding of children's learning styles and not rely merely on technology resources and technical capability.

There is little documented research into the way teachers are allowed to acclimate their instructional styles when IWBs are introduced into their classroom. Miller and Glover (2007) conducted research in professional development in seven secondary English schools where IWBs had been provided by a government funded project. The goal of the study was to determine participants' perception of their use of the IWB over the period of two terms and to find out if there was a relationship between the induction experience and the difference on their classroom practices. Seven schools involving 22 staff members were video recorded during lesson observations ranging from three to seven visits for the recordings. These recordings took place after the initial install of the equipment and then later in the second phase of the project. The induction phase consisted of the install of the IWB, implementation of math and internet software packages, and a day of technical training by the vendor. The developmental phase was helped along by six of the schools developing department leaders that assisted the other teachers in preparations and developmental use of the IWB. "The starting point for changed pedagogy has been identified as teacher awareness and implementation of interactivity with the IWB" (Glover et al., 2007, p 6). Miller and Glover concluded that implementation of technology without sufficient and appropriate training, time to adjust to the equipment, and time to adjust instructional practices, may inhibit the intention and

purpose of the equipment. Their recommendations for future implementations were to insure opportunities for professional development, team planning, and time for exploration and development of teaching materials.

Kennewell and Beauchamp (2007) researched how teachers used Information and Communication Technology (ICT), specifically IWBs, to enhance learning. The goal of the study was to investigate the effect on teaching and learning from the use of ICT. The study was conducted in a primary school in South West Wales and involved observation of a single lesson from six English, math, and science teachers. Field notes and interviews followed the observations and the main exploration was for use of the IWB and its effects on learning-related activity. Results of the interviews revealed that teachers felt the IWB was effective in gaining students' attention, maintaining their attention, and stimulating thinking for longer periods of time. The difference factor was the large visual display the board presents. Results of the field notes found that teachers used the IWB software for focusing students' attention, highlighting the key points in a lesson, and for revisiting those key points during review. Finally, Kennewell and Beauchamp (2007) concluded the importance of professional development to ensure the technology can be embedded in teachers' pedagogical knowledge and reasoning.

In the United Kingdom, teachers are under pressure to implement technology into their pedagogic practices for improvement of teaching and learning. Gray, Pilkington, Hagger-Vaughan, and Tomkins (2007) compared the government policy in the UK regarding the implementation of technology into teaching and learning, with foreign language teachers and their efforts of complying with policy. The goal of the study was to examine 17 foreign language teachers and their integration of IWBs into their classroom

approach while looking for signs of transforming the learning process. This in depth study revolved around case studies of four teachers. The UK published new teacher standards in 2007 which require newly qualified teachers (NQTs) to "use a range of teaching strategies and resources, including e-learning" (TDA, 2007, Q25a). Data collection encompassed a variety of tools designed to focus the teacher's attention on the pedagogical implication of the IWB while still allowing them to maintain the direction and pace of their lessons. Other data collection methods included group focus meetings, individual teaching logs, video recordings of lessons, and interviews to disaggregate any emerging patterns. The intent was to identify continual themes through the data that was prevalent from all the teachers. The outcomes of the study emphasized the need to allow teachers time to understand the different factors of using the IWBs as it affects their work and to allow the extra time and effort needed to change their teaching practices. Finally, Grey et al., (2007) agreed that teachers will change in areas they are primed for a change, otherwise teachers will hold to their own theories and practices of teaching.

Jewitt, Moss, and Cardini (2007) studied teachers' design of IWB texts with a focus on pace, interactivity, and multimodality in core-subject departments in the schools of London. The goal of the study had two purposes. First, to recognize the capabilities of an IWB and the value it can bring to the classroom, and secondly, how teachers' use of this technology shapes curriculum choices and pedagogic changes in the classroom. Population for the study involved nine core-subject departments in the schools of London, three each of math, science, and English, for a total of 27 classes. Data collection involved a week long session of class observations, video recordings of two lessons from each group, a collection of texts used during the recorded lessons, and

interviews with department heads and teachers. In addition, focus group interviews with students along with a pupil survey made up the basis for data collection. Findings concluded that pedagogic text design for IWBs would benefit from a shift toward pedagogic development and movement away from the emphasis of technology integration. Jewitt, et al., (2007) concluded that use of IWB technology has the capacity to increase the pace of lessons but the advantage needs to be from a pedagogic value in order to realize a specific aim of the lessons.

A goal of using IWBs is to raise student achievement through improving pedagogic practice. Strong claims have been made that IWBs can transform teachers' practice by both policy-makers and manufacturers with the assumption that this technology will have blanket benefits for learning. Gillen, Staarman, Littleton, Mercer and Twiner (2007) investigated how IWBs actually function as a communicative and pedagogic tool in classroom interactions between teachers and pupils. Data collection consisted of observations and interviews of four teachers working within urban primary schools in the south of England. The results indicated that in terms of technical interactivity the IWB seems to facilitate a quick, smooth presentation compared with earlier technology. In addition, use of the IWB as a mediating artifact seems to have a significant effect on teachers in that it enabled them to use a combination of innovative styles of presentation and the rapid succession of different kinds of multimodal information. However, the pedagogical interactivity is more difficult to analyze. While IWBs can provide varied interactive lessons, when the board is located at the front of the classroom a more traditional style of teaching may be reinforced. Consequently, their

results found IWBs may not necessarily transform teaching in terms of classroom dialogue and underlying pedagogy.

The strength of the IWB rests in the potential of using the technology for interactive instruction. Hennessy, Deaney, Ruthven, and Winterbottom (2007) researched how pedagogy is developed through the use of the IWB in schools in the UK and in other countries. The goal of the study was to explore how secondary teachers use the IWB to structure and support subject learning. Participants included ten science departments from state supported, secondary schools. Research began with teachers in each department relaying what they felt were successful implementations of IWBs within their pedagogy. Data collection was in the form of observed lessons, follow-up interviews, and focus groups made up of students. The results indicated strong support for the IWB for shared cognition, collective evaluation, beginnings of new knowledge, and the reworking of student ideas. "Future research would perhaps show more emphasis on pair and group work with less dependency on teachers remaining in front of the class" (Hennessy, Deaney, Ruthven, and Winterbottom, 2007).

Most literature reviewed offers positive attributes of the IWB and the difference it has on instruction. Some of the attributes include increased student motivation, increased student engagement, improvement in achievement, and access to interactive resources. However most of the positivity derives from teachers and students and does not always stem from empirical data. Smith, Higgins, Wall, and Miller (2005) conducted a review of literature regarding IWBs as a pedagogical tool in teacher instruction. The goal of the study was to investigate the influence IWBs have on literacy and math for students nine through 11 years of age between the years of 2003 and 2004. In particular, this

investigation wanted to determine the impression IWBs had on classroom interaction, and on student engagement, progress, and attitudes. Two themes were evident within the literature review: (1) the IWB as a tool to enhance teacher, and (2) the IWB as a tool to support learning. Smith, et al., (2005) concluded that while there is much literature regarding the positive effect of the IWBs, there was no empirical evidence to actually identify the bearing the board had on attainment and achievement of students. "This leaves an opening for research that can lead to empirical evidence the IWB has on student achievement and teacher instruction" (Smith, et al., 2005).

The United Kingdom has conducted several studies into the influence of IWBs in the classroom. Smith, Hardman, and Higgins (2006) investigated the effect of IWBs in the UK on teacher and student interaction in literacy and numeracy instruction by looking at the interactive styles used by the teachers. The goal of the study was to research the claims that IWBs can be used as a pedagogic tool for promoting interactive teaching and learning. Schools that participated were part of a national pilot project that placed IWBs in Year fifth and sixth classes in six local education authorities in the UK. A team from the Centre for Learning and Teaching at Newcastle University conducted the research. Data collection was comprised of structured observations, teacher and student interviews, teachers' weekly records of IWB use, and student performance on national key state two tests. This study concentrated on the observation data collections. During 2003, 114 Year five lessons were observed from a total of 30 teachers. Each teacher was observed four times, once using the IWB to teach literacy and once without using the IWB; once using the IWB to teach numeracy and once without using the IWB. During 2004, 184 Year Five and Year Six lessons were observed with teachers using the IWB for lessons.

Observations were carried out using a computerized observation schedule created by the Classroom Interaction System (Smith & Hardman, 2003). Findings resulted in suggestions that IWB lessons contained more whole class instruction and less group work than what occurred in the non-IWB lessons. This was true for both literacy and numeracy classes. There was also evidence that suggested the IWB is useful for presentations in the classroom, however the board alone will not bring about a change in whole class instruction. Finally, Smith et al., (2006) concluded that IWBs are not the sole technological fix that will change pedagogy of whole class teaching. More research needs to occur into ways of supporting teachers through professional development.

In Minnesota, research was conducted by Olsen (2008) to determine how IWBs were being used in media centers. The study concentrated on how the IWBs were used and the effect of training on the use of the board. Data was collected from a sample of university media specialists, interactive whiteboard vendors, and schools to inquire how IWBs were used in their programs. Results indicated that schools are implementing the IWB technology in the classrooms but not as extensively in the media centers of those schools. The researchers suggested in their conclusion that media specialists are intermediate to advanced users of technology and it was assumed they needed less training on new technology, when in reality they needed training just like any teacher would receive.

The introduction of IWBs into the classroom involves more than just the presence of the board and software. Armstrong, Barnes, Sutherland, Curran, Mills, and Thompson (2005) conducted research directed toward capturing, analyzing, and communicating the interactions between teachers, students, and technology in a primary school in the UK.

The goal of the study was to focus on the use of the IWB for teaching and learning in four classrooms over a two-year project. Data collection included three-one hour video recordings of lessons from each of the four participating teachers. Videos were reviewed by several researchers and a set of categories evolved that were deemed useful in investigating the interactions within the classrooms. In addition to the video recordings, interviews were conducted between the four teachers along with focus visits of six students following each recorded lesson. The findings of the research demonstrated that the introduction of IWBs into teaching and learning involves more than just the presence of the board and software in classrooms. Training and ongoing support are critical components for teachers integrating the technology into their instruction. Without this awareness, the potential of IWBs are not fully realized.

Observations conducted by Smart Technologies (2009) concluded that IWBs can increase student engagement. Teachers noticed through the use of IWBs that they could increase their lesson pace, concentrate on student response and progress, gather extensive feedback, and gain a deeper understanding of pedagogy. Through the IWBs, teachers could address many leaning styles including visual, hearing-impaired and special needs. Teachers noted that they were challenged to think and teach in a new way. One special feature they found was that they could record a lesson for students who were absent so that students received the same instruction the rest of the class received. IWBs also promoted organization by using it as a lesson preparation tool and for follow-up remediation.

Shenton and Pagett (2007) found that the use of IWBs supports interactive teaching. This project studied the impact of IWBs on teaching and learning in literacy

lessons for year five primary classes in England. Observations and teacher and student interviews were used to gather data. Problems however included technical difficulties and pressure on teachers to constantly improve lessons. One teacher used IWBs to save and revisit student work as a meta-cognitive strategy and memory aid. IWBs were primarily used as a teacher's tool during observations. Results indicated that the use of IWBs changed their teaching completely, allowing experimentation and creativity. Teachers saw it as an extra, powerful resource to support teaching. It allowed flexibility, helped in organization, fewer distractions, and led to more whole-class, teacher led lessons. Students believed the IWB helped increase their understanding because the teacher used different software, different visuals, and incorporated games into lessons.

The success and failure of IWB integration often rests in the attitude of the classroom teacher. Miller and Glover (2002) researched the use of interactive whiteboards in five elementary schools in England. The goal of the study was to investigate the use of IWBs and to document the potential benefits. Data collection was in the form of a questionnaire containing open and closed questions, observations of lessons, and structured interviews of teachers. Findings indicated that the integration of the IWB into instruction had required a rethinking of the way in which students were learning. Teachers had to be ready to implement the technology if it were to be successful. As a result of the study, teachers became more aware of student learning needs and had a better understanding of the learning process.

Latham (2002) conducted a study of The North Islington Education Action Zone RM Easiteach Mathematics Project (NIEAZ) which began in 2000. It was evaluated in 2002 to determine the bearing of IWBs as a resource for teaching and learning in Years

six and seven students. The focus of the evaluation was to identify the bearing of the NIEAZ RM Easiteach project on the quality of teaching and learning and to measure the effectiveness of the project's training and support program. Five lesson observations and two training session observations were made; six teachers were interviewed; questionnaire responses from seven teachers were obtained; and 14 children from the classes were interviewed. The study found the use of IWBs as a resource were effective by providing potential for all pupils to be actively involved with improved levels of concentration and fewer distractions and by providing opportunities for teachers to structure and manage interactive teaching and learning. The study also showed that teachers need to have confidence in using the resource, good knowledge of the curriculum, a secure understanding of the key principles of interactive teaching and high expectations of pupils' abilities in order for the potential of the IWB to be fulfilled.

Further research by Gerard (1999) found that IWBs support teaching by presenting new linguistic and cultural elements, supporting interaction, and promoting organization in foreign language classrooms. This study, conducted in a 6-12 independent school, used the IWB to facilitate teaching and learning. Advantages of using interactive boards include allowing the teacher to focus students' attention by overwriting, underlining, highlighting and circling as well as organize information. IWBs allow the teacher to navigate from the board instead of going to a computer. It allows the instructor to focus on the learning process of students and enhances conversation because the teacher can face and interact with the class. Teachers can keep track of vocabulary introduced in class and save it for future use, which promotes reinforcement.

Long term changes in teaching and learning occur when there is successful implementation of the IWB. Miller, Averis, Door, Glover, D. (2004) researched the essential features of interactivity that are fundamental in the use of IWBs and what makes them more effective than current classroom resources such as whiteboards and data projectors. The goal of their study was to develop principles that might improve the use of IWBs thereby promoting and sustaining this resource into instructional methods of teachers. Participants included ten mathematics teachers and 13 foreign language teachers. Data collection included video recordings and interviews from each of the participants. Their findings revealed that successful implementation of this technology requires teachers to be able to bridge the connection between learning needs of their students with the interactive opportunities the IWB provides. The key effect of IWB implementation is continual training either individually or in groups, that assists teachers in developing instructional strategies with the use of interactivity resources.

The extent to which IWBs will be used in classrooms has the potential to grow exponentially. Robert J. Marzano conducted a study that involved 85 teachers and 170 classrooms in which an IWB was used to teach lessons. Lessons were taught to a group of students while the teacher was using the IWB for instruction and later, the same lessons were taught to a different group of students without the use of the IWB for instruction. Marzano's study concluded, "In general, using interactive whiteboards was associated with a 16 percentile point gain in student achievement. This means that we can expect a student at the 50^{th} percentile in a classroom without the technology to increase to the 66^{th} percentile in a classroom using whiteboards" (Marzano, 2009). Of course, use of an IWB cannot automatically guarantee student achievement. Teachers must become

comfortable with the technology and integrate it daily into their instructional methodology, along with good classroom practice.

Summary

The purpose of this study was to examine literature relevant to IWBs and the effect on students' math and reading scale scores along with teacher's instructional methods in classrooms that have IWBs. The interactive capabilities of the IWB, along with the instructional methodologies of the teacher can equate into more student interest and engagement. With proper planning, training, preparation, and time, it can become a tool that adds greater enhancement to the learning opportunity and motivation of students.

Initial research on the use of IWBs is substantial. Studies have documented that both teachers and students like the technology (Beeland, 2002; Hall & Higgins, 2005; Smith, Higgins, Wall & Miller, 2005) and that students are more engaged and motivated to learn when IWBs are integrated into the instructional day (Beeland, 2002, Miller, Glover & Averis, 2004: Smith, Hardman & Higgins, 2006). Additionally, many studies have documented that use of IWBs transfers instruction to more of an interactive mode instead of a presentation mode and makes lessons more student-centered (Bell, 2002; Miller, Glover& Averis, 2004). The British Educational Communications and Technology Agency states that "students are motivated in lessons incorporating an IWB because students enjoy interacting physically with the board, manipulating text and images, thereby providing more opportunities for interaction and discussion" (BECTA, 2003, p.3).

Interactive whiteboards are not and will never be the salvation within the classroom. When the teacher is ready for a pedagogic change, technology and IWBs can play a role in creating new opportunities of learning for students and teachers alike. Most of the studies reviewed in this chapter concluded with one common theme. Teachers need time, training, and an interest in using technology, specifically IWBs, to assess how the features of this resource can achieve a wider pedagogic purpose in their instruction (Armstrong, 2005; Glover & Miller, 2002; Smith, Harman, and Higgins, 2006; Glover, Miller, Averis, & Door, 2007). Armstrong et al., (2005) came to the realization that IWBs alone will not motivate students to learn, rather it is the teacher as the critical component in order for the lesson and IWB to work together to promote quality interactions and student achievement.

In this chapter, the researcher provided a comprehensive review of the literature pertaining to IWBs and how they have been used in educational settings and studies around the world. The literature review examined the classroom practices of teachers who had been provided an IWB for instruction and how the IWB affected achievement in reading and math. Six concepts were discussed: Interactive Whiteboards and Learning Styles, Children and Technology Today, History of Classroom Boards, Interactive Whiteboards, Interactive Whiteboard and Student Achievement, and Interactive Whiteboard and Teacher's Instructional Methods. Through this review of literature, the researcher revealed the instructional value of IWBs and their effect on student achievement.

In Chapter Three, the researcher will discuss the methodology of the study in detail, including the data analysis and the method used to address each research question.

Local data was used from the 2007-2008 and 2008-2009 Academic years of EOG scale scores in grades three, four, and five for the quantitative section of this study. For the qualitative section, the sample group for this research included 44 third, fourth, and fifth grade teachers that had used the IWB for at least one academic year. The focal point of the focus groups was instructional methodology and how the IWB made instruction different in the classroom. The 44 teachers' student test scores ranged from the highest to the lowest in the school system. Focus group sessions were recorded and digitized for later analysis.

CHAPTER 3: METHOD

This study is a mixed methods design investigation involving both quantitative and qualitative components. Consistent with Glaahorn's (2005) definition of a quantitative study, the study conducted by this researcher is experimental in nature, emphasizes numerical objectivity, emphasizes measurement, and searches for relationships. The methodology for collecting and analyzing data will be examined to determine the effect of interactive technologies, specifically interactive whiteboards (IWBs), on student scale scores in math and reading and on the instructional practices of teachers.

The quantitative section of this mixed methods research studies and investigates the effects of IWBs on student scale scores in grades three, four, and five through comparisons of 2007-2008 Math and Reading End-of-Grade (EOG) standardized test scores and 2008-2009 Math and Reading End-of-Grade (EOG) standardized test scores as published by the North Carolina Department of Public Instruction. The qualitative section of this mixed methods research investigates the perceptions of third, fourth, and fifth grade teachers about their instructional practices while using interactive whiteboards through participation in focus group sessions. Participating teachers had experience using the IWB for at least one academic year.

The purpose of the research is to determine:

1. Are there differences between classrooms that use IWBs and those that do not use IWBs in third, fourth, and fifth grade students' math and reading scale scores?
2. How has instruction in the classroom changed by using an IWB?

Contained in this chapter are: (1) research questions and null hypotheses; (2) design of the study; (3) participants; (4) data collection procedures; and (5) data analysis procedures.

Research Questions and Hypotheses

To achieve the objectives of this study, the researcher will address two research questions and related hypotheses.

Research Question 1: Are there differences between classrooms that use IWBs and those that do not use IWBs in third, fourth, and fifth grade students' math and reading scale scores?

H_0: There is no difference between classrooms that use IWBs and those that do not use IWBs in third, fourth, and fifth grade students' math and reading scale scores.

H_1: There is a difference between classrooms that use IWBs and those that do not use IWBs in third, fourth, and fifth grade students' math and reading scale scores.

Research Question 2: How has instruction in the classroom changed by using an IWB?

Design of the Study

Mixed methods design investigation was used in this study (Hanson, Plano Clark, Petska, Creswell, and Creswell, 2005). Data analyses were done sequentially and examined the effect of IWBs on two outcomes, student scale scores and teacher instruction. The following sections describe the quantitative and qualitative parts of the study.

Mixed methods research has gained momentum as a feasible alternative method of research (Hanson, Plano Clark, Petska, Creswell, and Creswell, 2005). It can be defined as "the collection or analysis of both quantitative and qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of the data at one or more stages in the process of research" (Creswell, Plano Clark, Gutnam, & Hanson, 2003, p. 212).

An ex post-facto design was used in this study since EOG testing had already occurred. In this type of research, the researcher is only interested in determining the influence of the independent variable, use of IWBs, on the dependent variable (EOGs) without manipulating any of the independent variables (IWBs). A limitation of this type of study is the lack of manipulation, and control over the independent variable. Classrooms either had IWBs or they did not have IWBs. Additionally, students were already placed in classrooms and were not randomly assigned before research began.

For the quantitative section of this research, an analysis of covariance was used to determine the effect of IWBs on Math and Reading EOG scale scores for students in third, fourth, and fifth grades during the academic years of 2007–2008 and 2008-2009. For this study, scores (2008-2009) for children in classrooms that used an IWB (IV) were

compared to classrooms that did not use IWBs (IV) after controlling for the previous year's test results (2007-2008). In the qualitative section of this research, focus groups sessions that included teachers that use IWBs were conducted that centered on technology integrated instructional methodologies and student attitudes toward learning.

For the qualitative section of this research, the teacher population included 44 third, fourth, and fifth grade teachers that had used the IWB for at least one academic year. The focal point of the focus groups was instructional methodology and how the IWB made instruction different in the classroom. The 44 teachers' student test scores ranged from the highest to the lowest in the school system. Focus group sessions were recorded and digitized for later analysis.

Focus groups in the words of Richard Krueger, "are about paying attention, being open to what people have to say and being nonjudgmental. It is about creating a comfortable environment for people to share." The purpose of a focus group is to not only listen but to gather information, gather opinions, interview, and share perceptions of the topic at hand. It is a collection of qualitative data from people who share a common interest involved in a group focused discussion (Krueger, 2009).

Participants

This study of the connection between the use of an IWB and math and reading scale scores along with teacher's instructional methods was conducted in a rural county in the foothills of North Carolina. The student performance-data for the quantitative part of the study included third, fourth, and fifth grade EOG Reading and Math scale scores from 16 elementary schools and two intermediate schools for the academic years of 2007-2008 and 2008-2009.

The Accountability Services Department of this rural county in North Carolina used the ten categories of "No Child Left Behind" to compare EOG scale scores among the 16 elementary schools and two intermediate schools, schools that serve grades three through five. Three categories emerged within the schools that resulted in similar demographics among this county's elementary and intermediate schools and those categories were African-American enrollment, socio-economic status reflected in free and reduced lunch percentage, and Exceptional Children enrollment. Students and teachers in these 16 elementary schools and two intermediate schools were selected for participation in this research.

Demographics

For grade three, 16 elementary schools were comparable based on the three categories selected from No Child Left Behind. Student demographics based on the categories of No Child Left Behind are described below.

Table 1

Grade 3 Demographics

	African-American Enrollment	Free or Reduced Lunch	Exceptional Children Enrollment
School 1	19.9%	50.51%	16.2%
School 2	7.92%	53.47%	15.8%
School 3	1.69%	49.15%	10.2%
School 4	22.73%	65.91%	18.2%
School 5	27.00%	52.00%	10.0%

School 6	11.54%	58.65%	18.3%
School 7	70.31%	85.94%	14.1%
School 8	21.74%	66.67%	23.2%
School 9	67.14%	85.71%	25.7%
School 10	38.95%	43.16%	15.8%
School 11	26.47%	58.82%	20.6%
School 12	9.92%	44.27%	16.0%
School 13	40.78%	69.90%	9.7%
School 14	26.83%	59.76%	17.1%
School 15	18.92%	56.76%	17.6%
School 16	14.52%	43.55%	16.1%

As evidenced from Table 1, third grade students in most schools were similarly homogeneous with regard to race, socio-economic status, and exceptional children enrollment.

For grade four, 13 elementary schools and one intermediate school were comparable based on the three categories selected from No Child Left Behind.

Table 2

Grade 4 Demographics

	African-American Enrollment	Free or Reduced Lunch	Exceptional Children Enrollment
School 1	17.89%	45.26%	12.6%

School 2	14.85%	39.60%	16.8%
School 3	0%	57.45%	14.9%
School 4	19.57%	63.04%	19.6%
School 5	29.13%	43.69%	12.6%
School 6	12.77%	54.26%	19.1%
School 8	7.32%	56.10%	13.4%
School 17	54.79%	69.15%	15.4%
School 11	19.05%	54.76%	14.3%
School 12	11.30%	39.13%	16.5%
School 13	36.07%	72.13%	16.4%
School 14	26.67%	64.0%	12.0%
School 15	30.36%	80.36%	16.1%
School 16	18.84%	37.68%	11.6%

As evidenced from Table 2, fourth grade students in most schools were similarly homogeneous with regard to socio-economic status, and exceptional children enrollment.

For grade five, eight elementary schools and two intermediate schools were comparable based on the three categories selected from No Child Left Behind.

Table 3

Grade 5 Demographics

	African-American Enrollment	Free or Reduced Lunch	Exceptional Children Enrollment
School 2	15.18%	48.21%	20.5%
School 3	0%	59.02%	16.4%
School 5	37.17%	43.36%	8.8%
School 6	10.09%	52.29%	12.8%
School 18	20.83%	55.95%	13.4%
School 17	56.05%	72.61%	16.6%
School 12	13.43%	46.27%	12.7%
School 13	37.27%	65.45%	12.7%
School 14	26.44%	57.47%	14.9%
School 15	28.89%	70.0%	14.4%

As evidenced from Table 3, fifth grade students in most schools were similarly homogeneous with regard to race, socio-economic status, and exceptional children enrollment.

Academic Year 2007-2008

Table 4 represents EOG scale scores in math for students in grades three, four, and five during the academic year of 2007-2008. Scores are divided into classrooms of students who received instruction using the IWB and classrooms of students who did not

receive instruction using the IWB. To be included, students had to have EOG scale scores from 2007-2008 and 2008-2009.

Table 4

2007-2008 Student EOG Math Scores

Math	N	No IWB	IWB
Grade 3	1200	815	385
Grade 4	1112	754	358
Grade5	1189	864	325

Table 5 represents EOG scale scores in reading for students in grades three, four, and five during the academic year of 2007-2008. Scores are divided into classrooms of students who received instruction using the IWB and classrooms of students who did not receive instruction using the IWB. To be included, students had to have EOG scale scores from 2007-2008 and 2008-2009.

Table 5

2007-2008 Student EOG Reading Scores

Reading	N	No IWB	IWB
Grade 3	1187	806	381
Grade 4	1099	747	352
Grade5	1183	861	322

Each student had an EOG test score in math and/or reading for both academic years. Scores are divided into classrooms of students who received instruction using the

IWB and classrooms of students who did not receive instruction using the IWB. The IWB had been used for instruction for at least one academic school year.

The math sample included 3501 scale scores that were enrolled in the third, fourth, and fifth grades during the academic year of 2007–2008. The math group of students that did not receive instruction with the use of an IWB was comprised of 2433 scale scores and the math group of students that did receive instruction with the use of an IWB was comprised of 1068 scale scores. The reading sample included 3469 scale scores that were enrolled in the third, fourth, and fifth grades during the academic year of 2007–2008. The reading group of students that did not receive instruction with the use of an IWB was comprised of 2414 scale scores and the reading group of students that did receive instruction with the use of an IWB was comprised of 1055 scale scores.

Academic Year 2008-2009

Table 6 represents EOG scale scores in math for students in grades three, four, and five during the academic year of 2008-2009. Scores are divided into classrooms of students who received instruction using the IWB and classrooms of students who did not receive instruction using the IWB. To be included, students had to have EOG scale scores from 2007-2008 and 2008-2009.

Table 6

2008-2009 Student EOG Math Scores

Math	N	No IWB	IWB
Grade 3	1200	533	667
Grade 4	1113	674	439
Grade5	1148	618	530

Table 7 represents EOG scale scores in reading for students in grades three, four, and five during the academic year of 2008-2009. Scores are divided into classrooms of students who received instruction using the IWB and classrooms of students who did not receive instruction using the IWB. To be included, students had to have EOG scale scores from 2007-2008 and 2008-2009.

Table 7

2008-2009 Student EOG Reading Scores

Reading	N	No IWB	IWB
Grade 3	1187	529	658
Grade 4	1100	667	433
Grade5	1143	615	528

Each student had an EOG scale score in math and/or reading. Scores are divided into classrooms of students who received instruction using the IWB and classrooms of students who did not receive instruction using the IWB. The IWB had been used for instruction for at least one academic school year.

The math sample included 3461 student scores that were enrolled in the third, fourth, and fifth grades during the academic year of 2008–2009. The math group of students that did not receive instruction with the use of an IWB was comprised of 1251 student scores and the math group of students that did receive instruction with the use of an IWB was comprised of 1636 student scores. The reading sample included 3430 student scores that were enrolled in the third, fourth, and fifth grades during the academic year of 2008–2009. The reading group of students that did not receive instruction with

the use of an IWB was comprised of 1811 student scores and the reading group of students that did receive instruction with the use of an IWB was comprised of 1619 student scores.

Teacher Demographics

During the academic year of 2007-2008, the teacher population for the qualitative part of the study included 190 third, fourth, and fifth grade teachers from 16 elementary schools and two intermediate schools based on similar demographic statistics as indicated by the categories of No Child Left Behind. One hundred and twenty-six teachers did not utilize an IWB for daily instruction while 64 teachers regularly used an IWB for instruction and had used the IWB for at least one school year.

Table 8

Teacher Demographics

2007-2008	N	No IWB	IWB
Grade 3	69	47	22
Grade 4	61	37	24
Grade 5	60	42	18

During the academic year of 2008-2009, the teacher population for the qualitative part of the study included 190 third, fourth, and fifth grade teachers from 16 elementary schools and two intermediate schools based on similar demographic statistics as indicated by the categories of No Child Left Behind. Ninety-eight teachers did not utilize an IWB for daily instruction while 92 teachers regularly used an IWB for instruction and had used the IWB for at least one school year.

Table 9

Teacher Demographics

2008-2009	N	No IWB	IWB
Grade 3	67	29	38
Grade 4	61	37	24
Grade 5	62	32	30

Data Collection and Procedures

North Carolina EOG Tests

The quantitative section investigated the effects of IWBs on student scale scores in grades three, four, and five through comparisons of 2007–2008 Math and Reading EOG scale scores and 2008–2009 Math and Reading EOG scale scores as published by the North Carolina Department of Public Instruction. North Carolina EOG Tests are curriculum based multiple choice assessments for grades three through eight in the areas of math and reading. EOG Tests are mandated by the North Carolina State Board of Education Policy ID Number: GCS-C-018, "Policy delineating achievement-level ranges for the NC EOG Tests in Reading and Mathematics at Grades three-eight, Science at grades five & eighth, and the NC General Writing Assessments at Grade 10," (NCDPI, 1999). These tests are specifically aligned to the North Carolina Standard Course of Study and measure the achievement level of North Carolina students. EOG assessments are given during the last three weeks of school and are administered to all students at the same time and on the same days. The North Carolina EOG scale scores are used to assess a student's knowledge of subject content including the student's mastery of that content

material as stated in the goals, objectives, and grade level competencies of the North Carolina Standard Course of Study (NCDPI, 1999).

For mathematics, students are assessed in the five strands of the mathematics curriculum: 1) number and operations, 2) measurement, 3) geometry, 4) data analysis and probability, and 5) algebra. In grades three through seven, the mathematics EOG test is administered in two parts: calculator active and calculator inactive. Students are allowed to use calculators during the active part of the test but not allowed to use calculators during the inactive part of the test. The estimated testing time allotted for both the reading comprehension and the mathematics tests is approximately six hours over multiple days for grades three through seven.

Achievement levels relate a common meaning as to what is expected at various levels of competence in each subject area. Students' scale scores are categorized into one of the following four achievement levels based on their performance on the assessments.

> Level I – Students performing at this level do not have adequate mastery of knowledge and skills in this subject area to be successful at the next grade level.
>
> Level II – Students performing at this level exhibit inconsistent mastery of knowledge and skills that are fundamental in this subject area and that are minimally sufficient to be successful at the next grade level.
>
> Level III – Students performing at this level consistently demonstrate mastery of grade level subject matter and are well prepared for the next grade level.
>
> Level IV – Students performing at this level consistently perform in a superior manner above and beyond what is required to be proficient at grade level work (NCDPI, 1999).

Following are the scale scores that comprise each achievement level on the EOG scale scores in Math and Reading.

Table 10

North Carolina Achievement Level Ranges in Math for Grades 3, 4, 5

Subject/Grade		Level I	Level II	Level III	Level IV
Math (Starting	3	≤ 328	329-338	339-351	≥ 352
with 2005-06	4	≤ 335	336-344	345-357	≥ 358
school year	5	≤ 340	341-350	351-362	≥ 363

Table 11

North Carolina Achievement Level Ranges in Reading for Grades 3, 4, 5

Subject/Grade		Level I	Level II	Level III	Level IV
Reading (Starting	3	≤ 330	331-337	338-349	≥ 350
with 2007-08	4	≤ 334	335-342	343-353	≥ 354
school year	5	≤ 340	341-348	349-360	≥ 361

Focus Groups

The qualitative section of this mixed methods design investigated how interactive whiteboards influenced the instructional methods of teachers through teacher focus groups. The teacher population for the study included 44 third, fourth, and fifth grade teachers that had used the IWB for at least one academic year. The focal point of the focus groups was instructional methodology and how the IWB made instruction different in the classroom. The 44 teachers' student test scores ranged from the highest to the

lowest in the school system. Focus group sessions were recorded and digitized for later analysis.

Focus groups have been around for about ten years but the ways that focus groups are being used today is changing. Focus groups today can occur through face to face meetings, conference calls, webinars, online chats, interviews, blogs, and wikis. They are comprised of individuals that are similar to each other in a way that is important to the research. However, the premise of focus groups has not changed. People still want to be heard and listened to and understood where they are coming from and made to feel like they have shared a common experience with other folks in the same situations. They want to feel comfortable, respected, and free to share their opinion without being judged.

Krueger recommends three stages for implementation of focus groups: Understand, Pilot Test, and Evaluate (Krueger, 2009). The first stage involves gaining an understanding of the issue, through the eyes of the participants. Arrive at an understanding of how the user values the product or program and learn the language used to talk about the topic. The second stage involves pilot testing the product. Participants are asked what they liked and disliked about the product and determine if there are areas of improvement. Focus groups in this research occurred in the three stage, the evaluation stage of teachers using IWBs for their instruction and student learning. This stage develops when the product or program has already been implemented or produced. In the case of this study, IWBs had been in use in classrooms for an academic school year prior to participation in focus groups.

The focal point of the focus groups was instructional methodology and how technology was integrated into instruction. The sessions focused on technology integrated

instruction which met the learning needs and achievement levels of all students. The focus groups included four broad questions with underlying questions, for teachers to indicate how IWBs affected their instructional methods and the achievement of their students. Table 12 represents the focus group questions and the resulting common themes associated with each question.

Table 12

Focus Group Questions and Common Themes

Question	Common Themes
How has your instruction changed by using the IWB?	Planning, Structure, Lesson Delivery
In what ways do you use IWBs in your instruction to accommodate the needs of students?	Differentiated Learning, Learning Styles
During instruction, what methods do you use to help students learn?	Discussion and Hands on activities
How has your teaching changed since using the IWB?	More thought and planning, More resources
Why did you begin using the IWB for instruction?	Instructional Impact

How has achievement and/or student attitude changed since using the IWB?	Engagement, Excitement about learning
How does the IWB help you develop activities for different student needs?	Interactive lessons
How do you use the IWB in class?	Whole group, Small group
Do you allow students to use the IWB?	Small groups, Demonstrations
How have your technology skills improved?	Tremendous improvement, Comfortable with technology
How do you introduce new concepts?	Discussions, Illustrations
Is the IWB worth the investment?	Visual appeal, Impact on learning
How valuable is it as an instructional tool?	As valuable as the teacher makes it

Could you teach as effectively without the IWB?	Could, but would not want to, Less engagement, Less excitement

Data Analysis

This research study utilized descriptive statistics to summarize data in a way that permitted the researcher to test the research hypotheses (Gay, 2006). For the quantitative section of this research, EOG scale scores for the academic years of 2007-2008 and 2008-2009 in math and reading were analyzed using the Statistical Package for the Social Sciences SPSS/12.0 (SPSS Standard Version, 2003). An analysis of covariance was used to determine the effect of IWBs on Math and Reading EOG scale scores for student scores in the third, fourth, and fifth grades. For this study, scores for children in classrooms that used an IWB were compared to classrooms that did not use IWBs. The covariates in the analyzes were the previous year's test scores (2007-2008) and the dependent variable was the current year's test scores (2008-2009).

For the qualitative section of this research, 44 third, fourth, and fifth grade teachers that had used the IWB for at least one academic year participated in focus group sessions. The focal point of the focus groups was instructional methodology and how the IWB made instruction different in the classroom. The 44 teachers' student test scores ranged from the highest to the lowest in the school system.

For data analysis of the focus groups, the process of coding responses through the common themes was used. The first and second rounds of coding were analyzed using

the digitized transcripts through a comparison of reoccurring themes. Subsequently, codes that were not consistent throughout the remaining focus group sessions were removed and no new codes were added. This process provided the researcher with a master list of codes on which to base research. From this list, the data was analyzed for findings that were repeated among the 44 teachers. All focus group sessions were recorded and digitized for later analysis in Chapter Four.

Summary

In this chapter, two research questions dealt with the extent to which using IWBs in grades three, four, and five improved math and reading scale scores and the extent to which IWBs changed teacher instructional methods. For the quantitative section of this research, Math and Reading EOG scale scores for grades three, four, and five were compared to investigate whether IWBs made a consistent difference in student scale scores. For the qualitative section of this research, focus groups containing teachers that used IWBs were conducted that centered on technology integrated instructional methodologies and student attitudes toward learning.

In summary, much documentation has made claims regarding IWBs and their effect on student achievement and teacher instructional methods. Research by Smart, Inc. (2009) indicates that when teachers use the IWB, students are more highly engaged and are more likely to retain knowledge learned during instruction.

In Chapter Four, the researcher will summarize the findings of the study specific to the research questions and hypotheses.

CHAPTER 4: RESULTS

In Chapter Three, the researcher discussed the methodology of the study in detail, including the data analysis and the method used to address each research question. Local data was used from the 2007-2008 and 2008-2009 academic years of EOG scale scores in grades three, four, and five for the quantitative section of this study. For the qualitative section, the sample group included 44 third, fourth, and fifth grade teachers from the 16 elementary schools and two intermediate schools in this county that had used the IWB for instruction at least one academic year.

In this section, Chapter Four, the researcher will examine two research questions. These questions are:

1. Are there differences between classrooms that use IWBs and those that do not use IWBs in third, fourth, and fifth grade students' math and reading scale scores?
2. How has instruction in the classroom changed by using an IWB?

This study used a mixed methods design investigation to examine the effect of interactive technologies, specifically interactive whiteboards (IWBs), on student scale scores in the classroom and on the instructional methods of teachers. Data analysis was done sequentially and examined the effect of IWBs on two outcomes, student scale scores in math and reading in grades three, four, and five, and on teacher instruction. The

following sections describe the research participants, research questions, results, and summary.

Participants

For the academic year of 2007-2008, the math sample included 3501 EOG scale scores from students who were enrolled in the third, fourth, and fifth grades. The math group of students that did not receive instruction with the use of an IWB was comprised of 2433 scale scores and the math group of students that did receive instruction with the use of an IWB was comprised of 1068 scale scores. The reading sample included 3469 EOG scale scores from students who were enrolled in the third, fourth, and fifth. The reading group of students that did not receive instruction with the use of an IWB was comprised of 2414 scale scores and the reading group of students that did receive instruction with the use of an IWB was comprised of 1055 scale scores.

For the academic year of 2008-2009, the math sample included 3461 EOG scale scores from students who were enrolled in the third, fourth, and fifth grades. The math group of students that did not receive instruction with the use of an IWB was comprised of 1251 scale scores and the math group of students that did receive instruction with the use of an IWB was comprised of 1636 scale scores. The reading sample included 3430 EOG scale scores from students who were enrolled in the third, fourth, and fifth grades. The reading group of students that did not receive instruction with the use of an IWB was comprised of 1811 scale scores and the reading group of students that did receive instruction with the use of an IWB was comprised of 1619 scale scores.

During the academic year of 2008-2009, the teacher population for the qualitative part of the study included 44 third, fourth, and fifth grade teachers that had used the IWB

for at least one academic year. The focal point of the focus groups was instructional methodology and how the IWB made instruction different in the classroom. The 44 teachers' student test scores ranged from the highest to the lowest in the school system.

Research Question 1: Math and Reading Scale Scores

1. Are there differences between classrooms that use IWBs and those that do not use IWBs in third, fourth, and fifth grade students' math and reading scale scores?

Math Participants

Third, fourth, and fifth grade students had already been assigned to classrooms. Students in third grade classrooms (*N*=667) received instruction using an IWB for an academic school year while other third grade students (*N*=533) received no instruction with the use of an IWB during class. Pre-test scale scores in math for third graders occurred at the beginning of their third grade through local benchmark testing. Post-test scale scores for the same third graders were their EOG Math scale scores that occurred in May at the conclusion of their third grade year.

Students in fourth grade classrooms (*N*=439) received instruction using an IWB for a school year while other fourth grade students (*N*=674) received no instruction with the use of an IWB during class. Fifth grade students (*N*=530) received instruction using an IWB for a school year while other fifth grade students (*N*=618) received no instruction with the use of an IWB during class. Pre-test scores for fourth and fifth graders in math were their previous year EOG scale scores in math. Post-test scores for the same fourth and fifth graders were their EOG Math scale scores that occurred in May at the conclusion of the same academic year.

The independent variable was use of an IWB in 2009 (IWB2009), classrooms either had IWBs or they did not have IWBs. The dependent variables were Math EOG scale scores from 2008-2009 academic year and the covariates were the 2007-2008 math scale scores. An analysis of covariance (ANCOVA) was used to examine differences in the grouping conditions on EOG scale scores in math for grades three, four, and five. The data were screened for outliers and normality. There were no missing data or outliers detected and the distribution appeared normally distributed. The means and standard deviations for math are reported in Table 13.

Table 13

Means, Standard Deviations, and Sample Sizes for Math

Grade	IWB2009	Mean	Std. Deviation	N
3	No IWBs	347.71	8.298	533
	IWBs	349.66	8.226	667
	Total	348.79	8.311	1200
4	No IWBs	348.42	7.911	667
	IWBs	348.64	7.832	433
	Total	348.51	7.877	1100
5	No IWBs	352.44	7.406	615
	IWBs	352.68	7.442	528
	Total	352.55	7.421	1143

Results of the ANCOVA for third graders in math indicated a statistically significant difference for the group that used an IWB for instruction and the group that

did not use an IWB for instruction, $F_{(1, 1197)} = 38.34$, p=.01 with the IWB having a higher mean score and an effect size as measured with Cohen's *d* of .234.

Results of the ANCOVA for fourth graders in math indicated there was not a statistically significant difference for the group that used an IWB for instruction and the group that did not use an IWB for instruction, $F_{(1, 1097)} = .32$, p=.57.

Results of the ANCOVA for fifth graders in math indicated a statistically significant difference for the group that used an IWB for instruction and the group that did not use an IWB for instruction, $F_{(1, 1140)} = 4.02$ p=.05, with the IWB having a higher mean score and an effect size as measured with Cohen's *d* of .032.

Reading Participants

Pertaining to reading, third, fourth, and fifth grade students had already been assigned to classrooms. Students in third grade classrooms (*N*=658) received instruction using an IWB for an academic school year while other third grade students (*N*=529) received no instruction with the use of an IWB during class. Pre-test scale scores in reading for third graders occurred at the beginning of their third grade through local benchmark testing. Post-test scale scores for the same third graders were their EOG Reading scale scores that occurred in May at the conclusion of their third grade year.

Students in fourth grade classrooms (*N*=433) received instruction using an IWB for a school year while other fourth grade students (*N*=667) received no instruction with the use of an IWB during class. Fifth grade students (*N*=528) received instruction using an IWB for a school year while other fifth grade students (*N*=615) received no instruction with the use of an IWB during class. Pre-test scale scores for fourth and fifth graders in reading were their previous year EOG scale scores in reading. Post-test scale scores for

the same fourth and fifth graders were their EOG Reading scale scores that occurred in May at the conclusion of the same academic year.

The independent variable was use of an IWB in 2009 (IWB2009), classrooms either had IWBs or they did not have IWBs. The dependent variables were reading scale EOG scores from 2008-2009 academic year and the covariates were the 2007-2008 reading scale scores. An analysis of covariance (ANCOVA) was used to examine differences in the grouping conditions on EOG scale scores in reading for grades three, four, and five. The data were screened for outliers and normality. There were no missing data or outliers detected and the distribution appeared normally distributed. The means and standard deviations for reading are reported in Table 14.

Table 14

Means, Standard Deviations, and Sample Sizes for Reading

Grade	IWB2009	Mean	Std. Deviation	N
3	No IWBs	342.77	9.620	529
	IWBs	343.50	9.299	658
	Total	343.18	9.447	1187
4	No IWBs	348.42	7.911	667
	IWBs	348.64	7.832	433
	Total	348.51	7.877	1100
5	No IWBs	352.44	7.406	615
	IWBs	352.68	7.442	528
	Total	352.55	7.421	1143

Results of the ANCOVA for third graders in reading indicated a statistically significant difference for the group that used an IWB for instruction and the group that did not use an IWB for instruction, $F_{(1, 1184)} = 4.17$, p=.04, with the IWB having a higher mean score and an effect size as measured with Cohen's d of .076.

Results of the ANCOVA for fourth graders in reading indicated there was not a statistically significant difference for the group that used an IWB for instruction and the group that did not use an IWB for instruction, $F_{(1, 1097)} = .32$, p=.57.

Results of the ANCOVA for fifth graders in reading indicated a statistically significant difference for the group that used an IWB for instruction and the group that did not use an IWB for instruction, $F_{(1, 1140)} = 4.02$ p=.05, with the IWB having a higher mean score and an effect size as measured with Cohen's d of .032

Research Question 2: Teacher Instructional Methods

2. How has instruction in the classroom changed by using an IWB?

The qualitative section investigated how interactive whiteboards influence the instructional methods of teachers through a series of focus groups. The teacher population for the qualitative part of the study included 44 third, fourth, and fifth grade teachers that had used the IWB for at least one academic year. The focal point of the focus groups was instructional methodology and how the IWB made instruction different in the classroom. The 44 teachers' student test scores ranged from the highest to the lowest in the school system. Focus group sessions were recorded and digitized for later analysis.

For analyzing data, this researcher used the process of coding responses through the common themes of instructional methodologies. Data analyzed for the first and

second rounds of coding involved using digitized transcripts through a comparison of reoccurring themes. Saturation of information began occurring during the third focus group in which the same ideas were repeated from the first two groups of teachers. Subsequently, codes that were not consistent were removed and no new codes were added. Two more groups were conducted and the same patterns and themes surfaced that aligned with the first three focus group sessions. This process provided the researcher with a master list of codes upon which to base the research. From this list the researcher was able to access and analyze the data for findings that will be repeated among the 44 teachers.

The focus groups involved three phases: planning, conducting, data collection and analysis (Stewart & Shamdasani, 1990). Forty-four teachers were invited to participate. Given that the 16 elementary schools and two intermediate schools are scattered throughout this county, five focus group sessions were held in five different locations to accommodate location and travel for the 44 teachers involved. Data were collected over a three week period. Teachers were asked to share their views on the impact of IWBs on their instructional methods and the influence of IWBs on student achievement.

Focus Group Sessions

This researcher conducted the focus groups, interpreted the data, and analyzed the data. Data analysis involved searching for common themes and patterns, keywords, experiences, intensity and frequency, and level of agreement among the teachers involved.

The focus groups included four broad questions with underlying questions, for teachers to indicate how IWBs affected their instructional methods and the achievement

of their students. As stated earlier, responses were grouped according to a master list of themes that developed from the focus group questions. Each question listed below indicated the breakdown of teacher responses from their participation in the focus groups.

1. How has your instruction changed by using the IWB?

Teachers that participated in focus groups were all passionate about their IWBs and the effect the board had on instruction. "Students are engaged more often, and I am more enthusiastic about teaching with technology," said one teacher right from the start of the session. Three common themes emerged with this opening question: Planning, Structure, and Lesson delivery, with planning being the most frequent response to the change in instruction. Teachers were in consensus that their instructional methodology had changed with the implementation of the IWB. Data compiled indicated teachers were spending more time preparing for instruction and finding interactive lessons that correlated with their curriculum. Also present in the research were the themes of structure and lesson delivery. Several teachers alluded to using the IWB everyday for instruction and that students came to expect the interactivity this technology provided. The ability to utilize the multi functions of the IWB allows instruction to reach a new level. One teacher is quoted as stating her lesson delivery with the IWB "is more exciting because it is not just me talking. I don't know if I could go back and not have one (IWB) after having one for so many years."

1a.) In what ways do you use the IWB in your instruction to accommodate the needs of all students?

Responses from teachers that use IWBs for instruction intensely believe the board is valuable for all levels of student learners and that all learning styles can be reached using the IWB. One teacher stated, "I have one student that is a kinesthetic learner. He has to touch everything. If I can get him up and actually touching the IWB, doing the work on the board, I can keep his attention." Two common themes emerged with this statement: Differentiated Learning and Learning Styles with learning styles being the majority response. Most teachers believe using the IWB provides them with an avenue of reaching all students in the manner in which they learn best. Data compiled indicated teachers were using the IWB for its interactive capabilities that would enable them to reach students that learn best through visual and auditory stimulation. "The students I work with need visual connections to reach a true understanding of the concepts I teach. Using the IWB allows me to provide vibrant, interactive visuals quickly and effortlessly" said a fifth grade teacher.

1b.) During instruction, what methods do you use to help students learn?

All teachers that participated in focus group sessions strongly agree that hands-on activities and discussion are the best methods that help their students learn best. Frequent responses indicated that all teachers employ their students to be actively involved with the IWB. A fourth grade teacher commented, "I teach math and it has been wonderful for symmetry. The students can flip everything upside down, turn it, and rotate it. It is hands on and really good for them." The common theme of this statement was discussion and hands on activities. All teachers agreed the IWB provided large amounts of activities that allowed

students to be actively involved both in class discussions and when completing methods that provided them opportunities to be engaged in hands on movements. "Students really like working with the IWB because they are constantly watching. It is not like it is once a week on the computer, it is there in front of them all the time."

1c.) How has your teaching changed since using the IWB?

Everyone that participated in focus group sessions completely agreed their teaching had changed with the implementation of the IWB in their classrooms. Teachers nodded in agreement as one stated, "Mine complain when I say get out your textbook now. They don't like textbooks. I don't know how life existed without the SmartBoard." Two common themes emerged with this statement: More thought and planning, and more resources. Data compiled indicated twice the number of teachers placed more thought and planning into their teaching as compared to those teachers looking for more resources in which to use the IWB. All teachers commented on the focus of students and how they were able to maintain attention for longer periods of time. "Fun, exciting, peppy, more with it," were words that dominated conversation as talk continued regarding what IWBs had done for instruction. Teachers also conduct more research that allows them to bring in additional resources to emphasize the objectives of the lessons they are presenting. One teacher phrased the consensus of the group by adding, "I can fine tune my lessons to ensure they exactly pinpoint and appropriately instruct the precise information my students need in order for them to learn the desired objectives successfully."

1d.) Why did you begin using the IWB for instruction?

All teachers unanimously agreed they began using the IWB because of the instructional impact this technology had on the achievement of their students. There was only one theme for this statement which was instructional impact. Comments like, "I first saw the board at a tech conference about six years ago and was amazed at the capabilities and potential for impact on instruction and learning." Another teacher said, "I want my students to be engaged and become active learners, I want them to be excited." Data compiled indicated, in what seemed like one passionate group response, participants described their instruction as being cool, exciting, creative, successful, and new every day. The interactive modules that are packaged with the board enables teachers to capture attention and maintain concentration for longer periods of time. The impact on instruction the IWB has is best summed up with one last teacher comment. "I remember seeing the board for the first time. It was a life changing moment for me, a Dr. Phil moment."

2. How has achievement and/or student attitude changed since using the IWB?

In a profession where so much time is spent with classrooms of children, teachers come to know and understand how each student learns and interacts best with instruction in order for them to be successful. "Students are learning and retaining more. They pay better attention, they are more focused and more engaged," was a frequent comment. Two common themes emerged with this statement: engagement, and excitement about learning, with engagement being the majority response more than twice the time. Nearly all teachers remarked

about the improvement in attention from their students due to the IWB and the tools the board provides. Data compiled indicated students are more willing to be interactive, they want to achieve more, high time on task is present, and students are eager to have their turn using the board. Teachers also feel that students, who are not always successful on paper, can be successful in interactive situations. It allows the different achievement levels in classrooms to co-exist at the same time. Many comments resembled the following, "Children with ADD (attention deficit disorder) have really succeeded because it holds their attention" and "I can tell the difference in the kids' body language and their interaction is a lot different when I use the board." Overwhelmingly, teachers stated that using the IWB promoted more engagement and excitement from their students like no other resource.

2a.) How does the IWB help you develop activities for different student needs?

All teachers that participated in focus group sessions strongly agree that the IWB meets the needs of students through the use of interactive lessons. Frequent responses included, "The board can be used in small groups or the whole class and all learning styles can be met" and "Interactive lessons, particularly with math concepts, provide students with a bridge from the concrete to the pictorial that is missing with traditional paper/pencil learning." The common theme of this statement was interactive lessons. Data compiled indicated teachers agreed the IWB provided numerous amounts of interactive lessons that bring in different activities involving whole class, small groups, or individual learning. "So you are hitting all levels. Auditory, visual, you're hitting them all that way." Universally,

teachers agree the IWB provides countless opportunities for using interactive lessons to meet the learning needs of all students.

3. How do you use the IWB in class?

In education, teachers try lots of methods, looking for just the right one that will help their students achieve more. Two common themes emerged equally in this category: whole group and small group. Teachers use the IWB both in groups that involve all their students and also in ways that accommodate small groups of students at a time. Comments like, "I use mine for whole class and small group instruction. I use it for hands on activities, activities where the kids come up and manipulate things on the board" were frequently mentioned. Data compiled indicated teachers were using the IWB in areas such as having directions on the board as students enter the classroom, using the interactive properties of the board to hide and reveal math problems, PowerPoint, and web resources, all with the intent of higher achievement. This comment sums up how the IWB is used in class. "I use the board with whole group and small group lessons for a variety of purposes: to introduce new concepts, practice, and review."

3a.) Do you allow students to use the IWB?

Focus group participants strongly agreed that all students use the IWB at some point during the day. Comments included, "I allow them to use it (IWB) while monitored whole group, or in centers. Students figure out how the board works, often times, sooner than the teacher." Two common themes emerged with this statement: small groups and demonstration. Data compiled indicated students use the board interactively, with websites, and when they demonstrate lessons

learned. One teacher explained how students used the IWB in her classroom. “We used it when parents came for EOG prep night. We had selections on the board and parents completed the assignments. They really liked using it. Now, when their kids come home talking about the board, they know what they are talking about.”

3b.) How have your technology skills improved?

Everyone was in agreement that using the IWB had improved their technology skills. Teachers mentioned always learning something new with the board and the accompanying software, and not feeling as afraid of getting in and experimenting with the properties of the IWB. Two common themes emerged with this question: tremendous improvement and more comfortable with technology. Participants in the group proudly mentioned much of what they had learned had been through practice and experimentation with the board and software. Data compiled indicated they had received professional development but felt like they really gained experience with the board when they had it in their classroom and had the time to play and investigate the technology. One teacher expressed, “It used to intimidate me because I was afraid I would do something wrong or mess it up. But now, you get over that.” The most common comment was “My skills have dramatically improved over time. Each time I use the board or plan a new lesson, I discover a new idea to use the IWB for instruction.”

3c.) How do you introduce new concepts using the IWB?

The majority of participants expressed using the IWB to introduce new concepts was extremely beneficial. They use PowerPoint, interactive sites,

literature, scanned materials, videos, and numerous other forms of instruction when introducing something new to their students. Two common themes emerged: discussion and illustrations. “Kids will not have the background or knowledge of the topic you are getting ready to introduce so before I start with that subject, I take them to different places and go on a virtual tour of the subject so they can start building that base knowledge.” Data compiled indicated teachers were evenly divided on using the board for introductory discussions and for illustrations on new concepts. Basing experiences on previous learning concepts, teachers introduce new ideas and have students talk about, brain storm, ways they have approached new avenues of information and how they can investigate ways to achieve this new knowledge. Other times, teachers use video, interactive pictures, and thinking maps to introduce new concepts. Summing it best, states one teacher, “Anything to peak their interest.”

4. Is the IWB worth the investment?

This question returned perhaps the shortest answers to any of the focus group questions. Nearly everyone answered with a simple yet passionate, “YES!” Two common themes emerged from this question: visual appeal and impact on learning. “Anything that engages students and increases learning is worth the investment” was an opening remark that strayed from the consensus “yes” replies. The visual appeal of the IWB allows teachers to reach students on a technology level they have become accustomed to. Data compiled indicated the board visually captures attention and maintains that attention for longer periods of time. Use of the board enables teachers to really think and evaluate their instruction

from beginning to end. Teachers feel more effective because they are no longer the "dog and pony show" but rather a more effective guide for learning. It provides a "Wow" appeal for student knowledge. Stating it best was one teacher, "the visual appeal and its impact on the education of a visual generation cannot be discounted and it is definitely worth the monetary investment this district is making."

4a.) How valuable is it as an instructional tool?

All teachers that participated in the focus group sessions strongly agree that the IWB is only as valuable as the teacher allows it to be. There was only one common theme with this question: as valuable as the teacher makes it. Data compiled indicated most teachers feel like they could not teach without it anymore. It has the capability of capturing student attention and maintaining it for longer periods of time but also for making lessons more interesting and more effective. Many teachers remarked having had comments from parents stating they want their children in classrooms with IWBs. They want their child to have the opportunity to work with this technology. The final comment stated by one teacher summarizes the instructional purpose of the IWB, "If you know your instructional objectives and your students well, you are privy to an immeasurable wealth of instructional resources that you can specifically tailor to your objectives and needs of your students."

4b.) Do you think you could teach as effectively without the IWB?

Replies from teachers were intensely skewed toward nodding of heads to indicate an emphatic "NO." Answers varied toward "No, it wouldn't be as much

fun" to "I believe my student's motivation and excitement would diminish if I did not have an IWB now that they have been exposed to this type of technology." Three common themes emerged with this statement: could, but would not want to; less engagement; and less excitement. Data compiled indicated teachers felt like their instruction was more exciting and their attitude was contagious. They firmly believe the IWB has made a difference in test scores because of the engagement component of the board. One teacher remarked, "You would have to take me kicking and screaming from my classroom if you come to take it away." They remarked over and over again what happens to the levels of engagement and excitement in their classrooms when the power goes out or when the bulb in their projector burns out. Teachers and students struggle to deliver and learn lessons that were no longer effective or interactive or just plain interesting. Summing up this section was a teacher comment, "I would rather change grade levels or change schools than teach without my IWB."

Interactive and engagement were key words that continually emerged in focus group sessions. One teacher stated, "Students are engaged more often, and I am more enthusiastic about teaching with technology." Numerous comments suggested teachers would not nor could not go back to teaching without the IWB as a resource for instruction. Whole group, small group, discussion, visual appeal, learning impact, learning styles, and more, all seemed to be solutions to instruction that were solved with the integration of the IWB. This researcher can confidently state from focus group data, IWBs make a difference in the instructional methods of teachers.

Summary

In this chapter, Chapter Four, the researcher presented statistical results from the study of interactive whiteboards on student scale scores in the classroom and on the instructional methods of teachers. Data analysis was done sequentially and examined the effect of IWBs on two outcomes, student scale scores and teacher instruction. A mixed methods design investigation was used to examine quantitative and qualitative data to test these two outcomes.

The quantitative section investigated the effects of IWBs on student scale scores in grades three, fourth, and five through comparisons of Math and Reading EOG scale scores as published by the North Carolina Department of Public Instruction. The purpose was to compare two grouping conditions, one receiving instruction using an IWB for at least one year and one group not receiving instruction using an IWB and whether the IWB had an effect on the math and reading scores of students. An analysis of covariance (ANCOVA) was used to examine differences in the grouping conditions on EOG scale scores in reading and math for grades three, four, and five. The findings suggested that there were statistically significant differences in reading and math for third and fifth graders in classrooms that use IWBs versus classrooms that do not use IWBs for instruction.

The results suggested that classrooms that use IWBs for instruction may improve the Math EOGs scale scores of third and fifth graders. Given the large sample size of 1197 EOG Math test scores for grades three and five and the very small effect size, these scores out number fourth grade test scores better than two to one.

The results suggested that classrooms that use IWBs for instruction may improve the Reading EOGs scale scores of third and fifth graders. As in the math analysis, the large sample size of 1186 EOG Reading scores for grades three and five and the small effect size, these scores also out number fourth grade test scores better than two to one. The next section will focus on the results of Research Question Two.

The qualitative section investigated the effects of IWBs on the instructional methods of teachers in classrooms that use IWBs through a series of focus group sessions. The results of the focus groups suggested the use of an IWB made a difference in the instructional methods of teachers. Overwhelmingly, teachers believe IWBs are worth the investment for what it brings to instruction in the classroom and for what it does for the achievement level of all students. In summary, much documentation has made claims regarding IWBs and their successful effect on student achievement and teacher instructional methods.

Finally, in Chapter Five the researcher interprets and discusses the findings, implications, and conclusions of the study that might be used for future research and instruction within education.

CHAPTER 5: SUMMARY, DISCUSSION, CONCLUSION, AND RECOMMENATIONS

The researcher's desire to examine this topic stemmed from laying the foundation for implementation of 21st Century classrooms within a rural county of North Carolina. It was designed to examine the effect of interactive technologies, specifically interactive whiteboards (IWBs), on student scale scores in the classroom and on the instructional methods of teachers. As stated in Chapter One, this research examined the need for the study, presented a statement of the problem, and provided a description of the purpose of the study. Chapter Two examined a comprehensive review of the literature pertaining to IWBs and how they have been used in educational settings. The chapter also included how the IWB affected scale scores in reading and math for students in grades three, four, and five, and on the instructional methods of teachers. In Chapter Three, the researcher discussed the methodology of the study in detail, including the data analysis and the method used to address each research question. In Chapter Four, the researcher summarized the results of the study by providing data gathered to address each of the research questions outlined in Chapter Three. In this final chapter, the researcher will summarize the findings and discussions of this study by revisiting the major areas of research, outlining conclusions and stating specific implications of these results, followed by recommendations for future research.

Children today know all about the internet, cell phones, multitasking, and computers. They have grown up in a time when they have been immersed in technology

long before they arrive in our classrooms. They are connected to the entire world through television, computers, youtube, Facebook, and countless personal devises in electronic and digital form (Prensky, 2008). As technology drives the workforce in the 21st Century, all phases and stages of education must adjust. Technology has revolutionized our society and made every corner of the world accessible for students and teachers. It has the capability of transforming the learning process in the classroom through educators who can integrate it effectively and efficiently within their curricula. Knowlton states, "Today's students expect to experience their lessons, and it is perhaps their preferred mode of learning" (Knowlton, 2006, p.1). Students in classrooms today have different expectations growing up. Educators need to prepare students for a future that requires a different set of skills and technology has to be assimilated in order for that to happen.

With this information in mind, one could surmise that teachers acknowledge today's students grow up differently and learn differently and that education must find every way possible to teach children and improve learning. While chalkboards, whiteboards, and overhead projectors still exist in classrooms today, they are losing their emphasis as the focal point of the classroom. School districts are beginning to change the way things happen in the classroom through the integration of technology.

Around the world school districts are investing hundreds of thousands of dollars in technology in order to modernize classrooms and utilize every means available to advance student achievement. From interactive whiteboards (IWBs) to handheld tablets, from student response systems to mini video cameras, the most successful of these technology products are those that can grab student attention and capture learning in new and productive ways in order to service all types of learning. Classrooms preparing for

the 21st Century must become innovative, interactive, and equipped with technology that offers numerous avenues for instructional methodologies. Technology can help provide an enriched environment that allows the teacher to better facilitate learning and instruction (Kennedy, 2008).

Research by Smart, Inc. (2009) indicates that when teachers use the IWB, students are more highly engaged and are more likely to retain knowledge learned during instruction. Results of the focus groups included in this study suggested the use of an IWB made a difference in the instructional methods of teachers. Overwhelmingly, teachers believe IWBs are worth the investment for what it brings to instruction in the classroom and for what it does for the achievement level of all students.

Statement of the Research Problem

All over the country, classrooms are being equipped with interactive whiteboards as a means of engaging ways that can help students succeed in the 21st Century. Since 2003, more than three quarters of British schools have installed IWBs in their classrooms (Schachter, 2010). An interactive whiteboard provides a large, computerized, touch sensitive board which allows access to the internet, audio and video presentations, and interactive activities. It works in conjunction with a computer and projector to allow digitizing media through the use of a stylus or even the finger of a child. IWBs can be portable or permanently affixed in the classroom. A typical setup includes the touch sensitive board, computer, LCD projector, and interactive software. The first interactive whiteboard was manufactured by SMART Technologies, Inc. in 1991 (Knowlton, 2006).

As explained in Chapter Two, the focus of this research was an analysis of the use of IWBs in elementary schools. It was designed to examine the effect of interactive

technologies, specifically interactive whiteboards (IWBs), on student scale scores in the classroom and on the instructional methods of teachers. Data analysis examined the effect of IWBs on two outcomes, student scale scores and teacher instruction.

The researcher examined the following questions:

1. Are there differences between classrooms that use IWBs and those that do not use IWBs in third, fourth, and fifth grade students' math and reading scale scores?
2. How has instruction in the classroom changed by using an IWB?

The IWB offers several features which make it particularly useful for classroom instruction: (1) The IWB enables teachers the flexibility of projecting a computer image onto a board and making additions or corrections to the projected image and then saving for future reference, enhancing the achievement opportunity for students, or the opportunity for remediation. A positive attribute of an IWB is the ability to control a computer from a touch of the board (Smith, et al., 2005). The teacher has the ability to flip from one screen to another, one document to another, and/or one software application to another. As one teacher puts it, "I can see much more evidence of learning carried from one lesson to the next because of the ability for reinforcement on the fly" (Smith, et al., 2005, p. 92).

(2) The second avenue for teacher instructional methods and IWBs is efficiency. Students who find it difficult to manipulate a mouse and keyboard find it much easier to work with an IWB. Smith reports that students who lack some fine motor skills find working with the IWB to be much more forgiving and easier to work with lessons and activities (Smith, et al., 2005). Teachers have the capability to develop lessons integrated

with multiple types of resources and save those lessons complete with notations, on their computer for reference later during the day, week, month, or year. Teachers can use IWBs to adapt materials for students of all learning needs through numerous ways such as resizing text and graphics, converting handwriting to text, adjusting brightness and darkness, using the board to integrate videos, or enlarging any image that is viewed on the screen of a computer (Knowlton, 2006). Teachers and students can use the stylus or a finger to click on the board and interact as one would on a touch screen. This type of interactivity lends an instructional opportunity not offered by any other presentation device.

Robert J. Marzano, respected education researcher, has studied over 200 classrooms in which teachers conduct lessons with and without the IWB (Manzo, 2010). "He found significant benefits when teachers used the boards, particularly among those who had been using the devices for more than two years, were confident in their skill with the boards' features, and used them for at least 75 percent of class time. The greatest benefits appeared to be in boosting student motivation and participation" (Manzo, 2010).

Literature and Research Related to IWBs

As classrooms move into the 21st Century, research on IWBs has become more documented and more substantial. Studies indicated that teachers and students like the technology (Beeland, 2005) and both feel like there is more engagement and increased motivation to learn. Research also indicated that through the use of IWBs, instruction shifts to an interactive mode rather than a presentation mode thereby making lessons more student centered.

Even though IWBs are increasing in numbers in classrooms everywhere, they cannot stand as the sole solution to increased achievement. Unless the teacher is ready for a pedagogic change, the IWB will never make a difference in classrooms or provide new opportunities of learning for students and teachers alike. Most research concluded with the same scenario, teachers need time, training, and a desire and interest in using technology in order to make a difference in student achievement. IWBs are a resource that can assist in providing a broader purpose during instruction. The ultimate implementation derives from the teacher as the critical component interacting with the IWB in order to achieve quality instruction and student achievement. With planning, training, preparation, and time, the IWB can become a tool that adds greater enhancement to the learning opportunity and motivation of students.

Review of the Methodology

This study used a mixed methods design investigation. It was designed to examine the effect of interactive technologies, specifically interactive whiteboards (IWBs), on student scale scores in the classroom and on the instructional methods of teachers. Data analysis was done sequentially and examined the effect of IWBs on two outcomes, student scale scores and teacher instruction. Results of this study will be used to lay the foundation for implementation of 21st Century classrooms within a rural county of North Carolina.

For the quantitative section of this research, an analysis of covariance was used to determine the effect of IWBs on Math and Reading EOG scale scores for students in third, fourth, and fifth grades during the academic years of 2007–2008 and 2008-2009. For this study, EOG scale scores for children in classrooms that used an IWB (IV) were

compared to classrooms that did not use IWBs (IV). North Carolina EOG Tests are curriculum based multiple choice assessments for grades three through eight in the areas of math and reading. These scale tests scores are specifically aligned to the North Carolina Standard Course of Study and measure the achievement level of North Carolina students. Scale scores equate to an achievement level as indicated by North Carolina Department of Instruction (NCDPI, 1999). Achievement levels relate a common meaning as to what is expected at various levels of competence in each subject area. EOG assessments are given during the last three weeks of school and are administered to all students at the same time on the same days. The North Carolina EOG scale scores are used to assess a student's knowledge of subject content including the student's mastery of the content material as stated in the goals, objectives, and grade level competencies of the North Carolina Standard Course of Study (NCDPI, 1999).

This rural county in the foothills of North Carolina has 16 elementary schools and two intermediate schools that house third, fourth, and fifth graders. The Accountability Department used the ten categories of "No Child Left Behind" to demographically compare all 18 schools EOG scale scores. Three categories emerged that resulted in similar demographics among this county's elementary schools and those categories were African-American enrollment, socio-economic status reflected in free and reduced lunch percentage, and Exceptional Children enrollment.

The qualitative section investigated how interactive whiteboards influence the instructional methods of teachers through a series of focus groups. The purpose of a focus group is to not only listen but to gather information, gather opinions, interview, and share perceptions of the topic at hand (Lutenbacher, Cooper, and Faccia, 2002). Focus groups

develop and create information on attitudes and values, and can provide relevant substance on a particular experience or program. It is a collection of qualitative data from people who share a common interest involved in a group focused discussion (Krueger, 2009).

The teacher population for the qualitative part of the study included 44 third, fourth, and fifth grade teachers that had used the IWB for at least one academic year. The focal point of the focus groups was instructional methodology and how the IWB made instruction different in the classroom. The 44 teachers' student test scores ranged from the highest to the lowest in the school system. Focus group sessions were recorded and digitized for later analysis.

For analyzing data, this researcher used the process of coding responses through the common themes of instructional methodologies. An analysis of the first and second rounds of transcribing the digitized transcripts produced a comparison of reoccurring themes. Subsequently, this researcher removed codes that were not consistent throughout the focus group sessions and did not add any new codes. This process provided the researcher with a master list of codes to base research on.

Summary of Findings

In Chapter Four, the researcher reported outcomes compiled to address each research question in detail. This section will revisit the results from each question. As stated previously, the quantitative section of this research examined the question of whether the use of an IWB made a difference in the Math and Reading EOG scale scores in classrooms in which teachers use IWBs compared to those in which they do not use IWBs as measured by EOG scale scores.

The effects of IWBs on student scale scores in reading and math in grades three, four, and five, were compared through two years of EOG scale scores as published by the North Carolina Department of Public Instruction. North Carolina EOG standardized tests are multiple choice, curriculum based, assessments given in grades three through eight. These annual tests are aligned to the North Carolina Standard Course of Study and measure the achievement level of students through scale score test results. Achievement levels relate a common meaning as to what is expected at various levels of competence along with the level of students' mastery of content material and subject knowledge (NCDPI, 1999).

The participants in the quantitative section of this study included third, fourth, and fifth grade EOG Reading and Math scale scores from 16 elementary schools and two intermediate schools for the academic years of 2007-2008 and 2008-2009. Two grouping conditions were compared, one group receiving instruction using an IWB for at least one year, and one group not receiving instruction through the use of an IWB. These conditions determined whether the IWB had an effect on EOG scale scores in third, fourth, and fifth grades.

Results of the analysis of covariance indicated statistically significant differences in Math and Reading in grades three and five in classrooms that used IWBs for instruction. There was not a significant difference in either subject in grade four. From these results, the researcher concluded classrooms that use an IWB for instruction may make a difference in the scale scores of students in reading and math.

As stated previously, the qualitative section of this research examined the question of whether the use of an IWB made a difference in the instructional methods of

teachers. The teacher population for the qualitative part of the study included 44 third, fourth, and fifth grade teachers that had used the IWB for at least one academic year. The focal point of the focus groups was instructional methodology and how the IWB made instruction different in the classroom. The 44 teachers' student test scores ranged from the highest to the lowest in the school system.

Robert Marzano studied 200 classrooms in which teachers delivered instruction with and without IWBs. He found significant benefits when teachers used the boards at least 75% of the time. The most impressive benefits were student motivation and student participation (Maine, 2010). Marzano concluded, "The teachers who were most effective using the whiteboards displayed many of the characteristics of good teaching in general….The whiteboards can be a powerful tool. If I had been a teacher in a classroom where I had access to those tools, I could have been a better teacher" (Maine, 2010).

Focus group summaries indicated teachers unanimously agree that use of the IWB made a difference in their instructional methods. IWBs allow for increased student engagement and make instruction more exciting.

Interactive Whiteboards

Moving quickly into the 21st Century, classrooms need to evolve into arenas that meet student needs and resolve the learning styles of all children. With over a million IWBs used in classrooms all over the world, the interactive whiteboard is here to stay (Knowlton, 2008).

Use of an IWB in the classroom improves student engagement, accommodates learning needs of students, and provides new levels of classroom instruction. Findings in this study agree with this statement. Teachers that participated in focus group sessions

were in consensus that their instructional methodology had changed with the implementation of the IWB. Data compiled from these teachers indicated they were spending more time preparing technology integrated lessons that would reach all levels of students. Several teachers alluded to using the IWB everyday for instruction and that students came to expect the interactivity this technology provided. The ability to utilize the multi functions of the IWB allows instruction to reach a new level. Most teachers believe using the IWB provides them with an avenue of reaching all students in the manner in which they learn best. Data compiled indicated teachers were using the IWB for its interactive capabilities that would enable them to reach students that learn best through visual and auditory stimulation. These findings are consistent with Glover and Miller (2002) which states there are three elements in effective teaching: verbal, visual, and kinesthetic learning styles and using an IWB supports all three of these elements. Technology, specifically IWBs, is one avenue that can assist teachers with instruction and can satisfy all learning styles. When students have opportunities to learn in classrooms that use technology, specifically IWBs, students are more engaged in the lesson content and comprehend more information. Interactive resources are in demand for teachers who want to involve all students with technology.

A majority of teachers from focus group sessions believe using the IWB provides them with an avenue of instructing all students. Data compiled indicated teachers were using the IWB for its interactive capabilities that would enable them to reach students that learn best through visual and auditory stimulation. The more students participate in classroom instruction, the more likely students will retain that knowledge. When teachers teach in ways that students learn, students are more engaged and interested in the lesson.

These findings coincide with the research of Bell (2002). He endorsed the use of the IWB as a means of providing an instructional tool in the classroom to accommodate different learning needs with research that indicated students respond to the color and interaction the board provides. Students who learn from touching can benefit from marking at the board. Audio learners benefit from the class discussions the board can initiate, and visual learners see what is taking place during the lesson. In agreement with Bell (2002), the IWB is a powerful instructional tool that can be implemented within a wide range of subjects and is advantageous for students of all ages. As teachers continuously strive to develop instructional strategies and tools, IWBs enable teachers to draw from whichever resource is needed for any particular student's learning style (Bell 2002).

Interactive Whiteboards and Student Achievement

Anything that can be viewed on the screen of a computer can be displayed using an IWB. This can allow for the entire class to see what is being displayed and interact with the presentation. Being able to involve the entire class enables the teacher to capture students' interests and makes information more visually understandable (Blanton, 2008).

Findings in this research suggest that there is a relationship between use of an IWB in classroom instruction and student scale scores. Third, fourth, and fifth grade student Math and Reading EOG scale scores from 16 elementary schools and two intermediate schools for the academic years of 2007-2008 and 2008-2009 were used in an analysis of covariance to determine whether use of an IWB for classroom instruction made a difference in student scale scores. Research compared two grouping conditions (i.e. one group receiving instruction using an IWB for one year and one group not receiving instruction using an IWB) and whether the IWB had an effect on the Math and

Reading scale scores of third, fourth, and fifth grade student EOG scale scores. The results suggested that classrooms that use IWBs for instruction may have a significant difference in the Math and Reading EOGs scale scores of third and fifth graders. Given the large sample size and the small effect size of 2383 test scores for grades three and five in classrooms that used IWBs, these scores out number fourth grade test scores better than two to one.

Results of this research support the results found by Oleksiw (2007) and Dill (2008). Oleksiw (2007) investigated the effects of IWBs on third grade math knowledge and skills. Students significantly improved math knowledge and skills and all students met proficiency on state achievement tests. Dill (2008) also investigated whether IWBs were positively associated with achievement in grades three through five. Students scored statistically significant at fifth grade level but did not reject or support the concept of achievement.

Findings of this research also support the results of Swan, Schenker, and Kratcoski (2008). This group researched reading and math achievement scores on students in grades three through eight to compare use of IWBs in classrooms that used them and those that did not. Findings returned a slightly higher performance score among students in the IWB math classes with students in grade four and five having the greatest advantage.

Finally, this research supports Marzano's (2009) research that studied IWBs and their potential to grow in classrooms exponentially and what this device can do for student achievement. His findings indicated use of IWBs was associated with a 16 percentile point gain in student achievement. This means that teachers can expect a

student at the 50th percentile in a classroom without the technology to increase to the 66th percentile in a classroom using whiteboards.

Interactive Whiteboards and Teacher's Instructional Methods

All teachers unanimously agreed they began using the IWB because of the instructional impact this technology had on the achievement of their students. Teachers that participated in focus group sessions completely agreed their teaching had changed with the implementation of the IWB into their classroom. Findings in this study indicated twice the number of teachers placed more thought and planning into their teaching as compared to those teachers looking for more resources in which to use the IWB. All teachers commented on the focus of students and how they were able to maintain attention for longer periods of time. Data also indicated most teachers felt like they could not teach without it anymore. It has the capability of capturing student attention and maintaining it for longer periods of time but also for making lessons more interesting and more effective. Many teachers remarked having had comments from parents stating they wanted their children in classrooms with IWBs. They wanted their child to have the opportunity to work with this technology.

Focus group participants were all passionate about their IWBs and the effect the board had on planning, structure, and lesson delivery. Teachers were in consensus that their lesson delivery had changed with the implementation of the IWB. Data compiled indicated teachers were spending more time preparing for instruction and finding interactive lessons that correlated with their curriculum. These findings were consistent with research conducted by Glover, Miller, Averis, and Door (2007). This research analyzed the way teachers who were comfortable using technology, specifically IWBs,

changed their pedagogy to enhance instruction and student learning through the use of the IWB. Glover concluded that teachers need adequate time to prepare lessons, become comfortable using the IWB, and have time to implement the technology into their teaching.

Teacher participants in focus group sessions believe the IWB can be used to accommodate the learning needs of all students. Responses from teachers that use IWBs for instruction intensely agree the board is valuable for all levels of student learners and that all learning needs can be reached using the IWB. Most teachers confirm using the IWB provides them with an avenue of reaching all students in the manner in which they learn best. Data compiled indicated teachers were using the IWB for its interactive capabilities that would enable them to reach students that learn best through visual and auditory stimulation. This research supports the findings of Kennewell and Beauchamp (2007). This group studied how IWBs can enhance learning in the classroom. Kennewell and Beauchamp (2007) concluded teachers felt the IWB was effective in gaining students' attention, maintaining their attention, and stimulating thinking for longer periods of time. The difference factor was the large visual display the board presents.

Everyone that participated in focus group sessions completely agreed their teaching had changed with the implementation of the IWB in their classrooms. Data compiled indicated twice the number of teachers placed more thought and planning into their teaching. They also agreed more time was spent looking for online resources to supplement their curriculum. All teachers commented on the focus of students and how they were able to maintain attention for longer periods of time. The interactive modules that are packaged with the board enabled teachers to capture attention and maintain

student concentration for longer periods of time. Teachers also conducted more research that allows them to bring in additional resources to emphasize the objectives of the lessons they are presenting. The IWB allows teachers to prepare lessons to ensure they exactly pinpoint and appropriately instruct the precise information students need in order for them to learn the desired objectives successfully. These findings are consistent with research conducted by Gerard and Widener (1999) in which they studied how the IWB could be used to facilitate teaching from the teacher's perspective. Gerard and Widener (1999) concluded the IWB supports teaching in three ways: interaction and conversation in the classroom; helps in presenting new and linguistic components; and enables the teacher to be more organized. The IWB brings resources into the classroom and makes information available to all students without having the need for a computer for every student.

Implications and Recommendations for Future Study

This researcher believes that classrooms benefit from the integration of IWBs. This technology changes the way things happen for students and teachers and provides an avenue for improved instruction. The purpose of this study was to examine the effect of IWBs on student scale scores in the classroom and on the instructional methods of teachers. Studies have documented that both teachers and students like the technology (Beeland, 2002; Hall & Higgins, 2005; Smith, Higgins, Wall & Miller, 2005) and that students are more engaged and motivated to learn when IWBs are integrated into the instructional day (Beeland, 2002, Miller, Glover & Averis, 2004: Smith, Hardman & Higgins, 2006). Additionally, many studies have documented that use of IWBs transfers

instruction to more of an interactive mode instead of a presentation mode and makes lessons more student-centered (Bell, 2002; Miller, Glover& Averis, 2004).

Interactive whiteboards are not and will never be the salvation within the classroom. When the teacher is ready for a pedagogic change, technology and IWBs can play a role in creating new opportunities of learning for students and teachers alike. Most of the studies reviewed in this chapter concluded with one common theme. Teachers need time, training, and an interest in using technology, specifically IWBs, to assess how the features of this resource can achieve a wider pedagogic purpose in their instruction (Armstrong, 2005; Glover & Miller, 2002; Smith, Harman, and Higgins, 2006; Glover, Miller, Averis, & Door, 2007). Armstrong et al., (2005) came to the realization that IWBs alone will not motivate students to learn, rather it is the teacher as the critical component in order for the lesson and IWB to work together to promote quality interactions and student achievement.

Future research should focus on other subject areas as well as other grade levels in the value of IWBs for achievement and instruction. It would also be interesting to determine if teacher experience, training for teachers, number of years using an IWB, socio economic status of students, or if some other teacher characteristic had an influence on IWBs in the classroom. This researcher would also recommend engaging more teachers in data analysis and perhaps even providing other ways to analyze instructional methods.

This research added to the already large numbers of studies of IWBs with its findings on student achievement and teacher instructional methods. The quantitative data added to the current knowledge base by reinforcing a consistently higher difference in

EOG scale scores in math and reading in grades three and five in classrooms that regularly used an IWB for instruction. Data used in this study included a large sample size with a very small effect size. Even though grade four did not find significant differences, that could be explained by the lack of fourth grade classrooms in this district that had IWBs in use.

The qualitative data was overwhelmingly positive and added to current knowledge that IWBs influence the instructional methods of teachers. Interactive whiteboards are not and will never be the solution for success within the classroom. When the teacher is ready for a pedagogic change, technology and IWBs can play a role in creating new opportunities of learning for students and teachers alike. Most of the studies reviewed in this research concluded with that common theme.

The key conclusions in this research indicated teachers would not want to teach without an IWB but could if they were forced into that classroom situation. The IWB is a resource for making instruction easier to incorporate the elements of good teaching for those interested in integrating the technology. It is one avenue for bringing classrooms, a difference in achievement, and instruction into the 21st Century.

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APPENDIX A: FOCUS GROUP QUESTIONS

Focus Group Questions for Teachers

1. How has your instruction changed by using the IWB?
    a. In what ways do you use IWBs in your instruction to accommodate the needs of students?
    b. During instruction, what methods do you use to help students learn?
    c. How has your teaching changed since using the IWB?
    d. Why did you begin using the IWB for instruction?
2. How has achievement and/or student attitude changed since using the IWB?
    a. How does the IWB help you develop activities for different student needs?
3. How do you use the IWB in class?
    a. Do you allow students to use the IWB?
    b. How has your technology skills improved?
    c. How do you introduce new concepts?
4. Is the IWB worth the investment?
    a. How valuable is it as an instructional tool?
    b. Could you teach as effectively without the IWB?

APPENDIX B: LETTER OF ENDORSEMENT

www.clevelandcountyschools.org
Cleveland County Schools
704 - 476 - 8000

March 23, 2009

To Members of the UNCC Institutional Review Board

Cleveland County Schools is strategically moving toward equipping our classrooms to become 21st Century learning environments, to provide our teachers with high quality professional development, and to equip all students with the knowledge and skills to become productive citizens in a globally competitive world by partnering with our community to provide appropriate educational experiences. As a result of this mission statement, we are striving to become one of the top 10 performing districts in the state.

In order to achieve our mission in preparing our students and teachers for a technology driven world, we are investigating technologies that supports teaching and learning in our classrooms. Cheryl Lutz, Director of Instructional Technology, will be conducting online surveys of elementary teachers throughout our district to assess teachers' ideals, opinions, and strategies of interactive white boards as they pertain to instruction and student engagement. The data and information collected from this survey will be useful in the future expenditures of technology devices in our school system. I am confident information collected from our teachers will be held in the upmost confidence and used strictly for research purposes.

I support Cheryl Lutz in her research efforts and look forward to reviewing the data collected from this research study. If you have any questions concerning support of this research project, please contact me. Thank you very much.

Respectfully submitted,

Bruce Boyles,
Superintendent

Administrative Center • 130 South Post Road, Suite 2 • Shelby, NC 28152 • FAX 704-476-8300
Instructional Center • 315 Patton Drive • Shelby, NC 28150 • FAX 704-476-8302
Business Center • 105 East Ridge Street • Kings Mountain, NC 28086 • FAX 704-476-8304

APPENDIX C: IRB CONCENT FORM FOR FOCUS GROUP PARTICIPATION

UNC CHARLOTTE
College of Education

Department of Educational Leadership

9201 University City Blvd, Charlotte, NC 28223-0001
t/ 704.687.8686 f/ 704.687.3128

Research Participant Consent Form

Title: Interactive Whiteboards and their effect on student achievement and teacher's instructional methods.

Conducted By: *Cheryl Lutz, Cleveland County Schools, John Gretes and Claudia Flowers, UNCC Dept. of Education, and the University of North Carolina at Charlotte.*

You are being asked to participate in a research study. This form will give you information about the study. The person who gave you this form will also describe the study and answer all your questions. Before you decide whether you want to be in the study, please read the information below and ask questions about anything you don't understand. Your participation is entirely voluntary and you can refuse to participate without penalty or loss of benefits to which you are otherwise entitled. You can stop your participation at any time by simply telling the researcher.

The purpose of this study is to determine whether interactive whiteboards have an influence on student achievement and teachers instructional methods. Many students entering our classrooms today must "power-down" and revert to learning the same way their parents did many years ago (Kennedy, 2008). Chalkboards, overhead projectors, and lectures are instructional methods still being used in schools all across our state and nation. The findings of this study will add to what is known with information about the extent to which the financial investment many schools are making in Interactive whiteboards (IWBs) results in increased student achievement as well as improved teacher instructional methods. The findings will be useful to parents, school administrators, Boards of Education, and classroom teachers as they search to find reasons for the investment of IWBs in efforts to positively impact student achievement and teacher instruction and attitudes along with preparations for 21 Century classrooms.

If you agree to be in this study, we will ask you to do the following things:

- Participate in a 45 - 60 minute focus group

You are a volunteer. The decision to participate in this study is completely up to you. If you decide to be in the study, you may stop at any time. You will not be treated any differently if you decide not to participate.

Total estimated time to participate is 45 - 60 minutes for initial focus group.

Risks and Benefits of being in the study:
*A primary risk involves the loss of confidentiality which means someone may learn you have participated in the study. We cannot guarantee complete confidentiality of your responses since this is a group discussion and individuals may divulge the group discussion outside of the group.
*There is a slight risk that you may find that discussing interactive whiteboards and student achievement along with teacher instructional methods is upsetting, although the risk is probably no greater than everyday experiences.
*There are no individual benefits to participating in the study. Although possible benefits to society include a greater understanding of how students learn and what technology can do to assist in student achievement.

Focus groups will be audio recorded. Digital recordings will be stored on a password protected computer in the investigator's locked office; and they will be heard or viewed only for research purposes by the investigator and his or her associates. Any identifiers inadvertantly collected on the digital recordings will be deleted during transcription. After transcription, the digitial files will be saved for a period of one year and will then be destroyed. The final report and all ensuing publications will exclude any information that will make it possible to identify you as a subject.

Contacts and Questions:

If you have any questions about the study, you can ask now. If you think of questions later or want additional information, call the researchers conducting the study. Their names and e-mail addresses are at the top of this page.

UNC Charlotte wants to make sure you are treated in a fair and respectful manner. If you have questions about your rights as a research participants, please contact University of North Carolina at Charlotte Research Compliance Office at 707 687-3309.

You will be given a copy of this information to keep for your records.

Statement of Consent:

I have read the above information and have sufficient information to make a decision about participating in this study. I am 18 years of age or older and give my consent to participate in this study.

Print Name:_____

Signature:_____Date: _____

_____ _____Date: _____
Signature of Person Obtaining Consent

_____Date: _____
Signature of Investigator

This form was approved for use on November 30, 2009 for the period of one (1) year.

APPENDIX D: APPROVAL FORM FOR RESEARCH PROJECT TO BE CONDUCTED IN THE CLEVELAND COUNTY SCHOOLS

Cleveland County Schools

www.clevelandcountyschools.org
Cleveland County Schools
704 - 476 - 8000

March 23, 2009

To Members of the UNCC Institutional Review Board

Cleveland County Schools is strategically moving toward equipping our classrooms to become 21st Century learning environments, to provide our teachers with high quality professional development, and to equip all students with the knowledge and skills to become productive citizens in a globally competitive world by partnering with our community to provide appropriate educational experiences. As a result of this mission statement, we are striving to become one of the top 10 performing districts in the state.

In order to achieve our mission in preparing our students and teachers for a technology driven world, we are investigating technologies that supports teaching and learning in our classrooms. Cheryl Lutz, Director of Instructional Technology, will be conducting online surveys of elementary teachers throughout our district to assess teachers' ideals, opinions, and strategies of interactive white boards as they pertain to instruction and student engagement. The data and information collected from this survey will be useful in the future expenditures of technology devices in our school system. I am confident information collected from our teachers will be held in the upmost confidence and used strictly for research purposes.

I support Cheryl Lutz in her research efforts and look forward to reviewing the data collected from this research study. If you have any questions concerning support of this research project, please contact me. Thank you very much.

Respectfully submitted,

Bruce Boyles,
Superintendent

Administrative Center • 130 South Post Road, Suite 2 • Shelby, NC 28152 • FAX 704-476-8300
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Business Center • 105 East Ridge Street • Kings Mountain, NC 28086 • FAX 704-476-8304

APPENDIX E: NORTH CAROLINA STATE BOARD OF EDUCATION
POLICY MANUAL, POLICY GCS-C-018
(Policy appended to include information pertaining to this study)

NORTH CAROLINA STATE BOARD OF EDUCATION
Policy Manual

Policy Identification
Priority: Globally Competitive Students
Category: ABCs Accountability Model
Policy ID Number: GCS-C-018

Policy Title: Policy delineating achievement-level ranges for the NC EOG Tests in Reading and Mathematics at Grades 3-8 , Science at grades 5 & 8, and the NC General Writing Assessments at Grade 10

Current Policy Date: 10/01/2009

Other Historical Information: Previous board dates: 01/10/2002, 05/01/2003, 10/02/2003, 03/02/2006, 10/12/2006, 12/07/2006,05/03/2007, 12/09/2007,10/02/2008,12/04/2008

Statutory Reference: GS 115C-174.11

Administrative Procedures Act (APA) Reference Number and Category:

THIS POLICY HAS BEEN ADOPTED BY THE NC STATE BOARD OF EDUCATION, BUT IS STILL PENDING CODIFICATION IN THE NC ADMINISTRATIVE CODE. ALL CODIFIED RULES MAY BE ACCESSED BY GOING TO THE OAH WEBSITE.

The achievement level ranges approved by the State Board of Education for the North Carolina EOG Tests in Reading and Mathematics at Grades 3-8, Science at Grades 5 & 8, and the North Carolina General Writing Assessment at Grade 10 for the ABCs Accountability Program are as follows:

Subject/Grade		Level I	Level II	Level III	Level IV
Reading (Prior to 2002-03 school year)	3	≤130	131-140	141-150	≥151
	4	≤134	135-144	145-155	≥156
	5	≤138	139-148	149-158	≥159
	6	≤140	141-151	152-161	≥162
	7	≤144	145-154	155-163	≥164

Subject/Grade		Level I	Level II	Level III	Level IV
	8	≤144	145-155	156-165	≥166
Reading					
(Starting with	3	≤229	230-239	240-249	≥250
2002-03	4	≤235	236-243	244-254	≥255
school year)	5	≤238	239-246	247-258	≥259
	6	≤241	242-251	252-263	≥264
	7	≤242	243-251	252-263	≥264
	8	≤243	244-253	254-265	≥266
Reading	3	≤ 330	331-337	338-349	≥ 350
(Starting with	4	≤ 334	335-342	343-353	≥ 354
2007-08	5	≤ 340	341-348	349-360	≥ 361
school year)	6	≤ 344	345-350	351-361	≥ 362
	7	≤ 347	348-355	356-362	≥ 363
	8	≤ 349	350-357	358-369	≥ 370
Mathematics					
	3	≤237	238-245	246-254	≥255
(Beginning	4	≤239	240-246	247-257	≥258
with 2001-02	5	≤242	243-249	250-259	≥260
through	6	≤-246	247-253	254-264	≥265
2004-05)	7	≤249	250-257	258-266	≥267
	8	≤253	254-260	261-271	≥272
Mathematics					
	3	≤328	329-338	339-351	≥352
(Starting with	4	≤335	336-344	345-357	≥358
2005-06	5	≤340	341-350	351-362	≥363
school year)	6	≤341	342-351	352-363	≥364
	7	≤345	346-354	355-366	≥367
	8	≤348	349-356	357-367	≥368

Achievement Level Descriptors North Carolina EOG Tests

North Carolina Reading Achievement Level Descriptors – Grade 3

Achievement Level I

Students performing at this level do not have sufficient mastery of knowledge and skills in this subject area to be successful at the next grade level.

Students performing at Level I typically show minimal use of decoding and comprehension skills required in the North Carolina *Standard Course of Study* at grade three. Students can identify characters and setting. These students read a variety of short and repetitive texts. Students at this level have limited vocabulary.

Achievement Level II

Students performing at this level demonstrate inconsistent mastery of knowledge and skills that are fundamental in this subject area and that are minimally sufficient to be successful at the next grade level.

Students performing at Level II can apply limited enabling strategies and skills to read and comprehend some texts, including fiction, nonfiction, poetry, and drama as required in the North Carolina *Standard Course of Study* at grade three. Students read and demonstrate literal comprehension of some third grade genres. Students are able to identify literary elements, such as characters, setting, problem, and main events. They use basic word identification strategies. They can draw simple conclusions and identify sequence of events in a variety of texts. They are developing the ability to use story structure and text organization.

Achievement Level III

Students performing at this level consistently demonstrate mastery of grade level subject matter and skills and are well prepared for the next grade level.

Students performing at Level III demonstrate grade-level reading comprehension skills as required in the North Carolina *Standard Course of Study* at grade three. Students are developing fluency as they read and comprehend a variety of third grade genres, such as fiction, nonfiction, poetry, and drama. Students interpret and analyze text by utilizing skills and strategies such as summarizing, making inferences and predictions, drawing conclusions, determining main idea, and making connections. They also use text features and text structures to comprehend. Students analyze characters, identify problems, determine the meaning of unfamiliar words, and develop an expanded vocabulary.

Achievement Level IV

Students performing at this level consistently perform in a superior manner clearly beyond that required to be proficient at grade level work.

Students performing at Level IV demonstrate an independent application of the reading comprehension skills required in the North Carolina *Standard Course of Study* at grade three. Students at this level read with fluency and comprehend a variety of third grade genres, such as fiction, nonfiction, poetry, and drama. Students analyze and integrate information to infer, draw conclusions, determine author's purpose, and generalize. Students independently compare and contrast elements within and between texts. They also analyze the effect of figurative language, author's craft, and literary elements.

North Carolina Reading Achievement Level Descriptors – Grade 4

Achievement Level I

Students performing at this level do not have sufficient mastery of knowledge and skills in this subject area to be successful at the next grade level.

Students performing at Level I can apply minimal enabling strategies and skills to read and comprehend some texts as required in the North Carolina *Standard Course of Study* at grade four. These students can use basic word strategies, text features, and structure to assist them in reading and comprehending text and identifying genre. Students can identify basic, explicit details and elements of a selection.

Achievement Level II

Students performing at this level demonstrate inconsistent mastery of knowledge and skills that are fundamental in this subject area and that are minimally sufficient to be successful at the next grade level.

Students performing at Level II can apply limited enabling strategies and skills to read and comprehend some texts, including fiction, nonfiction, poetry, and drama, as required in the North Carolina *Standard Course of Study* at grade four. Students can identify an explicitly stated main idea, relevant information, story sequence, and basic story structure and elements. In addition, they can interpret simple dialogue and character actions, connect text to self, follow two-step directions, form simple questions from text, draw simple conclusions, and use basic word-identification strategies.

Achievement Level III

Students performing at this level consistently demonstrate mastery of grade level subject matter and skills and are well prepared for the next grade level.

Students performing at Level III can apply a combination of enabling strategies and skills to read and comprehend a variety of texts, including fiction, nonfiction, poetry, and drama, as required in the North Carolina *Standard Course of Study* at grade four. This includes making generalizations, connections, inferences and relevant predictions; analyzing characters; identifying problems and solutions, main idea, and supporting details; drawing conclusions; summarizing; comparing and contrasting; and determining the meaning of unfamiliar words and author's purpose. Students are able to use information from multiple sources such as charts, graphs, and maps and can interpret information that is not explicitly stated in the text to determine theme, mood, main idea, and word choice.

Achievement Level IV

Students performing at this level consistently perform in a superior manner clearly beyond that required to be proficient at grade level work.

Students performing at Level IV demonstrate a highly proficient application of a combination of enabling strategies and skills to read and comprehend a variety of texts, including fiction, nonfiction, poetry, and drama as required in the North Carolina *Standard Course of Study* at grade four. Students can critically analyze, integrate, and evaluate information from multiple sources to generate connections and formulate and apply new ideas. They can interpret author's implicit and explicit purpose and information from multiple perspectives.

North Carolina Reading Achievement Level Descriptors – Grade 5

Achievement Level I

Students performing at this level do not have sufficient mastery of knowledge and skills in this subject area to be successful at the next grade level.

Students performing at Level I demonstrate minimal reading comprehension skills as required in the North Carolina *Standard Course of Study* at grade five. Students show evidence of some literal comprehension of limited fifth-grade texts. Typically students make simple predictions and simple concrete connections between texts with common themes. Students may be able to identify genre, main idea, and simple details. Students apply minimal strategies and skills to increase fluency and build background knowledge.

Achievement Level II

Students performing at this level demonstrate inconsistent mastery of knowledge and skills that are fundamental in this subject area and that are minimally sufficient to be successful at the next grade level.

Students performing at Level II can apply limited enabling strategies and skills to read and comprehend some texts, such as fiction, nonfiction, poetry, and drama as required in the North Carolina *Standard Course of Study* at grade five. Students typically show evidence of literal comprehension of a limited variety of fifth-grade texts. Students apply basic knowledge of text structure to locate information for specific purposes. They typically draw simple conclusions, make basic inferences, identify sequence of events, identify basic story elements, and recognize information in a limited variety of texts. Students demonstrate basic strategies to assist in vocabulary and comprehension development.

Achievement Level III

Students performing at this level consistently demonstrate mastery of grade level subject matter and skills and are well prepared for the next grade level.

Students performing at achievement level III demonstrate a proficient application of the reading comprehension skills required in the North Carolina *Standard Course of Study* at grade five. Students comprehend a variety of fifth-grade texts, such as fiction, nonfiction, poetry, and drama. Students typically apply comprehension strategies such as making predictions, drawing on personal understanding, extending vocabulary, evaluating inferences, analyzing content, and making connections within text. They also utilize a variety of metacognitive strategies to monitor comprehension, such as skimming, scanning, questioning, paraphrasing, and summarizing. Students are able to integrate main idea and details to further their understanding. Students are able to reference text to support conclusions. Students typically evaluate inferences and conclusions. Students can recognize media techniques such as bias, propaganda, and stereotyping.

Achievement Level IV

Students performing at this level consistently perform in a superior manner clearly beyond that required to be proficient at grade level work.

Students at Level IV demonstrate a highly proficient understanding of grade-level skills and comprehension as required in the North Carolina *Standard Course of Study* at grade five. Students comprehend a greater variety of fifth-grade texts, such as fiction, nonfiction, poetry, and drama. Students achieve a higher level of comprehension by predicting, questioning, evaluating,

analyzing, justifying, integrating, critiquing, and making judgments about elements of text. They also identify elements of fiction and nonfiction by referencing the text for author's choice of words, plot development, figurative language, and tone. Students make multiple connections within and between texts by recognizing similarities and differences based on a common theme or message. Students are also able to cite supporting evidence when evaluating such elements as character, plot, and theme.

Achievement Level Descriptors for North Carolina EOG Tests--Grade 3 Mathematics

Achievement Level I:

Students performing at this level do not have sufficient mastery of knowledge and skills in this subject area to be successful at the next grade level.

Students performing at Level I show minimal understanding and computational accuracy. The students often respond with inappropriate answers or procedures. They rarely use problem-solving strategies.

Level I students demonstrate a lack of development of number sense for whole numbers through 9,999 and a lack of evidence of ability to perform multi-digit addition and subtraction. They can rarely show knowledge of multiplication facts. Students inconsistently compare, order, and represent rational numbers (halves, fourths, and eighths; thirds and sixths) concretely and symbolically. They rarely use appropriate vocabulary to compare, describe, and classify two- and three-dimensional shapes. Students are not able to correctly measure length, capacity, weight, time, and temperature (Fahrenheit and Celsius). They can sometimes identify and extend simple numeric or geometric patterns. Students show minimal understanding of organizing and displaying data using a variety of graphs. They are rarely able to identify points on rectangular coordinate system. Students seldom correctly use symbols to represent unknown quantities in number sentences and to solve simple equations. They rarely solve problems using a variety of strategies.

Achievement Level II:

Students performing at this level demonstrate inconsistent mastery of knowledge and skills in this subject area and are minimally prepared to be successful at the next grade level.

Students performing at Level II typically show some evidence of understanding and computational accuracy. The students sometimes respond with appropriate answers or procedures. They demonstrate limited use of problem-solving strategies.

Level II students show some evidence of number sense for whole numbers through 9,999 and some evidence of multi-digit subtraction. They inconsistently apply multiplication facts in single-digit multiplication and division. Using fractions, they often incorrectly compare, order, and occasionally misrepresent (halves, fourths, thirds, sixths, and eighths). Students sometimes use appropriate vocabulary to compare, describe, and classify two- and three- dimensional shapes. They are inconsistent in measurement of length, capacity, weight, time, and temperature (Fahrenheit and Celsius). Students show limited understanding of the concept of probability. They are inconsistent when they identify and extend numeric and geometric patterns. Students are

sometimes successful at organizing and displaying data using a variety of graphs. They sometimes correctly identify points on the rectangular coordinate system. Students occasionally correctly solve problems where symbols are used to represent unknown quantities in number sentences and to solve simple equations. They sometimes solve problems using a limited variety of strategies

Achievement Level III:
Students performing at this level consistently demonstrate mastery of grade level subject matter and skills and are well prepared for the next grade level.

Students performing at Level III generally show understanding, compute accurately. The students consistently respond with appropriate answers or procedures. They use a variety of problem-solving strategies.

Level III students demonstrate number sense for whole numbers through 9,999 and show consistent evidence of ability with multi-digit subtraction. They know multiplication facts and are fluent with single-digit multiplication and division. They regularly are successful at comparing, ordering and representing rational numbers (halves, fourths, thirds, sixths, and eighths). Students consistently use appropriate vocabulary to compare, describe, and classify two- and three-dimensional shapes. They frequently measure length, capacity, weight, time, and temperature accurately (Fahrenheit and Celsius). Almost always, students identify and extend numeric or geometric patterns correctly. They correctly organize and display data using a variety of graphs. Students appropriately use the rectangular coordinate system to graph and identify points. They understand and use simple probability concepts.

Students generally are able to use symbols to represent unknown quantities in number sentences and to solve simple equations successfully. They can solve problems using a variety of strategies.

Achievement Level IV:
Students performing at this level consistently perform in a superior manner clearly beyond that required to be proficient at grade level work.

Students performing at Level IV commonly show a high level of understanding, compute accurately. The students are very consistent responding with appropriate answers or procedures. They demonstrate flexibility by using a variety of problem-solving strategies.

Level IV students demonstrate a high level of success with regard to number sense for whole numbers through 9,999. They show mastery of multi-digit subtraction and apply multiplication facts fluently with single-digit multiplication and division. They consistently correctly compare, order, and represent rational numbers (halves, fourths, thirds, sixths, and eighths). Students consistently use appropriate vocabulary to compare, describe, and classify two- and three-dimensional shapes. They accurately measure length, capacity, weight, time, and temperature (Fahrenheit and Celsius). Students successfully identify and extend complex numeric or geometric patterns. They successfully organize, display, and interpret data using a variety of graphs. Students use the rectangular coordinate system to graph, identify, and mentally manipulate points. They accurately apply simple probability concepts. Students correctly use symbols to represent unknown quantities in number sentences and to solve equations. They solve high level thinking problems using a wide variety of strategies.

Achievement Level Descriptors for North Carolina EOG Tests--Grade 4 Mathematics

Achievement Level I:
Students performing at this level do not have sufficient mastery of knowledge and skills in this subject area to be successful at the next grade level.

Students performing at Level I show minimal understanding and computational accuracy. The students often respond with inappropriate answers or procedures. They rarely use problem-solving strategies.

Level I students rarely show number sense by comparing, ordering, estimating, and representing numbers from 0.01 to 99,999. Students are rarely able to multiply and divide multi-digit numbers or use strategies for estimation of products and quotients in appropriate situations. Students are not able to add and subtract fractions with like denominators. They seldom solve problems involving the perimeter of plane figures and the area of rectangles. Students cannot make appropriate use of the coordinate plane to describe location and relative position of points. They seldom describe lines accurately as parallel or perpendicular. Students are rarely successful at collecting, organizing, analyzing, and displaying data using a variety of graphs. They are unable to use range, median, and mode to describe a set of data. Students can rarely design simple experiments to investigate and describe the probability of events. Students are unable to use the order of operations or the identity, commutative, associative, and distributive properties.

Achievement Level II:
Students performing at this level demonstrate inconsistent mastery of knowledge and skills in this subject area and are minimally prepared to be successful at the next grade level.

Students performing at Level II typically show some evidence of understanding and computational accuracy. The students sometimes respond with appropriate answers or procedures. They demonstrate limited use of problem-solving strategies.

Level II students sometimes show number sense by comparing, ordering, estimating, and representing numbers from 0.01 to 99,999. They inconsistently multiply and divide multi-digit numbers. Students sometimes use strategies including estimation of products and quotients in appropriate situations. They are inconsistent in addition and subtraction of fractions with like denominators. Students sometimes solve problems involving perimeter of plane figures and the area of rectangles. Students sometimes correctly use the coordinate plane to describe the location and relative position of points. They inconsistently describe lines correctly as parallel or perpendicular. Students have difficulty collecting, organizing, analyzing, and displaying data using a variety of graphs. They are inconsistent in their ability to use range, median, and mode to describe a set of data. Students sometimes successfully design and use simple experiments to investigate and describe the probability of events. Students inconsistently use the order of operations or the identity, commutative, associative, and distributive properties.

Achievement Level III:
Students performing at this level consistently demonstrate mastery of grade level subject matter and skills and are well prepared for the next grade level.

Students performing at Level III generally show understanding and computational accuracy. The students consistently respond with appropriate answers or procedures. They use a variety of problem-solving strategies.

Level III students frequently show number sense by comparing, ordering, estimating, and representing numbers from 0.01 to 99,999. They are usually consistent when multiplying and dividing multi-digit numbers; they use strategies including estimation of products and quotients in appropriate situations. They also add and subtract numbers with like denominators. Students solve problems involving perimeter of plane figures and area of rectangles. Students use coordinate planes to describe the location and relative position of points. They describe lines correctly as parallel or perpendicular. Students collect, organize, analyze, and display data using a variety of graphs. They use range, median, and mode to describe a set of data. Students design and use simple experiments to investigate and describe the probability of events. Students generally can use the order of operations or the identity, commutative, associative, and distributive properties.

Achievement Level IV:
Students performing at this level consistently perform in a superior manner clearly beyond that required to be proficient at grade level work.

Students performing at Level IV commonly show a high level of understanding and computational accuracy. The students are very consistent responding with appropriate answers or procedures. They demonstrate flexibility by using a variety of problem-solving strategies.

Level IV students successfully show number sense by comparing, ordering, estimating, and representing numbers from 0.01 to 99,999. They display fluency with multiplication and division of multi-digit numbers. Students effectively use strategies including estimation of products and quotients in appropriate situations. They exhibit mastery of addition and subtraction of fractions with like denominators and decimals through hundredths. Students consistently solve problems involving the perimeter of plane figures and area of rectangles. They show a thorough understanding and application of the coordinate plane when describing location and relative position of a point. Students consistently describe lines correctly as parallel or perpendicular. They successfully collect, organize, and display data using a variety of graphs. Students accurately use range, median, and mode to describe a set of data. They effectively design and use simple experiments to investigate and describe the probability of events. Students successfully use the order of operations or the identity, commutative, associative, and distributive properties.

Achievement Level Descriptors for North Carolina EOG Tests-- Grade 5 Mathematics

Achievement Level I:
Students performing at this level do not have sufficient mastery of knowledge and skills in this subject area to be successful at the next grade level.

Students performing at Level I usually show minimal understanding and computational accuracy and often respond with inappropriate answers or procedures. They rarely use problem-solving strategies.

Students rarely demonstrate number sense for rational numbers 0.001 through 999,999. They rarely demonstrate ability in the addition, subtraction, comparison, and ordering of fractions and decimals. They seldom can estimate the measure of an object in one system given the measure of that object in another system. They rarely identify, estimate, and measure the angles of plane figures and rarely identify angle relationships. Students rarely identify, define, and describe the properties of plane figures, including parallel lines, perpendicular lines, and lengths of sides and diagonals. Students are seldom able to identify, generalize, and extend numeric and geometric patterns. In solving problems, fifth-graders at Level I rarely organize, analyze, and display data using a variety of graphs. They rarely are able to use range, median, and mode to describe multiple sets of data. Students rarely use algebraic expressions to solve one-step equations and inequalities. They rarely identify, describe, and analyze situations with constant or varying rates of change.

Achievement Level II:
Students performing at this level demonstrate inconsistent mastery of knowledge and skills in this subject area and are minimally prepared to be successful at the next grade level.

Students performing at Level II typically show some evidence understanding and computational accuracy and sometimes respond with appropriate answers or procedures. They demonstrate limited use of problem-solving strategies.

Students demonstrate inconsistent number sense for rational numbers 0.001 through 999,999. They demonstrate limited ability in the addition, subtraction, comparison, and ordering of fractions and decimals. They inconsistently estimate the measure of an object in one system given the measure of that object in another system. They sometimes correctly identify, estimate, and measure the angles of plane figures and sometimes correctly identify angle relationships. Students inconsistently identify, define, and describe the properties of plane figures, including parallel lines, perpendicular lines, and lengths of sides and diagonals. Students are sometimes able to identify, generalize, and extend numeric and geometric patterns. In problem solving, fifth-graders at Level II inconsistently organize, analyze, and display data using a variety of graphs. They have inconsistent success using range, median, and mode to describe multiple sets of data. Students sometimes are able to use algebraic expressions to solve one-step equations and inequalities. They inconsistently identify, describe, and analyze situations with constant or varying rates of change.

Achievement Level III:
Students performing at this level consistently demonstrate mastery of grade level subject matter and skills and are well prepared for the next grade level.

Students performing at Level III generally show understanding, compute accurately, and respond with appropriate answers or procedures. They use a variety of problem-solving strategies.

Students generally demonstrate number sense for rational numbers 0.001 through 999,999. They generally demonstrate ability in the addition, subtraction, comparison, and ordering of fractions and decimals. They usually make correct estimates of the measure of an object in one system given the measure of that object in another system. Students generally identify, estimate, and measure the angles of plane figures and generally identify angle relationships. They generally identify, define, and describe the properties of plane figures, including parallel lines, perpendicular lines, and lengths of sides and diagonals. Students are usually able to identify, generalize, and extend numeric and geometric patterns. To solve problems, fifth-graders at Level III generally are able to organize, analyze, and display data using a variety of graphs. They generally use range, median, and mode to describe multiple sets of data. Students generally use algebraic expressions to solve one-step equations and inequalities. They generally identify, describe, and analyze situations with constant or varying rates of change.

Achievement Level IV:
Students performing at this level consistently perform in a superior manner clearly beyond that required to be proficient at grade level work.

Students performing at Level IV commonly show a high level of understanding, compute accurately, and respond consistently with appropriate answers or procedures. They demonstrate flexibility by using a variety of problem-solving strategies.

Students consistently demonstrate number sense for rational numbers 0.001 through 999,999. They consistently demonstrate ability in the addition, subtraction, comparison, and ordering of fractions, mixed numbers, and decimals. They correctly estimate the measure of an object in one system given the measure of that object in another system. Students commonly identify, estimate, and measure the angles of plane figures and commonly identify angle relationships. They consistently identify, define, and describe the properties of plane figures, including parallel lines, perpendicular lines, and lengths of sides and diagonals. Students are commonly able to identify, generalize, and extend numeric and geometric patterns. To solve problems, fifth-graders at Level IV consistently organize, analyze, and display data using a variety of graphs. They consistently use range, median, and mode to describe multiple sets of data. Students commonly use algebraic expressions to solve one-step equations and inequalities. They commonly identify, describe, and analyze situations with constant or varying rates of change.