IMPROVING STUDENT ENGAGEMENT:

USE OF THE INTERACTIVE WHITEBOARD AS AN INSTRUCTIONAL TOOL TO IMPROVE ENGAGEMENT AND BEHAVIOR IN THE JUNIOR HIGH SCHOOL CLASSROOM

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Improving Student Engagement: Use of the Interactive Whiteboard as an Instructional Tool to Improve Engagement and Behavior in the Junior High School Classroom

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Abstract

G. Lyn Morgan. IMPROVING STUDENT ENGAGEMENT: USE OF THE INTERACTIVE WHITEBOARD AS AN INSTRUCTIONAL TOOL TO IMPROVE ENGAGEMENT AND BEHAVIOR IN THE JUNIOR HIGH SCHOOL CLASSROOM. (Under the direction of Dr. Clarence (Chick) Holland) School of Education, October, 2008.

This study examined the impact of interactive whiteboard use on student engagement and appropriate at-task behaviors of junior high school students. Two hundred twenty-six students at two public schools in northeast Florida were observed during the second quarter of the school year. Data were collected using an at-task checklist, and students completed an attitude survey regarding their perception of their own engagement and enjoyment with interactive whiteboard use. Significant differences were noted in student behavior between instruction without interactive whiteboard use and instruction with interactive whiteboard use. No significant correlations were found between the variables gender and ethnicity and improved student behavior. Results indicate that use of the interactive whiteboard as an instructional tool has a beneficial effect on student engagement in classroom lessons and leads to improved student behavior. Suggestions for further research are incorporated as part of the study results.

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Chapter One: Introduction

Technology in education today is practically an oxymoron. Though the last twenty years have seen a rate of technological progress equivalent to the entire 20th century, in the field of education technological change has lagged noticeably behind (Prensky, 2007). New technology and applications have occurred in all other areas of society: government, industry, finance, military, healthcare, and more. Yet educators are reluctant to accept new technologies for classroom use. As early as 1989, Gillman reported "considerable disappointment to date about the extent to which the increasing potential of this innovation [technology use in instruction] has been exploited within education circles" (p. 1). Since then, little advancement has been made to incorporate technology as an integral mainstream pedagogical tool. The educational sector has both procrastinated and haphazardly adopted available new technology. According to Russell and Haney (2000), though computer use in education is increasing, schools have been much slower than society at large in adopting new technologies. In many classrooms, the instructional tools of choice remain the board and the overhead projector. TVs on carts or mounted on the walls look down blank-faced and silent. The computer on the teacher's desk or in some isolated corner lies dormant. Despite federal and state legislation requiring inclusion of technology into educational delivery systems, educators continue to play catch-up with the incorporation of technology into instruction rather than being at the forefront of emerging technology applications. There may be many reasons for this resistance, among them cost, adapting innovations to the educational setting, teacher resistance to change, and lack of leadership at the administrative and district levels (Basilicato, 2005). Prensky states in his article that "In general, students are

learning, adopting, and using technology at a much more rapid pace than their teachers, and many teachers are highly fearful of the technologies that the students take for granted" (p. 40). This lack of interest may be attributed to teacher fears, but may also stem from deep-rooted teacher beliefs that traditional instructional methodologies have withstood the test of time, a "go with what you know" mentality. Today, however, technology has given rise to the information and digital ages and has rapidly expanded communication to the global level. As such, it is imperative that educators incorporate various technologies into their educational toolkits to reach students and to remain relevant in a changing society.

This study examined the use of one specific type of computer-assisted technology for classroom use, the interactive whiteboard (IWB). Interactive whiteboards have the potential to fulfill legislative mandates while serving as technological instructional tools which have positive effects on student engagement as evidenced by their at-task behavior in the classroom. The interactive whiteboard is a technological tool that, used in conjunction with a computer, makes a dramatic impact as a presentation device. But, unlike other computer technologies, interactive whiteboards are intended for whole-class instruction rather than individual use. They are large, touch-sensitive screens that are connected to a computer and projector. The computer screen is projected onto the whiteboard, thus allowing the teacher to conduct class at the board rather than being attached to the computer. Information can be displayed and manipulated by touching the screen. Notes and diagrams can be added by overwriting directly onto the screen with special pens, and then saved for further discussion or review. Informational, research, and real-time Internet sites can be easily incorporated and accessed during the lesson.

Other interactive features include drag and drop, hide and reveal boxes, diagramming, and highlighting. Lesson plans, created to support curricula and teacher ease of use, can be accessed by teacher users and downloaded from the accompanying software. The IWB creates a powerful visual impact on student attention, warranting teacher attention to its instructional applications.

Background

In order to participate fully in 21st century information-based society, students today must be prepared with technological knowledge, understanding, and skills. Technology has evolved dramatically in the last twenty years, yet teaching methodologies have not kept pace with these developments. Students need exposure to and practice with a variety of technologies as part of their general education. In recognition of the essential role that education plays in advancing the technological skills of the next generation, the federal government has intervened to ensure that the future United States workforce remains competitive with the rest of the world. The *No Child Left Behind Act of 2001* (NCLB) decrees that school districts incorporate technology into the educational system at the administrative and instructional levels. This act provides for "a national technology plan, based on an assessment of the continuing and future needs of the nation's schools in effectively using technology to provide all students the opportunity to meet challenging state academic standards" (PL 107-110). In addition to federal mandate, state technology standards also require that teachers use educational technologies professionally. Technological educational goals generally include two components: a focus on computer literacy, and on the improvement of instruction. According to Gillman, "Educational technology . . . has the power to enhance the

instructional program, to improve student academic performance, and to provide effective and efficient classroom, school, and administrative systems" (p. 16). The International Society for Technology in Education (ISTE) has published a list of technology standards which provide a framework on which states have built their technology standards. The ISTE *Technology Foundation Standards for Students* include six areas of competence: basic operations and concepts; social, ethical, and human issues; technology productivity tools; technology communication tools; technology research tools; and, technology problem-solving and decision-making tools. These standards are replicated in some way in most of the state technology standards of learning. A search of the Academic Benchmarks website revealed that professional use of technology is mandated in the state education standards of all fifty states and the District of Columbia. All states also have technology standards for students as part of their state standards of learning. Thirty-six states specify Technology Education standards as a separate component of the state education requirements. Fourteen states and the District of Columbia incorporate their technology standards within subject area standards.

The introduction to the Connecticut Computer Technology Competency Standards for Students (2007) states that "Being computer literate is becoming as important as being literate in the traditional sense . . . educational goals must be adjusted to accommodate the impact of technology on society" (p. 10). The Florida Department of Education, the state in which this research study was carried out, utilizes the Sunshine State Standards of Learning. Technology standards are integrated into subject area standards, such as the Language Arts: Grade 7 Standard (LA. 7.3.5.1) which states that "The student will: 1. Prepare writing using technology in a format appropriate to

audience and purpose" (FL DOE, 2007). The Florida Education Standards Commission has published a guide, *Educator Accomplished Practices: Competencies for Teachers of the Twenty-first Century* (2007) which contains competencies for preprofessional, professional, and accomplished level teachers. At the professional level, the technology competency states "The professional teacher uses technology to establish an atmosphere of active learning with existing and emerging technologies available at the school site. He/she provides students with opportunities to use technology to gather and share information with others, and facilitates access to the use of electronic resources" (p. 20). A list of key indicators provides a sampling of activities that satisfy the competency requirements, among them "Uses technology tools that enhance learning opportunities that are aligned with the Sunshine State Standards; teaches students to use available computers and other forms of technology as they relate to curricular activities" (p. 20).

The *No Child Left Behind Act* also allocates funds to be used for the purchase of technology at the district level and at the school level. Besides technology hardware, training and professional development are provided for by the act. In addition, it states that funding must be provided "with special attention given to the integration of advanced technologies (including emerging technologies) into classroom curriculum". However, the expense associated with computer purchase can still be prohibitive for many schools. Educators must, therefore, look for more economical alternative technologies that are appropriate for instruction. Gillman reports that, for classroom use, "the ideal ratio needed to provide free access is two students to one computer which few schools have been able to afford at that level of funding" (p. 4). Handheld computers may also be

utilized on a 2:1 ratio. These tools represent a considerable expenditure, however, for technologies that may not be used daily.

Fiscally responsible decisions by school district personnel about the selection of technological hardware and software that dovetail with curriculum and instructional strategies are vital to ensuring that students are being prepared to interact with technology proficiently. In many schools, however, there is no comprehensive plan for the acquisition and use of technology in the classroom (Ryan & Cooper, 1995). Although there are more computers in classrooms across the country today than 10 years ago, and computer use in schools has been increasing, mainstream technology persists in being underutilized in instruction or used in simplistic, unsophisticated ways (Prensky). Currently, computer use in schools has not kept up with societal integration. According to Twist and Withers (2007, p.36), "We are witnessing an educational deficit between new media activity at home, in private, and that which takes place in formal educational and public environments. We know that literacy is not confined to technical processes of reading, writing and numeracy. Being literate is much wider, and has social and cognitive consequences to how individuals think".

Most classroom technology use takes the form of an "add-on" approach to instruction because many teachers only reluctantly or intermittently implement computer use, being unwilling to devote the time and energy required to become competent technology users (Alexiou-Ray, Wilson, Wright & Peirano, 2003; Gillman, 1989). Computers are routinely used by educators for management tasks such as grades, attendance, correspondence, lesson planning, and student state assessment data. But, educational technology today is more than just a classroom computer; it also includes a

much wider range of tools to enhance teaching and learning. With school support and training, technology can become an integral instructional resource. For curriculum delivery, interactive whiteboards specifically meet the criteria as innovative technology according to NCLB and the Florida *Educator Accomplished Practices* recommendations.

Interactive whiteboards are a relatively simple new type of technology that teachers can use in the classroom as instructional aids which improve the learning environment by engaging students in the instruction (BECTA, 2003). They are more economical than providing an individual computer system for each student; they are intended for use in direct whole class instruction; they do not require relocating students to the "computer lab"; and, they allow students to be interactive with each other, the teacher, and the board utilizing visual, verbal, and tactile modalities. They can also incorporate a range of multimedia and other digital resources to enhance content; support interactive and collaborative learning; and, foster student control of learning. Best practice literature supports interactive learning to engage students and to encourage higher order thinking and problem-solving skills, particularly for middle school students. Use of interactive whiteboards for whole class instruction combines technology integration, interactive learning, and attention to students' developmental needs in ways that engage students, mentally and physically in the instructional process.

Problem Statement

The purpose of this small-scale quasi-experimental quantitative study was to investigate the effects of interactive whiteboard use on junior high school students' engagement in classroom lessons in an objective fashion utilizing an at-task behavior

observation instrument to record their engagement and for comparison of the data collected to a student attitude questionnaire.

The major research questions are:

1: Does use of the interactive whiteboard affect junior high school student engagement?

2: Do students exhibit more at-task behaviors when the interactive whiteboard is used in the classroom?

These major research questions raise the following ancillary questions in this investigation:

3: Is there a difference in student engagement between males and females with use of the IWB?

4: Is there a difference in student engagement among ethnicities with use of the IWB?

5: How do student perceptions of their level of engagement during IWB use correspond to the observation data?

The following hypotheses were developed from the research questions after reviewing previous studies on the effects of IWB use on student engagement and at-task behavior.

H_1: Use of the interactive whiteboard as an instructional tool will have a positive effect on the engagement and at-task behavior of middle school students in the classroom.

H_0: Use of the interactive whiteboard as an instructional tool will have no effect on the classroom behavior or engagement of middle

school students.

$H_{2:}$ Use of the interactive whiteboard as an instructional tool will show a difference in its effects on the at-task behavior of male and female middle school students in the classroom.

H_0: Use of the interactive whiteboard as an instructional tool will show no differences in effect on the classroom behavior or engagement of male and female middle school students.

$H_{3:}$ Use of the interactive whiteboard as an instructional tool will show a difference in effect on the engagement and at-task behavior among ethnic groups of middle school students in the classroom.

H_0: Use of the interactive whiteboard as an instructional tool show no difference in effect on the classroom behavior or engagement among ethnic groups of middle school students.

Professional Significance of the Study

The importance of this study lies in its practical value and its contribution to the pedagogical body of knowledge. Technology utilization and proficiency are required of teachers and students as requisite 21st century skills. The interactive whiteboard is one type of technology that can be successfully integrated in schools' technology plans at low cost for the school. Currently, however, interactive whiteboards are not widely used for regular classroom instruction. To date, there have been few studies conducted regarding interactive whiteboard use and its effects on student engagement and behavior. Most of the research that has been done focuses on teacher use, perception, pedagogy, and training needs. Studies involving the student perspectives have examined learning styles, teaching styles, and application in particular academic disciplines. Those studies that

have explored student engagement and motivation have looked primarily at teacher perceptions of student engagement and student self-perceptions through survey response regarding their own enjoyment and interest as the determinants. This study proposes that student engagement is also evidenced by student at-task behaviors during the lessons. The visual impact and interactive nature of whiteboards may involve students in ways that increase their at-task behaviors due to their engagement in instruction. This has usefulness for teachers in the areas of maintaining student focus and attention, retention of course material, and for classroom management issues.

Use of the interactive whiteboard in middle school classrooms also addresses the developmental needs of this age group. Literature on middle school student characteristics and performance indicate that student motivation and academic achievement decline during this maturational stage (Norton & Lewis, 2000; Andeman & Midgley, 1998). Student focus shifts from academic performance to social relationships as the driving priority. Consequently, they respond well to teaching strategies that use collaboration, interactivity, and problem-solving. Whiteboard use can incorporate these strategies in ways that engage students more fully in lessons, foster greater enthusiasm for learning, and increase student motivation.

Financial considerations concerning technology expenditures for school administrators may also be impacted by this study. As demand for the use of technology in educational settings increases, administrators must make decisions regarding the type of technology, the intended use of the technology such as whole-class versus individual instruction, and the cost/benefits of particular technologies with regard to available financial resources. A typical personal computer system may cost a school district up to

$2,000 per unit, but interactive whiteboards with stands can be purchased for half that amount. While a projector must also be purchased for the IWB to function at another $2,000 or less, the IWB remains considerably less costly for whole class instruction than providing individual computers for an entire class. As school personnel strive to stretch educational dollars as far as possible, interactive whiteboards offer a means of fulfilling technology requirements economically.

Overview of the Methodology

This was a quantitative quasi-experimental study. The research utilized a quantitative approach as the primary data source. Although students were randomly assigned to classes by the school district computer program TERMS, they were not randomly assigned in the traditional sense of experimental research. Those students assigned to classes of the participating teachers were the subjects of the study. The students in this experiment were junior high public school students, in grades seven and eight, attending schools located in a specified county in northeast Florida. Those students, ages 12-14, participated if they were assigned classes with Teacher A or Teacher B at School A, and with Teacher C at School B. A control class at each school was also observed for the duration of the research. Because this was a same group study, the subjects were exposed to both conditions in the study, no IWB use followed by IWB use, the independent variable in this study. The dependent variable, student engagement as evidenced by their behavior during lessons, was measured through systematic direct observation by the researcher. Access to School A and School B was granted by the schools' principals. The school district's Director of Instruction for Secondary Education was also informed. Parental permission was deemed unnecessary by the

school principals because anonymity of the study participants was maintained by the researcher.

The study was conducted over a six week period during the second quarter of the school year. Observations were conducted weekly to tally student engagement behaviors with and without use of the whiteboard. Data collection was made through direct observations using an at-task observation checklist to tally at-task/off-task behaviors as a measure of student engagement. At the end of the observation period, students completed an attitude survey regarding interactive whiteboard use and their perceived levels of enjoyment and engagement. Data were summarized using descriptive statistics, organized into tables. Data tables showing percentage data for each class were tabulated and arranged into charts. The tests of significance used for data analysis were paired sample and independent sample T-tests. Subgroups of male/female students and ethnicities were identified for further analysis using ANOVA.

Operational Definitions

Constructs were given the following operational definitions:

- Interactive whiteboard (IWB) was defined as a large, touch-sensitive screen connected to a computer and projector. The computer screen is projected onto the whiteboard allowing the teacher freedom to interact directly with the class. The term interactive whiteboard is used interchangeably with the brand name SMART Board.
- Interactive learning was defined as instruction which involves students directly in the learning process through a variety of mental and physical activities, including

reading, writing, and discussion; problem-solving, cooperative learning, simulations, and investigations.

- Social cognitivism is defined as a learning theory in which learning occurs through the filter of a student's culture and through social interactions within the group.
- Constructivism, another learning theory, conceives of learning as a process in which students build on past knowledge and experience to make sense of new information. Student engagement in the context of this research referred to student attentiveness, participation, and interest in the lesson.
- At-task behaviors were identified to include paying attention to the instruction, verbally interacting on the subject matter, participating in the assigned lesson activities, cooperating with classroom procedures, listening to instructions, making eye contact with the task or teacher, and seeking teacher assistance in the appropriate manner, as defined in the *Florida Performance Measurement System Manual for Coding* (FPMS, 1996). Off-task behaviors, according to FPMS, were defined as displaying disruptive behavior, being turned around in the seat, doing schoolwork other than that assigned or other non-subject-related activity, being out of the seat, head down on desk, making noises or faces, stalling, and talking out.
- Middle school students in the school district in which this study was conducted were those students who attended two of the junior high schools in the county, inclusive of grades seven and eight.

There is very little quantitative research as yet on the effectiveness of interactive whiteboard use on student engagement and behavior in educational settings. This study was conducted to determine and measure its effects with a student population recognized as experiencing a decline in grades and motivation during the early adolescent period of development. The results showed an increase in student engagement and improvement in at-task behaviors, thereby justifying IWB use from both instructional and financial perspectives.

Chapter Two: Review of the Literature

Technology is transforming classroom practice. Its use helps students learn better by providing a learning environment that is interactive, collaborative, learner-controlled, and inquiry-based (Prensky, 2007; Fawcett, 2000). Although the literature on instructional use of technology in general is extensive, there are a limited number of research studies conducted specifically to investigate interactive whiteboard use in the classroom. Initially developed in the 1990's by SMART Board for use in the corporate sector, interactive whiteboards have been used only within the last several years as educational instructional tools in classrooms. A wide base of literature related to technology and pedagogy exists, but for the purposes of this study, the search was limited to research relevant to IWB use. There is currently more qualitative than quantitative research available for IWB use. Research was located through Internet sources in journals, ERIC, and dissertation sites, but no landmark studies were located. A number of studies were located exploring IWB functions, usages, teaching methods, teacher attitudes, and subject-specific classroom applications. Of those studies located, the issues of student engagement and motivation were included in general terms as by-products of the research investigations, rather than as the primary focus. There has been considerable research conducted in the United Kingdom, much of it by the British Educational Communications & Technology Agency (BECTA) or its agents, monitoring the integration and effectiveness of interactive whiteboard use in British schools since their widespread adoption across that country. Studies conducted in the United States were far fewer in number and were limited in applicability to the investigation undertaken in this research. Consequently, the relevant issues of constructivism and social cognitive

learning theories, interactive learning, learning styles, middle school student needs, and student motivation related to the use of the IWB were also reviewed as integral components related to the concept of student engagement.

Theoretical literature

Use of instructional technology has been supported by a number of critical learning theories. Educational theories relevant to this investigation include the social cognitive and constructivist paradigms of learning. Social cognitive theory, as advocated by Bandura and Vygotsky, holds that learning is filtered through a child's culture, both in its content and style of thinking. In the social cognitive learning perspective, students learn best in the company of others, social groups playing a influential role in the development of understanding. Pedagogically, learning is facilitated through guided instruction, problem-solving, and peer interactions. Bandura (1977, p. 22) states "Learning would be exceedingly laborious, not to mention hazardous, if people had to rely solely on the effects of their own actions to inform them what to do . . . most human behavior is learned observationally through modeling: from observing others one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action". This is consistent with Vygotsky's (1978) perspective that social interactions are fundamental to learning. Because he believed that social exchanges are so important to learning, he advocated designing curricula emphasizing the dynamic role students must play in learning activities. He stated "that instruction is most efficient when students engage in activities within a supportive learning environment and when they receive appropriate guidance that is mediated by tools" (p. 231). Among the tools available for implementation as cognitive strategies are

the computer-supported interactive whiteboard. Glover, Miller, Averis, and Door (2007, p. 17) state that through the use of the IWB, teachers "become more aware of the nature of interactivity and its stimulation as the basis for conceptual development and cognitive understanding". This is supported by an earlier study evaluating teacher perceptions of student collaboration and interactivity. Bell (1998) concluded that IWB use encouraged interactive and collaborative learning consistent with Vygotsky's model. In their textbook, *Curriculum Foundations, Principles, and Theory*, Ornstein & Hunkins (1993) contend that development of critical thinking skills into more sophisticated information processing abilities is supported by technology use through collaboration and discussion during which students can explore concepts from varying perspectives and social backgrounds.

The constructivist approach to learning which theorizes that children construct new meaning and understanding from a synthesis of both their prior experiences and new information through exploration, inquiry, and social interactions also underpins technology, and, more specifically interactive whiteboard, use in the classroom. Computer-supported learning permits the construction of knowledge through collaboration and discourse. Constructivism, as a philosophy of learning, is an amalgam of the tenets of Dewey, Piaget and Bruner, among others. Each of these educational theorists emphasized learner-initiation and involvement in the learning process. The teacher's role, from the constructivist point of view, is that of a facilitator who assists students in constructing knowledge through dialogue, questioning, guided learning activities, and reflection. Constructivism, then, places the focus on the learner who actively participates in the learning process by engaging in meaningful experiences.

Through this active learning, students apply concepts and make connections between prior knowledge and new information. Alexiou-Ray, Wilson, Wright & Peirano (2003) maintain that use of interactive whiteboards "emphasized a more constructivist approach in which students are actively learning with "real world" implications" (p. 73). Like social cognitive theory, constructivist instructional design emphasizes collaboration and learner control while ascribing individual responsibility for creating understanding. LeDuff (2004) indicated in her study that manipulation of the IWB allows biology students to control the pace of their learning. Though interactive whiteboards are used mainly in whole class instruction, they contribute to the presentation of new knowledge and concepts, allow access to a variety of educational sources, and encourage dialogue and the exchange of ideas. Students are then able to construct meaning from these diverse sources of information.

The social cognitive and constructivist theories of learning encompass the milieu and needs of the learners themselves. These theories accommodate the diversity of learning styles within a group, the developmental stage of the learners, and the attitudes of the learners. Accordingly, the concepts of interactive learning, learning styles, middle school students, and student motivation and engagement were examined within the context of the empirical literature review.

Empirical Research

Interactive whiteboards are a technology medium that can serve students' needs in a variety of ways. Though there are a limited number of research studies specific to interactive whiteboard use in classrooms in the United States, numerous studies and research articles on various aspects of IWB use in the United Kingdom have been

published, most notably by Glover and Miller, researchers affiliated with BECTA. According to Levy (2002, p. 1), BECTA states in a research report that interactive whiteboards are tools which "enable access to and use of diverse resources for the benefit of the whole class while preserving the role of the teacher in guiding and monitoring learning". Although there have been studies conducted in the United States recently involving whiteboard use in classrooms, much of that research has investigated whiteboard use from teacher perspectives: teaching methodologies including interactive learning, learning style accommodations, integrating technology use in educational instruction, and middle school student needs; training and professional development needs and practices; subject area applications; and lesson preparation. A number of studies which focused on student perspectives evaluated learning style applications, subject areas, student achievement, and student attitudes. These studies were conducted across the spectrum of grade levels, with college, secondary, and elementary school students.

Two studies were located which specifically investigated the effects of whiteboard use on middle school students' motivation and engagement. The Beeland (2002) study examined whiteboard use and student engagement as a function of the visual nature of the technology. The Weimer (2001) study investigated IWB use and student motivation of middle school students after project completions through student self-perception surveys. The scarcity of research that was directly applicable to this investigation is indicative of a lack of research to date, particularly quantitative, regarding IWB use and its effects on students, and the need for further investigation of learner-related aspects of interactive whiteboard use as an instructional tool in the classroom.

Interactive whiteboard use accommodates the overarching theories of social cognitivism and constructivism, and the several pedagogical considerations of concern to educators related to student needs: inclusion of interactive learning methodologies, consideration of student learning styles, the developmental needs of middle school students, and the affective influences of student motivation and engagement. The research regarding these considerations is explored next for relevance and applicability to the current research endeavor.

Interactive Learning

Interactive learning, espoused and advocated by both social cognitivism and constructivism, requires that students be dynamically engaged in lesson activities. It incorporates a variety of educational strategies, such as use of visuals, reading, writing, discussing, and manipulating concepts. With effective planning, teachers can use the interactive whiteboard to satisfy each of these strategies. Smith, Hardman and Higgins (2006) investigated teacher-student discourse interactions in the context of interactive whole class teaching using the IWB. One hundred eighty-four literacy and numeracy lessons in the primary grades were observed over a two-year period. They found that lessons using the whiteboards had more reciprocal dialogue, faster pace, and greater frequency of answers. The IWB lessons were found to comprise a high level of interactive exchanges in the classroom and "that IWB lessons contained more whole class teaching and less group work" (p. 454) with an increase in the "indicators of engagement" (p. 455). Interactive whiteboards play a vital role in stimulating student interactivity in classroom instruction.

Levy conducted research in secondary schools in Sheffield, England, investigating the visual impact of whiteboard technology on the instructional practices utilized by teachers and the learning experiences of the students across the disciplines. Her objectives were to identify how teachers used the boards, what worked, the perceived benefits of whiteboard use, and what constituted good pedagogic practice. Among other findings, she concluded from her study that interactive whiteboard use triggers more teacher-student interactions by encouraging discussion, questioning, and greater student participation in the lessons. She also states that according to BECTA "High-quality direct teaching is oral, interactive and lively . . . It is a two-way process in which pupils are expected to play an active part by answering questions, contributing points to discussions, and explaining and demonstrating their methods to the class" (p. 1). A study conducted earlier by Gerard, Greene, and Widener (1999) of whiteboard use in high school foreign language classes supported Levy's conclusion, in which it was stated that "The merit of SMART Board [a brand of IWB] is that it enhances conversation" between teacher and students (p. 3).

In the LeDuff study, an investigation was undertaken regarding the relationship between the use of the interactive whiteboard in high school biology classes and the quality of learning taking place. She found that whiteboard use allowed students "to view processes on a large screen and interact with what is actually happening, which . . . helps them take control of the pace of their learning" (p. 5). She concluded that the interactive nature of the whiteboard is a critical part of its value as an instructional tool. This observing, dialoguing, and doing model is also discussed by Fink (1999) as a method of integrating active learning into classroom proceedings.

An early study by Bell examined teacher perceptions of the value of IWB use. She posted a survey on the Internet to poll IWB user perceptions on a number of issues, particularly on teaching effectiveness, effect on learning, and importance of interactive learning. Thirty teachers from a variety of backgrounds and subject areas responded during the eight day response time. The survey utilized both Likert Scale questions and open-ended questions. Bell concluded from her analysis of the responses that there was an overall positive attitude to IWB use. According to the responders, students were found to be more attentive and motivated, and therefore, more engaged, during lessons. Ninety-three percent of respondents rated the interactivity of the IWB as important, very important, or extremely important. The interactive and collaborative nature of IWB use was found to be among its most valuable attributes, according to Bell's research, supporting its effectiveness as a tool fostering interactive learning.

Learning Styles

The social cognitive and constructivist perspectives also embody the concept of individual student learning styles. Learning style preferences impact the way in which information is processed and stored. Because every classroom contains students with a variety of leaning styles, educators strive daily to incorporate instructional strategies that will meet the needs of each child. Interactive whiteboards provide a means of addressing those individual learning style differences. The range of learning styles with which educators are most familiar include the visual, auditory, and kinesthetic modalities. But the concept of learning styles and multiple intelligences has been expanded, most notably by the contributions of Gardner (1993) who identified eight core intelligences. With careful planning, use of interactive whiteboards in instruction can incorporate the various

learning modalities in ways that make learning more appealing. Lessons using the IWB can be structured to allow hands-on participation, while encouraging reflection through whole class discussion. Interactive whiteboards can display facts and data, sequence information, and include video clips, real-time sites, pictures, animations, diagrams, and be used to preview content, connect it to prior knowledge, and explore real-world applications. Visual learners benefit from seeing information displayed in colorful, large format. Kinesthetic learners have the opportunity to write on, highlight, and interact with the IWB. Auditory learners are accommodated through dialogue, sound effects, and oral stimulation.

Schut (2007) conducted a study with her high school biology classes to investigate student perceptions of IWB use in science classrooms. The results indicated that students found the whiteboard to be more engaging due to its visuals, multimedia capabilities, and enhanced note-taking. One student in the study stated that "the IWB helps the visual learner because it can give pictures and really nice diagrams . . . the pictures and animations make it easier to remember . . . colors help me relate and remember things better" (p. 52). Weimer asserted that with middle school students, "utilizing a range of different processes in teaching and using technology has more appeal than using just one process" also applies to the accommodation of different learning style preferences (p. 1).

A study conducted by Passey and Rogers (2004) investigated the effects of various computer technologies on student motivation at both the primary and secondary levels. It was noted as well that the visual, auditory, and kinesthetic impacts were enhanced with its use. They reported that technology use has a "motivational impact on

particular learning activities . . . the visual and kinesthetic forms of the ICT [information and communication technology] are engaging pupils to greater extents, as is the auditory form" (p. 26).

Middle School Students and Issues

Facilitation of learning, a social cognitive precept, is dependent on the age and developmental level of the learner. The middle school years are a particularly stressful time for students due to the rapid and significant changes they experience physically, mentally, and socially. According to the National Center for Research in Vocational Education (NCRVE, 1999), in making the transition from the elementary to the secondary setting, middle school students frequently suffer academically. As they strive for individuality and independence, for that period of time they are vulnerable to academic distress. The social aspects of development begin to take precedence over scholastic success, and typically grades decline. Best practices for middle school student instruction include active hands-on exploration, brief lecture, cooperative learning, and reciprocal communication of ideas. Positive social interactions and meaningful participation are essential to support their developmental needs (Wiles & Bondi, 2001; Watson, 1997).

Pedagogic practices integrating whiteboard use beneficially affects student performance and motivation while also addressing the social and emotional needs of middle school students. Beeland's study of the impact of IWB use on student engagement was conducted with middle school students. He found that they responded well to the interactive and collaborative aspects of whiteboard use. Weimer's investigation with middle school students also found that they were more motivated when

completing a project using the IWB. Two classes totaling 49 students completed two assignments, only one incorporating IWB use. Comments of students in the study when exposed to the experimental condition of IWB use reflected greater enjoyment of the learning experience and "Enjoyment suggests higher motivation to learn", according to Weimer (p. 4).

Student Motivation

According to social cognitive and constructivist theory, learning is impacted by the environment in which the learning occurs. A factor in the learning environment is the value attached to the learning, which may affect motivation either positively or negatively. Consideration of such affective aspects is important in creating an effective learning environment. Ornstein & Hunkins (1993) believe that students' affective needs outweigh their cognitive needs. Therefore, in the educational setting, for learning to take place, affective needs must be addressed. Motivation is one such need that educators must be attentive to in order to promote learning. In a study conducted by Fisher (2006), fourth grade student academic performance was measured before and after exposure to IWB use. Although no significant gains were identified, she noted that motivation is an essential ingredient in learning and that future research "may want to focus more on student motivation to learn instead of focusing completely on test sores" (p. 34). Painter and Whiting (2005) collected several categories of data during their examination of three second grade classes and interactive whiteboard use, including lesson delivery, instructional strategies, and student reactions. They also considered student learning styles and multiple intelligences as part of their investigation of teaching practices. When looking at response data indicative of student engagement and motivation, they found

comments which featured student descriptors such as “involved . . . engaged . . .eager . . . excited” (p. 6).

Student motivation, defined as interest and enjoyment causing action, was previously investigated by Miller, Glover, and Averis (2004) in their study with university students in England. Teaching styles when using whiteboards were assessed, then correlated with both student time on-task and attitudes to learning. The findings indicated that increased student motivation was due to “the intrinsic stimulation offered by the IAW. . . the dynamic features . . . and the use of virtual manipulatives” (p. 7).

In a study with five elementary schools in England, Miller and Glover (2002) investigated the impact of whiteboard use on teaching methods. They also surveyed teachers’ rankings of the advantages most often associated with interactive whiteboard use. In addition, the advantages were also ranked for student motivation. They deduced that “motivation was clearly enhanced and there were 14 references to improved behaviours” (p. 9). Cogill’s (2002) case study with primary school children considered the instructional practices used with whiteboards and class interactions. Her observations of five teachers and their classrooms led to a conclusion similar to that of Miller and Glover, that whiteboards “helped to capture children’s attention” (p. 31).

Weimer conducted a study with two classes of middle school students to ascertain the effect of IWB use on student motivation. Two groups of students completed two projects, one project using IWB technology and one project without. While one group used the IWB for their project, the other group did not. Use of the IWB was then reversed for the second project. Students completed a Likert Scale questionnaire after each test condition. The results, according to Weimer, indicated a correlation between

motivation and technology use. The students expressed enjoyment in using the IWB, and according to Weimer, "Enjoyment suggests higher motivation to learn" (p. 4). He concluded that SMART Board [a brand of interactive whiteboard] technology is an instructional tool that stimulates student motivation.

Student Engagement

Student engagement is also an essential component in the learning process. Ornstein & Hunkins state that "both the quality and quantity of engaged time . . . are considered to be important in improving . . . student learning" (p. 375). Without the involvement and attention of the student, learning cannot occur. Studies show that interactive whiteboards, because of their visual nature and manipulative capabilities, engage student interest during class instruction. Schut conducted a study with high school biology students investigating student perceptions of IWB use. Among her findings was a noted increase in student involvement in the lessons. They were engaged through the use of visuals such as games, animations, diagrams, and hands-on activities. The results of this study are supported by a number of earlier studies which included other aspects of student involvement, such as interest, motivation, and engagement.

Berque (2004) surveyed university students regarding their experiences using a technology system that included whiteboards. He reported that student surveys indicated greater student engagement when using the whiteboard. In another investigation with college students, Tate's (2002) study of college general education literature students investigated the effects of interactive whiteboard use on student performance, participation, retention, and interest. She found that there was no difference in student performance, but she reported increased interest and enthusiasm of students resulting in

greater retention of students in the experimental course sections. She attributed this to the high level of student engagement during the presentation of course material using the whiteboard.

The Levy study, conducted in two secondary schools in England across a range of subject areas, also reported that IWB makes lessons more enjoyable, interesting, and stimulating for the students. She noted that IWB use promoted involvement of all the classes under observation, and helped to focus their attention, and engage them in the lessons.

The Beeland study investigated the level of middle school student engagement as a function of teaching methodology utilizing three learning modalities: visual, auditory, and tactile. He hypothesized that instruction incorporating these modalities with IWB use would increase student engagement in the lessons. One lesson with one hundred and ninety-seven students in ten classes were involved in the investigation. A modified survey based on the Computer Attitude Questionnaire was administered to students immediately after classroom use of the IWB. Students responded to Likert Scale questions which were then analyzed for levels of student enjoyment and engagement. He concluded that use of interactive whiteboards led to increased student engagement due to its inclusion of each learning modality, particularly the attraction of its visuals. He also postulated that increased student engagement can potentially raise student achievement.

Solvie (2001) investigated student engagement and motivation in the elementary school setting. She conducted a study with a class of first grade students, assessing their attention to task during lessons. Data were collected by tallying the minutes of inattention during each thirty minute lesson. She found that there was no significant

difference in student attention with IWB use and without IWB use. She concluded that other distracters in the room may have influenced student attention and recommended further research on use of the IWB to gain student attention.

Two studies were located which noted the effects of information technology utilization on student behavior in the classroom. Alexiou-Ray (2006) reports that use of hand-held computers during the lessons decreased the behavioral problems exhibited by previously unruly students. This was attributed to the students' engagement in the instructional activities using hand-helds. Passey and Rogers study of the motivational effects of technology use included consideration of student behavior in classrooms in English schools at various grades levels and across geographic regions. Among their findings, it was reported that both teachers and students noticed positive effects of technology use on student behavior. They report that "pupils are better behaved in lessons when ICT is used (p. 31).

Christophy and Wattson (2007) conducted a study with high school chemistry students to determine whether IWB use would capture student attention more significantly than the teacher-led lecture method of instruction, leading to greater understanding of the concepts by students. Two classes were involved, one using the IWB to learn the material, and one using the traditional means of lecture, followed by a group practice assignment. The group exposed to the traditional lecture method scored higher on the subsequent quiz. However, Christophy and Wattson noted that "One aspect of the research that was clear was the attention maintaining aspects of the SMART Board lessons" (p. 14). They concluded that students were more engaged and interactive using the whiteboard that the group who did not.

Summary of the Relevant Research

This literature review has examined the links between interactive whiteboard use and a variety of topics relevant to the use of this technology and student engagement in classroom instruction. The concepts of social cognitivism and constructivism were introduced as the umbrella paradigms of importance to this study. Secondary theories embodied the issues of student motivation; learning styles; the special needs of middle school students; and interactive learning in the educational setting. Studies have shown that collaboration, active participation, and a student-centered approach benefit students' learning needs, particularly with middle school students. According to the research, use of interactive whiteboards stimulates student interest and attention leading to increased motivation and engagement during lessons. Student engagement, as evidenced by behavior during lessons, is an essential component of learning. Incorporation of technology into classroom instruction not only kindles student attentiveness, satisfies the accommodation of student needs, and utilizes instructional strategies consistent with the current technological tools available, but also complies with state and federal technology mandates.

Chapter Three: Methodology

In describing the methods used to conduct this study, the research design, participants, instrumentation, procedures, and data organization and analysis will be discussed. This investigation used a quantitative methodology as the primary research perspective. According to Bailey (2004), there is very little research as yet on technology's effectiveness in education, and much of that has been qualitative in nature. Because there is limited quantitative research on the effects of interactive whiteboard use in the educational setting, it was believed that using a primarily quantifiable approach to measure what was actually taking place in the classroom setting would be the most appropriate research methodology for statistically investigating the impact of interactive whiteboard technology on student conduct.

This study attempts to define more objectively what is happening regarding student engagement behaviors in the classroom during interactive whiteboard use. Other authors (Fisher, Schut, Alexiou-Ray) have also identified the need for more research on the use of IWB technology and its effects in the classroom using quantifiable methodologies, most of the current research having been conducted through subjective attitude surveys or from qualitative perspectives.

The main purpose of this study was to evaluate the impact of the computer-assisted technology tool, the interactive whiteboard, on student behavior as an indicator of student engagement. To further enhance the credibility of the study, standardized observations of classes were conducted throughout the entire cycle by only one observer, data were collected from more than one source, and threats to validity were managed as closely as possible.

Research Design

This research investigation utilized a quantitative same-subjects approach for data collection through systematic direct classroom observations combined with a post-study survey to assist in addressing the results. This small-scale research employed a quasi-experimental methodology because true randomness was not possible within the school system. Although the student groups were not randomly assigned by the researcher to the study, the students were randomly placed into the classes of the three participating teachers by the computer program utilized district-wide. Because this was a same group study, subjects were exposed to both conditions in the study, instruction without IWB use, followed by IWB use during lesson instruction. Use of the IWB was the independent variable in this investigation. The dependent variable, student engagement evidenced by their behavior during lessons, was quantified through the repeated measures design by direct observation of the researcher. Subjects in the research classes had not had prior exposure to the IWB, eliminating any pre-conditioning to the independent variable, though any transfer students into the classes may have experienced IWB use in other settings. Control groups of analogous students were observed at each school for the duration of the study as a means of managing the history effect by monitoring campus climate and to corroborate baseline engagement data.

Anonymity of the participants was ensured by the researcher. No names were used on any of the data collection instruments. Neither the At-Task Observation Instrument used by the researcher to tally subject behaviors nor the attitude surveys completed by the subjects contained any student names. Row and seat numbers only were used to identify individual students for the purposes of data analysis. The At-task

forms, questionnaires, and all other data materials have been maintained at the home researcher. No materials were housed at either of the schools at any time during the investigation nor were they made available to any of the participants in the study.

Se*tting*

The study was conducted at two junior high schools located in a county school district in northeast Florida. School A was located in an established suburban area, while School B was located in a rural area undergoing a housing development boom. The subjects of the study were students assigned to classes with either Teacher A or Teacher B at School A, or with Teacher C at School B. These teachers were experienced interactive whiteboard users and had been contacted for that reason regarding their willingness to participate in this study. Teacher A taught eighth grade Advanced Language Arts; Teacher B taught eighth grade Advanced and Regular Education Social Studies, U. S. History; Teacher C taught seventh grade Advanced and Regular Education Social Studies, Geography. These teachers agreed to participate in the study due to their personal interest in, familiarity with, and enthusiasm for interactive whiteboard use as an instructional tool. An eighth grade Language Arts control class at School A and a seventh grade Social Studies, Geography control class at School B were also observed on the same days that IWB classes were observed.

Context and Access

The sites of the investigation were two public junior high schools located in a northeast Florida school district. Teachers identified by the researcher as possible candidates interested in participating in a IWB study were contacted, as well as the principals of the two schools. Access to each school was obtained via consultation and

consent from the principals after discussing the content and logistics of the investigation. Principal A and Principal B granted permission to the researcher to conduct observations, collect data, and survey the subjects with the understanding that anonymity would be maintained. Each principal wrote a letter granting access to the classrooms of the selected teachers. A schedule of observations was agreed upon with the teachers and with approval of each school's principal. The principals were supportive of the investigation and welcomed the opportunity for their schools to participate. Because the principals had already purchased interactive whiteboards for use in the classroom, they were interested in whether teacher use and the educational effects on students justified the expenditures. The school district office was also contacted regarding the investigation. A letter was sent to Director of Secondary Education at the district office with the principal approval letters enclosed to acquaint him with the research being undertaken.

Topic of Study

This research study examined the relationship between the use of the interactive whiteboard as an instructional tool in the classroom and its effects on middle school student engagement as evidenced by student behavior during instruction. The investigation attempted to expand the body of knowledge regarding one aspect of the efficacy of the interactive whiteboard as an instructional tool.

Participants

Two hundred and twenty-six junior high school students, aged 12-14, in grades seven and eight participated in the investigation. Seventy-six subjects in the fourth, fifth, and sixth period Advanced Language Arts classes of Teacher A; and sixty-six subjects in

the first, second, and third period U. S. History classes of Teacher B at School A; and eighty-four subjects in the first, second, third, and fourth period Geography classes of Teacher C at School B were observed for a six-week period during the second half of the first semester of the 2007-08 school year, from early November through mid December, 2007. The three teachers were veterans who were experienced with and had been using interactive whiteboards for classroom instruction in previous school years. The students were either in Regular Education classes of mixed ability levels or in Advanced classes of the three teachers. There was gender diversity in each class, plus a mix of ethnicities: white, black, Hispanic, and Asian. The students also came from a variety of socio-economic backgrounds. A control class at each school, comparable to the experimental classes, was also observed for the duration of the research. The control class at School A consisted of twenty-six eighth grade Language Arts students, while the control class at School B was made up of twenty seventh grade Advanced Social Studies, Geography students, observed during the same time frame, in addition to the 226 test subjects. Control classes were included as barometers of campus climate during the investigation period. For these classes, the at-task observation checklist was utilized to tally student engagement behaviors. There was no IWB use at any time in these classes. This also allowed comparison of test groups with the control groups, in addition to single-group test comparisons, to measure average at-task classroom behavior.

Demographics

According to the 2000 Census data obtained from epodunk.com, the total population of the United States was over 281 million while in this northeast Florida county, the population includes 169,528 individuals. The median household income for

this county was $48,854, while in the US it was $41,994. In 2002, the per capita personal income in this county was $26,739 compared to the national per capita income of $30,906. Nationally, the gender make-up is 49% male and 51% female, with a racial profile of 75% white, 12% black, 4% Asian, and 13% Hispanic (percentages add to more than 100% because individuals may report more than one race). Countywide for the selected Florida region, the population by gender is comprised of 49% male, 51% female, and by ethnicity it is white 87%, black 7%, Asian 2%, Hispanic 4%. Educationally, 32% of the county population are high school graduates, and 55% have some college or higher educational degrees compared to 20% high school and 80% some college and above nationally for those over age twenty-five.

The student make-up of the two participating schools involved in the study was similar to the local community with the exception of the ethnic diversity represented in School B. Other than ethnically, the schools were very similar to each other demographically, reducing the likelihood of socio-economic or developmental differences among the two groups of subjects. School A is in a town with a population of 9,081, 47% male and 53% female. Ethnically, it is 83% white, 11% black, 2% Asian, and 5% Hispanic. Of the population over age twenty-five, 29% are high school graduates, and 58% have some college or above. Local median household income is $41,631. School B is in a town with a total population of 10,338 people, 50% male and female. There are 93% white, 3% black, .6% Asian, and 2.6% Hispanic. Educationally, 40% are high school graduates, while 41% have some college or above. The median income is $45,722.

School A, located in an established suburban locale combined with a more recently developed zone, was a junior high school which draws its student population from a mixed socio-economic strata. The school has 35 permanent classrooms and 18 portables. In addition to Regular Education and Exceptional Student Education programs, School A provides gifted Social Studies, an adaptive PE program, speech and language therapy, physical therapy, autistic units, Emotionally Handicapped self-contained units, and a Language Impaired unit. There are 927 students in grades seven and eight. Ethnically, the student population consists of 80% Caucasian, 9% African-American, 6% Hispanic, 3% Asian, and 2% other representative of the surrounding community. The gender compilation of the school is 46% female and 54% male. The percentage of students with disabilities is 22%, while the percentage of students on free and reduced lunch is 17%. The number of eighth grade students who scored below grade level on the Florida Comprehensive Assessment Test (FCAT) were 25% of those who took FCAT Reading, and 26% for FCAT Math.

School B, a junior high school consisting of grades seven and eight and located in a rural area of the county, was also composed of diverse socio-economic groups. The school has 56 permanent classrooms and 18 portables. In addition to Regular Education and Exceptional Student Education programs, School B services the gifted population through a Social Studies Enrichment Program. It houses one PMH unit, two TMH units, two EMH units, one Physically Impaired unit, and one Emotionally Handicapped self-contained unit. An adaptive PE program, speech therapy, physical therapy, and occupational therapy are provided as needed. It also houses the county's only Multi-Sensory room specifically designed to meet the needs of ESE students.

There were 1097 students in grades seven and eight at School B. The student population consists of 77% Caucasian, 23% minorities made up of 11% African-American, 7% Hispanic, 2% Asian, and 3% other which is more ethnically diverse than the community at large. The gender compilation of the school is 48% female and 52% male. The percentage of students with disabilities is 20%, while the percentage of students on free and reduced lunch is 24%. The number of students who scored below grade level on the state assessment tests was 25% of those who took FCAT Reading, and 26% for FCAT Math.

School A and School B were very comparable in both the student population make-up and assessment data results. The ratio of male to female students was similar, as was the racial/ethnic make-up, the number of students on free and reduced lunch, and the numbers of special needs students. State Assessment data results were also very similar. Students scored within a very close margin on the FCAT Reading and Math state assessment tests, reflecting comparable academic standings. Individual classes at both schools were ethnically representative of the student bodies overall with 13% minority students in the classes of Teacher A, 27% minority in Teacher B's classes, and 23% minority with Teacher C. The gender make-up of the classes overall were representative of the school only for Teacher A with 49% female, 51% male. Teacher B classes overall were 36% female, 64% male; while for Teacher C, 42% female, 58% male.

Data Collection

The researcher observed classes once per week during the second quarter in November, 2007 using the At-Task Observation Instrument to tally student behaviors while the IWB was not in use, establishing a baseline of student engagement as

demonstrated by their classroom behavior. During December of the second quarter, the researcher observed each of the classes on the same day of the week at the same time of day once per week with IWB use, and recorded observations on the same momentary time-sampling instrument. At the end of the observation period, students completed a self-perception survey regarding their own attitudes and assessment of their behavior and engagement during instructional IWB use.

Instruments

The At-Task Observation Instrument was modified from a sampling of at-task tools from a variety of sources: the University of North Florida course, Clinical Educator Training; Liberty University doctoral course, Supervision of Instruction; and the Florida Performance Measurement System (FPMS) formative teacher observation materials. According to the FPSM training manual, teachers' effective use of time influences student engagement in academic activities. Hence, on-task behavior is an important indicator of student learning. At-task observation instruments are recognized as legitimate tools, and have long been utilized as a means of collecting data on student engagement. Direct recording of behaviors using seating charts is an established data collection method in clinical supervision. Hopkins & Moore (1993) indicate that such structured observations can "provide highly accurate, detailed, verifiable information" regarding what is occurring in the classroom (p. 48). Although the sources of these observation tools provide a substantial degree of credibility, research has also provided corroboration. According to Lavely, Berger, Blackman, Follman, and McCarthy's (1994) research on classroom performance observation instruments and related issues, overall inter-rater estimates for FPMS summative and formative instruments as reported in the

reliability studies of the Teacher Evaluation Projects of 1982 and 1984, were .85 (1982) and .98 (1984). Regarding accuracy and reliability, the FPMS manual itself states that "The concepts and indicators included in this document have been normed on a representative sample of teachers in Florida" (p. ii). Simpson's (1979) study of systematic direct observation of individual student on-task behavior using a Pupil-Teacher Classroom Observation Scale, identified significant inter-rater reliability with use of an on-task/off-task instrument of 88.5%, provided that proper training was delivered. Simpson's study is supported by the more recent research of Chalouleas, Riley-Tillman, Sassu, LaFrance, and Patwa (2008) comparing the use of systematic direct observation with daily behavioral report card observations. They stated in their paper that Salvia and Ysseldyke reported direct observation to be a recognized and accepted measurement strategy provided that standardized procedures for observing and scoring are maintained. The Chafouleas, et al study concluded that direct observations by external observers do "present a standard for behavioral data" (p. 35). Another study by Riley-Tillman, Chafouleas, Sassu, Chanese, and Glazer (2008) stated that with extensive training systematic direct observation "can allow for precise (i.e. reliable and accurate) measurements of specified behaviors because the information is collected as the behavior actually occurs" (p. 136). Riley-Tillman, et al, also state in their discussion that systematic direct observation is regarded as a well-established method of documenting student classroom behavior. The Silverman and Zotos (1987) study investigating how well measures of student engagement using time-sampling methods compared to actual videotaped class sessions, found that while use of the observation instruments

overestimated time on-task, the instruments were valid for comparison of engagement at different times with use of the same observation instrument.

The researcher modified the At-task Observation Instrument used in this investigation from CET teacher supervision training materials, doctoral course materials, and formative observation instruments obtained from school district training in teacher supervisory observations. In the current investigation, momentary time-sampling (sweeps) was utilized to collect at/ off-task behavioral data. The observation tool was used to manually record data concerning appropriate at-task student behaviors reflecting student engagement and specified off-task behaviors during classroom lessons. The observation instrument included space to record at/off-task behaviors for each student using momentary time-sampling at five minute intervals during each class period. At each sweep of the classroom, a coding symbol designating at-task or a specific off-task behavior was recorded for each subject. Conventional engagement behaviors, including listening to instructions, participating in the class activity, looking at the teacher or board, following directions, and seeking help properly were categorized as at-task. Off-task behaviors which were tallied included being turned around in the seat, making noises/faces, doing schoolwork other than assignment, stalling (daydreaming, doodling, looking out the window, digging through purse or backpack), out of seat, head down, or talking out off-topic.

Measurement of student attitudes towards the interactive whiteboard as an educational technology tool was obtained using an existing attitude survey modified by the researcher. There were a number of inventories and questionnaires regarding student attitudes towards technology. The Computer Attitude Questionnaire (CAQ), a 65-item

Likert-scale type instrument for measuring middle school students' attitudes, was chosen by the researcher. Selected items from Part I of the CAQ measuring the importance and enjoyment of computer use were modified into an attitude survey to measure student perceptions of the impact of the instructional technology being investigated, the interactive whiteboard, and their perceptions of their enjoyment and its importance in classroom instruction. The CAQ was developed by The Technology Applications Center of Educator Development as part of its Attitudes Towards Technology program. This is a free instrument available online at http://www.tcet.unt.edu/pubs/studies/survey/caq5-14.pdf. Although there are 7 subscales measuring various student attitude components, only Part I of this inventory was used. It was modified by changing the word *computer* to *interactive whiteboard* to reflect IWB exposure.

This tool has been tested and used extensively by researchers. Reliability data are provided as part of the survey packages. A study, *Validating the Computer Attitude Questionnaire (CAQ)*, conducted in 1995 by Knezek and Christensen with a population of five hundred eighty-eight seventh and eighth grade students in Texas to determine stability of measurement for the instrument, showed there to be high construct validity with high reliability of the questions. Construct validity had been previously established in a 1993 study for the Young Children's Computer Inventory (YCCI) which carried over to the CAQ from which it was developed, according to Knezek and Christensen. The reliability analysis revealed a total internal consistency reliability for the two sections used of .82 for both, indicating that these are accurate psychological measures for these areas. This attitude survey was modified by the researcher for comparative analysis of actual student behavior and their own perception of their attitudes towards the IWB. The

modified Student Interactive Whiteboard Attitude Survey (Appendix A) was administered in December, 2007 at the end of the research study.

Procedures

The classes of three junior high school teachers were observed during the second quarter of the 07-08 school year during which time interactive whiteboards were not in use, and during the latter part of the second quarter for sessions in which interactive whiteboards were in use. Observations were conducted one day per week at each school over a six-week period for a total of six observations of each teacher's designated classes. Simpson had noted in his study that three observations would provide an authentic quantification sample of student behavior. The research of Lavely, et al was consistent with Simpson, finding that increasing the duration and number of observations led to increased reliability estimates. Data were recorded once per week per class for a three week period in which interactive whiteboards were not in use during instruction. Traditional instructional tools, such as the standard whiteboard and overhead projector, were utilized during this time period. Data were next collected for another three week interval once per week with the IWB in use on the same days and during the same fifty-minute class periods. Once the whiteboards were introduced, they were used at least two times per week for the duration of the second quarter to reduce the novelty effect. At the end of that time, a post-use student attitude survey was completed by each class.

During that period of time, mid-November through mid-December, 2007, the researcher used the At-Task Observation Instrument to tally student behaviors while seated unobtrusively at the to the side of the back of each classroom. After the initial introduction by the teachers, the researcher did not interact at all with the subjects. The

observer was in place as subjects entered the room to reduce any distraction for the students. Each observation period consisted of eight momentary time-sampling sweeps made at five minute intervals throughout the class periods, except for the 3rd period of Teacher B, that being a split-lunch class. Sweeps for that period were made at three minute intervals. Behaviors were tallied as + for at-task or with a coding symbol designating specific off-task behaviors (See Appendix B). The data for the participating classes were calculated and assessed for student behaviors reflecting student engagement before and during interactive whiteboard exposure. Data were then organized, tabulated, analyzed, and formatted for presentation using the statistical package SPSS. Students were surveyed using the Student Interactive Whiteboard Attitude Survey questionnaires in late December after all of the observations had been completed.

Research Hypothesis

H_1: Use of the interactive whiteboard as an instructional tool will have a positive effect on the engagement of middle school students in the classroom.

H_0: Use of the interactive whiteboard as an instructional tool will have no effect on the engagement of middle school students.

Analysis of the Data

This study was analyzed from several different perspectives using several different types of data. Student engagement and classroom behavior was measured using two research instruments. The hypothesis and the related research questions regarding increased at-task behavior and gender and ethnic differences with IWB use were measured using the At-Task Observation Instrument. At-task behaviors for each subject

were tallied from the observation checklists, then descriptive and inferential statistics were tabulated. Researcher-calculated percentage data was computed after each observation session. For each observation period (at-task observation 1, at-task observation 2, etc), the mean, standard error, standard deviation, and skewness were compared. According to Ary, et al (2006), paired-sample t-tests must be applied for analysis of subjects' behaviors because of the single-group treatment subjects' experiencing both conditions of the investigation. The two-tailed test of significance was utilized to determine the probability of the pre-IWB use groups differing significantly from the with IWB use groups. To identify any significant differences between gender and ethnicity pre- and with IWB use, one-way ANOVA was used. This analysis of variance procedure assessed the independent variables of gender and ethnicity related to the dependent variable, at-task behaviors.

The research question regarding student self-perception of their engagement during IWB use was investigated using the Student Interactive Whiteboard Attitude Survey. Attitude survey results were converted into a numeric system allowing calculation of mean scores for each question and for each student. Survey means for each subject were then compared with subject at-task behavioral means, both pre-use and with IWB use, to determine whether there was a correlation in actual performance and their perceived benefit of IWB use in the classroom setting. From this information, analysis was conducted to determine whether use of the interactive whiteboard significantly affected student engagement behaviors during classroom instruction, and whether the observed behavioral scores differed from the students' perceptions of the influence of interactive whiteboard use on their behavior.

Data Organization

The methods used in this quasi-experimental quantitative study involved data collection at two school sites by the researcher using an at-task behavioral checklist to record subject behaviors during instruction and an attitude survey to explore subjects' perceived notions regarding the benefit of interactive whiteboard use and its effect on individual student behavior indicative of student engagement. The collected data were compiled and analyzed using the statistical program SPSS with resultant tables produced. Tables found in the Appendix represent the data compiled by SPSS and analyzed for this investigation.

The data were also converted into percentages after each observation period, representing the overall amount of at-task behaviors for any given classroom observation period. These percentages were then compared to established at-task percentage data determined from previous research. According to the FPMS manual, research conducted by Evertson showed that at-task behavior among low achieving student averaged 40% while for high achievers the average was 85%. FPMS also referenced the Good and Beckerman study which found average on-task behavior for high achieving students to be 75%; the Fredrick study which showed that 25% of on-task time was wasted by classroom disruptions; Stallings' research with high achieving students showing total on-task behaviors at 85%; and the Leinhart, Zigmund, and Cooley study which indicated that "the average off-task rate was 15%" (p. 82). These at-task estimates are somewhat consistent with Ornstein & Hunkins' view that students are engaged 73% of the time according to their interpretation of a study by Rosenshine with reading and math classes.

Tables portray descriptive and inferential data created from the At-task Observation Instrument data allowing comparison of observational data between pre-use and IWB use periods. Paired Sample t Tests tables were prepared to explore the significance of the pre-use and IWB use groups. Independent Sample t Test and ANOVA tables were created showing behavioral data by sub-groups: ethnicity and gender for each observation period. Attitude surveys were converted into a numeric system allowing calculation of mean scores for each question and for each subject which were displayed as data tables for the total sample and for each class. The attitude survey results were then compared to the observation instrument data means for each subject, depicting their perceived benefit of interactive whiteboard use and their actual behavior. Those results are presented and explained in detail in the following chapters.

Summary

This inquiry was conducted with junior high school students who were observed by the researcher once per week over a six-week period. An at-task observation tool was used for each observation to record subject behaviors during instruction. At the end of the investigation, students completed an attitude survey to detail their feelings towards school and IWB use in the classroom. The data generated from these instruments and an analysis of the results are presented next as it relates to each of the research questions in this review.

Chapter Four: The Results of the Research Study

This quasi-experimental study was implemented to investigate the effect of interactive whiteboard use on the dependent variable, student at-task behavior, as an indicator of engagement in the learning process. Data collection tools were modified from existing recognized instruments for the quantification of student behavior during instruction and student self-perception of attitude towards the IWB. The numerical data collected were then analyzed according to the research questions posed. Those questions were addressed after a six-week same-subject classroom observation period with the students of three different teachers. For the first three weeks during which interactive whiteboards were not in use, teachers used the overhead projector and standard classroom whiteboard as the instructional presentation tools. This was followed by three weeks of interactive whiteboard use in place of those traditional classroom accessories. Subject self-perception of their own degree of interest and engagement when whiteboards were in use was also assessed by comparison with their at-task behavior results to determine whether student thinking about IWB use correlated with their actual behavior when it was utilized for instruction.

Quantitative data were collected using two instruments, an at-task instrument and a student attitude survey, along with researcher-generated percentages for each observation session. Use of multiple methods of data collection enabled data analysis from several perspectives as a means of bolstering validation of the conclusions (Ary, et al). Analysis of both the at-task data and student perception data showed a significant overall positive educational impact. Results from the statistical tests applied to the data, however, were mixed. At-task behavior increased overall for the entire sample.

However, while no differences in engagement were noted between ethnicities, there was a significant difference between males and females without use of the interactive whiteboard, with males showing a greater increase in at-task behavior than females between pre-use and use of the whiteboard.

Analysis of the Data

The statistical program, SPSS, was utilized for analysis of the data. The combination of statistical evaluations applied to the data collected during the research included descriptive statistics, paired-sample and independent-sample t Tests, Contrast Tests, and one-way ANOVA. The results of these various statistical tests were then used for assessment of the research questions raised in this study after careful examination and analysis of the resultant data.

Research Questions 1& 2

To investigate these questions, (Does use of the interactive whiteboard affect junior high school student engagement? Do students exhibit more at-task behaviors when the interactive whiteboard is in use in the classroom?) data collected during classroom observations were analyzed to determine any differences in student behavior and engagement without use and with use of the interactive whiteboard. Initially, after each observation, the researcher did a quick percentage spot-check calculation to track at-task behavior. By percentages, the aggregate preliminary data showed 82% at-task behavior pre-use compared to 96% at-task with IWB use during the time period of the study (See Table 1). Subjects in the control classes exhibited at-task behaviors in numbers similar to the pre-IWB use classes, with 86% at-task for the six week period for Teacher D, and 83% for Teacher E. The control classes exhibited a total of at-task behavior of 85%

overall. This provided a preview of baseline student at-task behavior and the effects of IWB use on that behavior.

Table 1

Preliminary Analysis

Observation	Class	N	% At-task w/o IWB (Obs 1+Obs2+Obs3)	% At-task w/IWB (Obs4+Obs5+Obs6)
Aggregate Totals (excluding controls)		226	82.1%	95.6%
Teacher A	AA1		76.1	96.2
	AA2		87.7	94.7
	AA4		86.2	95.3
Teacher B	AB3		77.7	93.9
	AB5		83.9	93.8
	AB6		80.0	93.4
Teacher D	AD3 (control)		88.8	82.6
Teacher C	BC2		80.6	97.5
	BC3		78.9	96.7
	BC4		80.8	97.5
	BC5		90.2	98.6
Teacher E	BE6 (control)		85.4	80.5

Descriptive statistics utilized included the mean (M), standard deviation (SD), and standard error of the mean (SEM). Skewness was also included to detect the direction of the data distribution. The skew for each set of data showed an unequal distribution towards the upper end of the scale for both the pre-use and use data as would be expected in a classroom setting. Pre-use data (Observations 1, 2, 3) were then compared to IWB use data (Observations 4, 5, 6). The mean scores of at-task behaviors for each observation session and for the aggregate three week pre-use and use periods were

analyzed using the descriptive statistics that had been generated. Total mean score for the pre-use classes of 6.516 (Obs 1), 6.403 (Obs 2), and 6.456 (Obs 3) was 6.458, compared to 7.541, the total means of 7.538 (Obs 4), 7.502 (Obs 5), and 7.584 (Obs 6) for the IWB use classes, representing a gain in student at-task behavior indicative of engagement as shown in Table 2.

Table 2

At-Task Analysis

All Classes

Observation	N	M	SE of M	SD	Skewness	SE of Skew
At-task Obs 1	215	6.516	.119	1.75	-1.624	.166
At-task Obs 2	221	6.403	.119	1.77	-1.486	.164
At-task Obs 3	193	6.456	.127	1.77	-1.881	.175
At-task Obs 4	223	7.538	.084	1.25	-4.408	.163
At-task Obs 5	221	7.502	.090	1.34	-4.387	.164
At-task Obs 6	221	7.584	.068	1.00	-4.667	.164

The negative skew in the data corresponded to a directional shift to the upper end of the range representing extreme scores, or to the higher end of the numerical scale for behavior compared to a standard bell curve of results, and signifying an increase in the overall number of at-task behaviors exhibited by students during observations in which the IWB was in use.

The paired sample t Test was applied to identify whether the results were significant at the p=.05 level. Pre-use observations were paired with IWB use observations in the same order in which they occurred and the data collected. Therefore, Observation 4 (IWB use) was paired with Observation 1 (pre-use), 5 with 2, and 6 with 3.

The data gives a p value of .000 for Pairs 1, 2, and 3, meaning that the probability of achieving a difference of 1.05, 1.08, or 1.12 between means of pre-IWB use and IWB use for each pair is .000. The t values are also significant, indicating that the observed differences are approximately eight times as large as the expected mean difference if the results occurred by chance alone.

From these results, it can be inferred that a correlation exists between use of the IWB and increased subject at-task behaviors with a probability that .01% or less than 1 in 100 would occur by chance (See Table 3).

Table 3

Paired Sample t Test

Combined Classes	N	M	SD	t	df	Sig. (2-tailed)
Pair 1						
At-task Obs 4	213	7.559	1.252	8.237	212	.000
Obs 1		6.512	1.755			
Pair 2						
At-task Obs 5	216	7.491	1.350	7.712	215	.000
Obs2		6.407	1.763			
Pair 3						
At-task Obs 6	189	7.593	1.041	7.991	188	.000
Obs 3		6.476	1.770			

The results of the analysis of the descriptive statistics and the Paired-Sample t Test allowed the researcher to infer a positive correlation for questions 1 and 2. Use of the interactive whiteboard does affect student behavior and engagement in a positive manner during which time they do exhibit more at-task behaviors during classroom instruction. Therefore, the null hypothesis was rejected for questions 1 and 2.

Research Question 3 & 4

In order to answer these questions, (Is there a difference in student engagement between males and females, and among ethnicities with use of the IWB?) the data generated from the application of a one-way analysis of variance (ANOVA) to the variables of gender and ethnicity were analyzed at the .05 level of significance. In addition, because the analysis for gender involved only two groups, additional t Tests were conducted. Only the one-way ANOVA was necessary for analysis of the four groups in the ethnicity category as the data showed no significance in the differences in the means between each group. For that reason, no further analysis was necessary.

Table 4

*One-way ANOVA - **Gender***

All Classes		df	M Square	F	Sig.
At-task 1	Between Groups	1	44.409	15.474	.000
	Within Groups	213	2.870		
At-task Obs 2	Between Groups	1	13.899	4.495	.035
	Within Groups	219	3.093		
At-task Obs 3	Between Groups	1	23.939	7.911	.005
	Within Groups	191	3.026		
At-task Obs 4	Between Groups	1	9.853	6.489	.012
	Within Groups	221	1.518		
At-task Obs 5	Between Groups	1	3.241	1.820	.179
	Within Groups	219	1.781		
At-task Obs 6	Between Groups	1	.422	.417	.519
	Within Groups	219	1.010		

The one-way ANOVA showed significance for observations 1,2, 3, and 4 with regards to gender. The F scores for the observations measured the level of differences

between the means of the subgroups. The At-task 1 value of 15.5 indicates that the likelihood of these results occurring is 15.5 times what would be expected by chance alone. Thus, the pre-IWB use values support the significance data. The p values for these observations were all less than the critical value of p=.05 showing that there was a significant difference in at-task behaviors between males and females without the use of the IWB. In Observation 4, during which the IWB was in use, a significant difference in behavior was also noted. However, no significance was obtained for the subsequent Observations 5 and 6. The results would then indicate that when the whiteboard was not in use, the difference in the means of male and female subject at-task behaviors was significant. When the IWB was used, the differences were slight to negligible.

Instead of ANOVA Post Hoc tests, the Independent-Sample t Test and a Contrast Test were utilized because the sample contained only two subgroups (See Appendix C). The results of the various statistical tests were consistent with the p values shown in the ANOVA Table 4. The output of the Independent Samples t Test gave the descriptive statistics for the two groups. In Observations 1, 2, and 3 males had fewer at-task behaviors than females with lower means. When compared to the IWB use Observations 4, 5, and 6, the data showed that their at-task behaviors increased significantly. The Levene's Test for Equality of Variances showed significance (the value under "Sig." was less than .05), indicating that the two variances are significantly different. Based on the results of the Levene's test, it can be seen that the variances are not equal, therefore, using the lower line in the chart, a significant difference between the two groups (the significance is less than .05) was evident. The Levene's Test, generated by the Independent-Sample t Test, resulted in .000, .252, .002, .000, .052, and .491 significance values, showing significant differences between males and females for Observations 1, 3,

and 4; slight significance for Observation 5; and none for Observations 2 and 6. Thus, it can be stated that there is a somewhat significant difference between the male and female groups. The Levene's Test was followed with the Contrast Test using the "does not assume" values of .000, .033, .003, .006, .159, and .518, again supporting data evidencing significant gender differences. The overall consistency of each of the tests allowed for greater confidence in the finding that male-female differences were significant regarding these results. Consequently, for question 3 the null hypothesis was rejected.

The one-way ANOVA was utilized for analysis of differences in at-task behavior between ethnicities: Asian, white, black, and Hispanic. The "Between Groups" results show that the p values for each observation are greater that the critical value of .05 (See Table 5). The low F values also indicate that the probability of the results occurring by chance are considerable.

Table 5

*One-way ANOVA - **Ethnicity***

All Classes		df	M Square	F	Sig.
At-task 1	Between Groups	3	3.632	1.189	.315
	Within Groups	211	3.056		
At-task 2	Between Groups	3	.95	.302	.824
	Within Groups	217	3.172		
At-task 3	Between Groups	3	6.228	2.018	.113
	Within Groups	189	3.086		
At-task 4	Between Groups	3	.306	.195	.900
	Within Groups	219	1.573		
At-task 5	Between Groups	3	5.836	3.370	.019
	Within Groups	217	1.732		
At-task 6	Between Groups	3	1.081	1.074	.361
	Within Groups	217	1.007		

Therefore, it can be stated that the effects of the use or non-use of the IWB on at-task behavior and engagement made no difference and were nonsignificant for ethnicity, causing the null hypothesis for question 4 to be retained. The differences between the means of the subgroups were too small to be construed as significant.

Research Question 5

To answer the final research question, (How do student perceptions of their level of engagement during IWB use correspond to the observation data?) measures of subject attitude were compared with at-task behavioral results. Student self-perception of personal attitudes to IWB technology was collected using the modified CAQ, the Interactive Whiteboard Attitude Survey. Subject means were then compared to the means of their actual at-task behavioral scores. Perception of engagement was analyzed for each student and for the total subject sample using the mean and standard deviation to determine whether a correlation could be inferred from the data.

Overall mean scores of the total subject sample for each survey question with standard deviation are shown in Table 6. A Likert-type scale was used to rate each statement, with 1 indicating strong disagreement, 2 for disagreement, 3 representing agreement, and 4 signifying strong agreement. The total mean score was 3.4, reflecting a positive attitude overall towards IWB use. There were no questions that received a mean score below a 3.0 (agreement). The questions with the highest means were those indicating enjoyment of IWB and technology use, and the need to do well in school (questions 1, 2, 13, 22, 23). Of the 209 students who answered the survey completely, only six, or 2.9%, indicated negative attitudes. However, these subjects' at-task behavior means contradicted their survey response means, showing improvement in behavior with

IWB use consistent with the behavioral results of the total sample. The manifested negative attitudes may have been merely age-related contrariness, as opposed to a real negativity on their parts, or due to lack of serious consideration of the questions. Individual subject at-task behavior means were calculated for Observations 1, 2, and 3 during which the IWB was not in use, and for Observations 4, 5, and 6 during which time they were. The behavioral means were then compared to the survey means. All subjects in the study showed improved at-task behaviors with IWB use, which was consistent with the overwhelming majority of students expressing positive attitudes to this technology tool. Student self-perception of their level of engagement during IWB use did, then, correspond to the observation data (See Appendix E).

Table 6

Interactive Whiteboard Attitude Survey Results

N=236, 209 Included Total Sample

Question	Mean	SD
1. I enjoy classroom instruction using the IWB	3.6	.64
2. I am (not) tired of technology use in the classroom	3.7	.65
3. I will be able to get a good job if I know how to use an IWB	3.0	.76
4. I can concentrate better on the lesson with the IWB	3.4	.69
5. I would work harder if the IWB were used more	3.2	.83
6. I know that the IWB gives me more opportunities to learn new things	3.3	.75
7. I understand the lesson better when the IWB is used	3.4	.73
8. I believe that if more teachers used the IWB, I would enjoy school more	3.4	.82
9. I believe that it is important for me to be able to use technologies such as the computer and the IWB	3.4	.66
10. I can learn new things when the IWB is used	3.4	.68
11. I feel comfortable using the IWB	3.4	.75
12.I (do not) think lessons take longer using the IWB	3.1	.83
13. Using the IWB (does) not scare me	3.5	.76
14. Using the IWB does not make me nervous	3.4	.81
15. Using the IWB is (not) difficult	3.3	.80
16. I can (not) learn more from books than the IWB	3.2	.87
17. I want to work with technology whenever I can	3.4	.76
18. I work very hard on my schoolwork	3.3	.75
19. I (do) not try hard in school	3.5	.76
20. I pay attention in class	3.3	.69
21. When I am in class, I (do not)just act as if I'm working	3.0	1.0

22. It is important to do my best in school 23. I always try to complete my assignments	3.6 3.5	3 .65 .68
Total:	3.36	.75

*The scoring scale for questions 2, 12, 13, 15, 16, 19, and 20 was reversed. The reversed form of the question is in parenthesis.

The majority (97%, N=209) of subjects indicated that IWB use enhanced learning. Of the 226 subjects observed, 209 survey responses were included in the data results. Student positive perceptions of IWB use were supported by the results of the at-task data. Impromptu student remarks on observation days also supported the survey results (See Appendix F).

Summary

The results of this investigation showed that IWB use has a positive effect on the behavior of all students, and, thus, on their engagement in classroom instruction. Overall, subjects exhibited more at-task behaviors during instruction utilizing the interactive whiteboard. There was a significant difference in the at-task behaviors without the use of the IWB between males and females. Males demonstrated fewer at-task behaviors during observations when the IWB was not in use than did females. With its use, their at-task behavior improved nearly to the level of female behavior. However, no significant differences in the effect of IWB use on the behaviors of different ethnicities were identified. All ethnicities were favorably impacted by its use as at-task behaviors increased during IWB observations for each group. Students were aware of the positive impact of IWB use on their engagement in classroom instruction. They regarded the IWB positively, and this was evidenced by their at-task behavioral improvement. The interactive whiteboard data showed general improvement in student behavior which translates into improved student engagement.

Chapter Five: Summary and Discussion of the Findings

This research study was undertaken to ascertain whether interactive whiteboard use has a positive effect on student behavior during classroom instruction. Student at-task behaviors indicative of engagement in the lesson were tallied during classroom observations. The findings suggested a positive correlation between IWB use and student behavior. This was demonstrated by all subjects regardless of gender or ethnicity. Furthermore, favorable student attitudes towards IWB use were consistent with their demonstrated increase in at-task classroom behaviors. Because student behavior is an indicator of student engagement, it can be asserted that the IWB is an instructional tool that can be utilized to engage, motivate, and stimulate students in the learning process. This has clear practical implications for both pedagogical application and for administrative budgetary considerations.

This was a small-scale quasi-experimental repeated measures study examining the effects of IWB use on junior high school students' engagement in classroom instruction in an objective quantitative fashion. The research was conducted to determine whether students exhibited more at-task behaviors when the IWB was in use, whether there were differences in the at-task behavior between males and females or various ethnicities, and whether student perceptions of their personal attitudes towards lessons utilizing IWB use was consistent with their actual classroom behavior.

Direct systematic observations of class instruction were implemented by the researcher. An at-task behavioral tool was used to tally student behaviors in three to five minute sweeps throughout the lessons once per week for six consecutive weeks. The classes of three different teachers were observed at two different schools for the

experiment. A control class at each school was also observed by the researcher on those same days. As a same-group study, the subject students were exposed to both conditions of the research, instruction without the use of the IWB for a three-week period followed by instruction for three weeks with IWB use. At the end of the observation cycle, subjects completed an IWB attitude survey to measure self-perceptions of their attitude towards the IWB and its use in the classroom. The data collected were analyzed using a statistical program producing descriptive statistics, t Tests, and ANOVA tests.

Interpretation of the Findings

The findings indicate that use of the IWB for classroom instruction has a positive effect on student engagement as evidenced by their at-task behaviors during instruction. The data produced from the at-task observations showed a significant increase in engagement behaviors between the initial set of observations in which the IWB was not used and the subsequent observations in which it was used. This was suggested by the paired-sample t Test results used to identify whether or not the difference in the mean scores was significant. The findings also showed that this improvement was discernible for all subgroups, males, females, and the different ethnicities, and were not limited in any way. Additionally, the findings revealed that while there were no significant differences between ethnic groups in increased at-task behaviors with all groups showing a positive increase in engagement behaviors, there was a significant difference between male and female subjects, as shown by the results of the several statistical tests used to analyze the difference between means of these two groups. The fact that no statistically significant differences among ethnicities were shown while there were significant gender differences may be attributable to the fact that all subjects in the study showed increased

at-task behaviors with IWB use. However, it was interesting to note that males in general showed a greater increase in engagement behaviors than females in the study suggesting that their attention was especially captured by the IWB. A possible explanation for this may be the male inclination towards technology whereby males of this age group tend to play more computer and other technological device games than females, and, consequently, the IWB attracted their attention as another form of technological toy. Or, it may be attributable to the fact that females tend to be more attentive and better behaved in the classroom, especially at the junior high level.

It can be asserted, then, that the IWB is a powerful engagement and motivational tool in educational instruction. Because engagement in the lesson is an essential component for student achievement, the IWB has the potential for improving student academic performance as well as their classroom behavior. It can be used to engage male students in more productive educational behaviors during classroom instruction. It can be used to stimulate more active participation of all students in the lesson. It can also encourage more involvement of those students who are normally reticent and reluctant to actively contribute during instruction.

Overall, the attitude survey results showed that students had a positive attitude towards the IWB, indicating that it was enjoyable as an instructional tool and technological adjunct to lessons. When the means of the individual survey results and the individual at-task results were compared, there was consistency between what students thought about IWB use and their actual classroom behavior. Nearly 97% of subjects responded favorably to the survey, while 100% of subjects showed increased at-task behaviors. Students recognize that technology use can enhance instruction by

incorporating a wider variety of instructional methodologies, and they expressed this as a positive outlook towards IWB use. They were more receptive, excited, and participative in classroom lessons, demonstrating the interactive whiteboard's value in instruction.

Relationship to Previous Research

In general, most of the research literature is supportive of IWB use as an instructional tool, asserting it to be more engaging than conventional classroom strategies due to its ability to focus and maintain student attention. The findings of this study are consistent with other research that has been disseminated on this topic. Studies by Schut, Alexiou-Ray, Passey and Rogers, Painter, Berque, Tate, Beeland, Solvie, and Weimer in particular have all linked IWB use with increased student engagement in classroom activities. This research study concurs with the Schut study which found that student engagement was increased with IWB use. She attributes this improvement to the ability of the whiteboard to utilize a variety of multimedia applications. Schut specifically mentioned in her qualitative study conclusions the need for objective quantitative research regarding the effects of IWB on students. In addition, she noted that student interest and involvement increased due to the visual, eye-catching effects, and to the board's interactive aspects. The Painter study also linked increased student engagement with IWB use through evaluation of teacher journal entries, interview data, and videotapes. Her findings through research conducted with second graders support the conclusions of the present study.

The current study showed that at-task behavior indicative of student engagement increased with use of the interactive whiteboard consistent with the four studies that expressly addressed behavior. The Alexiou-Ray investigation with hand-held technology

specifically mentioned student at-task behavior as an indicator of engagement in lessons. Her study used a modified CAQ with students and parents regarding attitudes towards technology. She found that subject behavior improved when that technology tool was used in instruction. The Passey and Rogers study on information and communications technology use, including the use of the interactive whiteboard, and student motivation also affirms similar conclusions. They report that use of information and communications technology tools has a positive effect on student behavior, finding that students do not misbehave and are not disruptive during lessons. They distinctly note that IWB use has a positive effect on student motivation, in part, because of the visual, auditory, and touch elements. The Christophy and Wattson study investigating the relationship between IWB and increased student comprehension also substantiates the current study. It revealed, in addition to comprehension effects, the effects of whiteboard use on behavior. They maintain that "students were clearly on task" while using the whiteboard, and that "During the presentations, all students were involved in the lessons" (p. 14). The Solvie study showed only a slight nonsignificant improvement in student attention. Data for this study, collected through time on task observations of a first grade class, showed that the time duration for on-task behaviors increased for nine students, remained constant for two, and declined for five students. Despite Solvie's interpretation of the results as showing no significant improvement, the slight increase in student on-task behaviors is consistent with the increased at-task behaviors found by the current study.

Student perceptions of and attitudes towards technology use were found to be categorically positive after evaluating the survey data for the current research. The

results of this study support the Beeland study which explored subject perceptions of interactive whiteboard use and student engagement using a modified CAQ to assess student attitudes towards interactive whiteboards. His results showed a striking preference in favor of IWB use. Weimer's investigation of IWB use and motivation using survey data also concurs with the current study. After tabulating the results from subject responses to the seven-item researcher-created attitude scale, Weimer concluded that students were more motivated during class when the whiteboard was in use. The Tate study also utilized a student survey to assess college student attitudes towards the use and impact of the IWB on student performance, enjoyment, participation, and attendance in class instruction. Her survey was a five-point Likert-type rating scale developed with the assistance of her department head and others. Her investigation produced results in which, among other findings, students reported enjoyment and engagement with use of the interactive whiteboard. The Berque study of the impact of IWB use on college student engagement support the present study as well. The student survey responses were positive indicating increased student engagement and motivation.

Numerous studies investigating other aspects of the educational impact of IWB use have also acknowledged increased student engagement as a by-product effect identified during their research. These included studies done by Bell, Cogill, Fisher, Gerard, et al, LeDuff, and the numerous studies conducted in the United Kingdom, many by Glover, Miller, Levy, and the organization BECTA.

Implications for Use

This study concerning the effects of IWB use on student engagement and at-task behavior has implications for more widespread application of this technological tool.

Used as an instrument for whole class instruction, the IWB can also be employed to foster critical thinking through social discourse by creating whole-class dialogue among students, exposing them to various ways of thinking and to different experiential backgrounds. The whiteboard is useful then in terms of social learning theory tenets. It allows, as well, for interaction, exploration, and inquiry during which instruction may be tailored to build upon students' prior knowledge applying the constructivist approach to learning. From a theoretical perspective, then, the IWB is a tool that is consistent with current pedagogical thinking.

Interactive whiteboard use, due to its capacity to engage students, also has implications specifically for the junior high school level student. Students in this age group are recognized as frequently having academic difficulties. As such, any instructional tool that assists in maintaining the focus and involvement of these students would be beneficial. Interactive whiteboards allow for interactive learning and the accommodation of varying student learning styles. Used creatively, whiteboards allow for the integration of learning style accommodations and more interactive, collaborative, and authentic learning activities. This has implications for classroom management issues as well. With increased involvement in lessons, there tend to be fewer incidents of off-task or disruptive student behavior. The improvement shown in male at-task behavior has importance for special education classes which often have a preponderance of male students, who responded favorably with IWB use. In addition, most students today are exposed to technology outside of the school setting and have become accustomed to its use in their personal lives. They often become more easily bored and distracted using traditional classroom tools. Incorporating IWB use into instruction provides a

technological bridge between students' daily lives and their educational experiences. Interactive whiteboards present mot only a method for educators to incorporate technology use in an instructional setting, but also allows close control and monitoring of Internet website access. Since students are not manipulating Internet sites independently at individual computer stations, the possibility of gaining access to objectionable sites is greatly reduced through instructor management.

Besides being beneficial educationally, from a budgetary standpoint, purchase of this interactive whiteboard technology is economically sensible. Allocation of technology funds demands that fiscally responsible decisions be made. The cost of one complete PC system is approximately equal to the cost of one complete IWB set-up. This translates into a financial savings for schools because one IWB can serve an entire class of students compared to one PC which may serve two to three students at a time. Interactive whiteboards can also be readily integrated with existing technology at school sites, saving a portion of the cost to complete the system. Most schools are already equipped with at least one computer per classroom and have projectors available for instructional use, eliminating the need to purchase these components for the IWB system.

Interactive whiteboard use fulfills state technology standards and federal requirements for professional and student use of technology. With technology mandates a fact of life for schools, interactive whiteboards present an affordable, practical, and educationally sound option for compliance with those requirements.

Disadvantages

Certain disadvantages to IWB use were also identified. Technical difficulties arose at times. One problem noted on several occasions was the issue of reorienting the

board. If the stand, projector, or cart were disturbed at all, it became necessary to stop instruction and realign the board in order to use the touch-sensitive features, such as writing or manipulating images on the board. A solution to this problem could be to wall-mount the board to reduce the likelihood of it being bumped, or to rearrange the classroom to limit contact. Classroom space was a consideration as well. Careful seating and classroom furniture arrangements are required to prevent inadvertent bumping difficulties and for student visibility. Another difficulty was that of students being unable to see where they were writing because of shadows cast or body-blocking the projector. With practice, however, students can learn how to stand when they are at the board. Running the necessary cables and cords across the floor presented a safety issue, with the potential to cause tripping and stumbling. Using floor or cable coverings can eliminate this problem. Computer glitches and Internet access issues also arose on two occasions. Having a back-up plan for any technology is essential, possible solutions being to use only the slide presentation and omitting the web links should Internet access be unavailable, or having transparencies of slides at the ready enabling teachers to continue with the lesson using the overhead projector undeterred. Insufficient teacher training and support was also recognized as an area of difficulty. Adequate professional training must be provided for teacher confidence and effectiveness in the use of the technology. With practice, teachers can quickly become proficient IWB users. Insufficient numbers of boards at a school site can cause frustration among users who may have to compete for use time. Sign-up sheets, departmental whiteboards, or grade level boards could allow for greater availability for teachers. Access is, therefore, essential both for skill-building and for faculty harmony.

Strength of the study

This investigation involved the quantitative analysis of the educational use of a computer-assisted technological tool in a junior high school setting. The findings, however, can be applied to comparable regular education students of mixed ethnicities, gender, and socio-economic backgrounds of other grade and age levels. Limited generalizeability is possible since extensive demographic information is provided to allow for school-to-school correlations. The same classes of the same three teachers were observed during the six-week period, ensuring that the same teaching techniques, class activities and procedures, and classroom environment were maintained, and ensuring as much as possible that the IWB was the only variable. Using a same-subject repeated measures design, each class then became its own control regarding the effects of IWB use on behavior.

The classes of three different veteran teachers at two schools with similar demographics were selected for observation based on teacher familiarity with the technology and willingness to participate. Despite their different teaching styles, techniques, and skill levels in their use of the IWB, the student behavioral outcomes were very similar. Data collection was conducted in the same way at each school, with the researcher using a standardized systematic direct observation instrument, sitting unobtrusively at the back of the class, and recording subject behavior at regular sweep intervals. All subjects in attendance on the last day of the observation cycle were given attitude surveys to complete as the final step in the research process. Finally, the subjects were of mixed ability levels, including mainstreamed special education students,

high-performing advanced students, and regular education students, all within the regular education setting.

Limitations of the Study

A variety of elements needed consideration in the context of the investigation, such as the pedagogical perspectives of the researcher, the individual teachers involved, the students' attributes, the interaction between teachers and students, the instrumentation, and other effects during the study. Threats to internal validity were controlled as closely as possible through use of a same-group treatment to reduce the risk associated with non-random assignment. Although students were randomly selected onto the teachers' class rolls, they could not be randomly assigned by the researcher using any of the recognized random selection methods. This treatment design eliminated the concerns regarding subject selection and maturation. By using the subjects as their own controls, the possibility of those confounding variables affecting the outcome of the study was markedly reduced.

Student bias considerations were taken into account by observing classes of the same subject areas and academic levels, limited to seventh and eighth grade students in Social Studies or Language Arts classes. There was no pre-test, thus limiting student exposure to the research topic and eliminating pretest-treatment interaction. The history bias was reduced with the inclusion of control groups which did not experience IWB use to account for any simultaneous events influencing student behaviors that might have taken place at the same time at each school. The internal validity threat due to the Hawthorne effect, in which people behave better when they know they are being watched, was minimized through repeated exposure of the researcher to the students. By

being in the classroom regularly for an extended period of time, subjects tended to revert to their normal behaviors. The novelty effect, in which the newness of the event evoked excitement affecting normal student behavior, worked much the same way. After the initial exposure to the treatment condition, use of the IWB, students tended to become accustomed to its use in instruction due to repeated exposures, and no longer reacted to it as a novelty.

Teacher concerns focused on differences in the IWB use skill levels of the three teachers involved in the experiment. However, as shown by the data, the effect of teacher proficiency appears to be minimal. All subjects in all of the participating classes showed very similar behavioral results with subject means improving consistently across course and instructor variations.

Because the views and beliefs of the researcher cannot be separated from the study, the possibility of observational and experimenter effects existed whereby the personal bias of the researcher might have been unconsciously transmitted during observations. The researcher believed that the influence of the experimenter effect was reduced by awareness of it, by maintaining consistent procedures and behaviors with all classes, and by recording data as objectively as possible. In this way, selective attention and interpretation biases were curtailed. Observer reliability was controlled through the extensive training of the researcher in Instructional Supervision, Clinical Educator Training, and the Florida Performance Measurement System, with practical experience in conducting classroom supervisory observations as a former Peer Teacher and Assistant Principal using various data collection methods.

The instrumentation for the study remained the same throughout. The observation tool was modified from instruments obtained from credible sources, with adequate inter-rater agreement evidence, and with behaviors operationally defined using appropriate measures. Reliability and content validity information was provided for the unmodified survey instrument showing consistency of measurement from which the research instruments were developed. Although threats to the validity of the study were accounted and controlled as closely as possible, some unaccounted factors may have been outside the control of the researcher. Other threats to internal validity included the subject completion of attitude surveys in which responses appeared to be flawed through Christmas-treed, thoughtless, or inadequate responses. Out of over 200 returned surveys, however, the researcher counted less than five as questionable. Therefore, the researcher did not believe it to be necessary to use the 5% trimmed mean process applied to the survey data.

Because characteristics unique to the experiment could reduce generalizability, the external validity issue of subject selection-treatment was controlled by limiting the study to a specifically accessible group in a specific setting to permit comparison with other populations. The subject population was described in depth with demographic data for the two schools involved to illuminate any differences that they may have with other groups of middle school students. The subjects of the study represented a diverse group of students, representative of the surrounding community. They were typical middle class, suburban middle school students who were also representative of their schools at large. However, compared to other schools across the country, the sample may not generalize to other settings, nor the results of this study necessarily apply to all students

of any age, limiting generalizability to some degree. Generalizability due to the relatively small sample size of 226 subjects is also a consideration, as well as the length of the study. The duration of the investigation was limited to a six-week observation period. Campus and community setting factors were also taken into account as regards external validity. Although the researcher used a control class at each school, there exists a possibility that unknown events on campus or within the school zones may have influenced subject behavior.

Setting generalizability was considered to ensure that the classroom environments at the target schools were representative of schools at large. The schools used in the investigation were located in a school district able to provide the discretionary fiscal resources to fund adequate classroom instructional and technological equipment. Each classroom was equipped with standard instructional equipment including regular whiteboards, bulletin boards, overhead projectors, and at least one computer. No artificiality was detected at the research sites, nor any over-crowded, inferior, or poorly-maintained classrooms.

Other threats to external validity were ameliorated to reduce the potential for limited conclusions regarding the data generated in the study. The study was conducted during the latter half of the first semester of the school year to eliminate the beginning of the school year honeymoon period allowing the teachers and students to become acclimated to each other. The Hawthorne, experimenter, and novelty effects in the context of external validity were considered as possible threats. However, student attitudes, the presence of the experimenter, and the excitement of a new instructional tool

were controlled for through repetitious exposures of the subjects to the components of the study.

Suggestions for Further Research

There are a number of areas regarding IWB use as an educational tool that have yet to be thoroughly explored. This investigation focused exclusively on student behavior; it was not concerned with teacher attitudes, the effectiveness of the various types of lessons created, IWB proficiency, or the teaching methodologies utilized. Because the duration of the study was limited to a six-week observation period, additional investigations over a longer time period would be appropriate to assess consistency in outcomes. Teacher issues involving the types of training, support, and professional development also merit further investigation. Finally, research into best practices by those who use interactive whiteboards for classroom instruction would be beneficial to those who are cultivating their skills in its use. These considerations require further research for optimum use of the IWB.

With respect to student issues, several areas for further research are also noted. In light of the research recognizing the benefits of IWB use to accommodate the various learning styles, the focus has been primarily on the visual aspects of IWB use. Additional research in the areas of auditory and kinesthetic learning styles is also warranted. Pedagogy as applied to millennial students and their familiarity with technology should lead to generational research with a focus on the impact of various technologies including using the interactive whiteboard. Further research regarding the applications and benefits of IWB use with special needs students in terms of accommodations and learning modalities which could be introduced using the IWB

would be appropriate as well. Because engagement in lessons is a necessary component of student achievement, additional research in this area is also warranted. The research so far on the effects of IWB use on student achievement has been mixed. Additional study would be appropriate to identity the performance effects of interactive whiteboard use. Finally, investigation into the use of the IWB in block schedule settings would be appropriate. Its usefulness as a means of providing instructional activities incorporating different stimuli for variety in educational delivery systems is warranted.

Summary

The results of this study were emphatically positive. Student engagement behaviors increased significantly when the IWB was used for instructional purposes. As a presentation device, interactive whiteboards can be purchased economically, and can be mastered rapidly. Interactive whiteboards also satisfy district, state, and federal technology mandates. Most importantly, though, they can be incorporated into classroom instruction as a sound pedagogical teaching accessory.

Students indicated that interactive whiteboards were an enjoyable and engaging technological tool. This was evident to the researcher from personal experience with the IWB and during classroom observations for the current research. Students reacted with delight and enthusiasm when the IWB was to be used. Upon entry into the classroom readied for whiteboard use, smiles and excitement were unmistakable on the faces of students. They also participated more eagerly during instruction using the whiteboard. The desire to interact with the whiteboard is a powerful motivator for students. Their attention becomes intensely focused on the whiteboard and their behavior shifts into appropriate mode. Use of the IWB allowed instructors to access and interact with sites

that they would otherwise not have for demonstration and visualization of processes, events, and techniques. This ability brings an immediacy and dynamism to the information presented during instruction. This researcher felt that the student involvement, attention, and interest displayed was a more substantial recommendation for IWB use any data could convey.

The social aspect of the whiteboard is a big draw for junior high students. Because students overtly share in the learning, there was a high level of enjoyment and great interest in the comments and experiences expressed by other students evidenced during instruction. Students were also intensely focused whenever a classmate was working up at the whiteboard. Communication in today's world utilizes a variety of technology tools. Students routinely use technology in their daily lives for personal communication and information. Interactive whiteboard use is a natural extension from personal, social use of technology to use in the academic setting.

Schools must keep up with the times by integrating technology into educational practice. Technology is no longer the wave of the future; the future is now. It has pervaded all aspects of society and the field of education is no exception. Schools and educators must provide opportunities for students to access, interact with, and become skilled users of technology as part of a twenty-first century education. The interactive whiteboard is a tool that satisfies all of the requisites of today's world.

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APPENDICES

Appendix A

Row# ____, Seat # ____

Interactive Whiteboard Attitude Survey

Read each statement and then circle the number which best shows how you feel.

1 = Strongly Disagree **2** = Disagree **3** = Agree **4** = Strongly Agree

1. I enjoy classroom instruction using the IWB	1	2	3	4
2. I am tired of technology use in the classroom	1	2	3	4
3. I will be able to get a good job if I know how to use an IWB	1	2	3	4
4. I can concentrate better on the lesson with the IWB	1	2	3	4
5. I would work harder if the IWB were used more	1	2	3	4
6. I know that the IWB gives me more opportunities to learn new things	1	2	3	4
7. I understand the lesson better when the IWB is used	1	2	3	4
8. I believe that if more teachers used the IWB, I would enjoy school more	1	2	3	4
9. I believe that it is important for me to be able to use technologies such as the computer and the IWB	1	2	3	4
10. I can learn new things when the IWB is used	1	2	3	4
11. I feel comfortable using the IWB	1	2	3	4
12. I think lessons take longer using the IWB	1	2	3	4
13. Using the IWB does not scare me	1	2	3	4
14. Using the IWB does not make me nervous	1	2	3	4
15. Using the IWB is difficult	1	2	3	4
16. I can learn more from books than the IWB	1	2	3	4
17. I want to work with technology whenever I can	1	2	3	4
18. I work very hard on my schoolwork	1	2	3	4
19. I do not try hard in school	1	2	3	4
20. I pay attention in class	1	2	3	4
21. When I am in class, I just act as if I'm working	1	2	3	4
22. It is important to do my best in school	1	2	3	4
23. I always try to complete my assignments	1	2	3	4

Appendix B

At-Task Observation Instrument

This technique provides data on individual student's engagement levels. Each square is a student. Scan the classroom every 3 to 5 minutes ("sweep:). Record the time of the sweep and a brief notation as to the activity taking place. Focus once on each student briefly during each sweep. For each student, record an at-task (+) or off-task notation. The following questions could be asked in reviewing the data: What was the predominant off-task behavior? During which activity did most off-task behaviors occur? During which sweeps were most students off-task? Which students were off-task most often? Possible reasons/recommendations?

Teacher ______________________________ **School** ______________________

Start Time _______________ **End Time** _____________ **Date** ______________

+ = At- Task

Off-Task Codes

A – Turned around
C – Schoolwork other than assignment
O – Out of seat
H – Head down
N – making noises/faces
S – Stalling
T – Talking

Students

1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8
1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8
1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8
1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8
1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8	1 5 2 6 3 7 4 8

Sweeps: Every 3-5 minutes record the time of the sweep and a brief notation of activity taking place at that time:

sweep 1.	sweep 2.	sweep 3.	sweep4.
sweep 5.	sweep 6.	sweep 7.	sweep 8.

Appendix C

Output Data: Interactive Whiteboard SPSS Statistics for Total Sample

Descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean		Std. Deviation	Variance	Skewness	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error
gender	226	1	2	1.44	.033	.497	.247	.251	.162
ethnicity	226	1	4	1.46	.064	.967	.934	1.784	.162
at-task behaviors 1	215	.0	8.0	6.516	.1194	1.7504	3.064	-1.624	.166
at-task behaviors 2	221	.0	8.0	6.403	.1192	1.7725	3.142	-1.486	.164
at-task behaviors 3	193	.0	8.0	6.456	.1274	1.7705	3.135	-1.881	.175
at-task behaviors 4	223	.0	8.0	7.538	.0835	1.2474	1.556	-4.408	.163
at-task behaviors 5	221	.0	8.0	7.502	.0899	1.3370	1.787	-4.387	.164
at-task behaviors 6	221	.0	8.0	7.584	.0675	1.0039	1.008	-4.667	.164
Valid N (listwise)	173								

T-Test=***use4 use5 use6 WITH use1 use2 use3*** (PAIRED) /CRITERIA=CI(.9500)

Paired Samples t Test Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	at-task behaviors 4	7.559	213	1.2524	.0858
	at-task behaviors 1	6.512	213	1.7553	.1203
Pair 2	at-task behaviors 5	7.491	216	1.3502	.0919
	at-task behaviors 2	6.407	216	1.7629	.1199
Pair 3	at-task behaviors 6	7.593	189	1.0407	.0757
	at-task behaviors 3	6.476	189	1.7702	.1288

Paired Samples t Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	at-task behaviors 4 - at-task behaviors 1	1.0469	1.8550	.1271	.7964	1.2975	8.237	212	.000
Pair 2	at-task behaviors 5 - at-task behaviors 2	1.0833	2.0647	.1405	.8064	1.3602	7.712	215	.000
Pair 3	at-task behaviors 6 - at-task behaviors 3	1.1164	1.9205	.1397	.8408	1.3920	7.991	188	.000

ONE-WAY ANOVA

ONEWAY use1 use2 use3 use4 use5 use6 ***BY Gender***

ONE-WAY ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
at-task behaviors 1	Between Groups	44.409	1	44.409	15.474	.000
	Within Groups	611.284	213	2.870		
	Total	655.693	214			
at-task behaviors 2	Between Groups	13.899	1	13.899	4.495	.035
	Within Groups	677.259	219	3.093		
	Total	691.158	220			
at-task behaviors 3	Between Groups	23.939	1	23.939	7.911	.005
	Within Groups	577.937	191	3.026		
	Total	601.876	192			
at-task behaviors 4	Between Groups	9.853	1	9.853	6.489	.012
	Within Groups	335.573	221	1.518		
	Total	345.426	222			
at-task behaviors 5	Between Groups	3.241	1	3.241	1.820	.179
	Within Groups	390.008	219	1.781		
	Total	393.249	220			
at-task behaviors 6	Between Groups	.422	1	.422	.417	.519
	Within Groups	221.280	219	1.010		
	Total	221.701	220			

Independent-Sample t Test

Gender

Group Statistics

	gender	N	Mean	Std. Deviation	Std. Error Mean
at-task behaviors 1	male	121	6.116	2.0297	.1845
	female	94	7.032	1.1212	.1156
at-task behaviors 2	male	123	6.179	1.8556	.1673
	female	98	6.684	1.6283	.1645
at-task behaviors 3	male	109	6.147	2.0038	.1919
	female	84	6.857	1.3185	.1439
at-task behaviors 4	male	125	7.352	1.5568	.1392
	female	98	7.776	.6012	.0607
at-task behaviors 5	male	124	7.395	1.5345	.1378
	female	97	7.639	1.0225	.1038
at-task behaviors 6	male	123	7.545	1.0102	.0911
	female	98	7.633	.9988	.1009

Gender **Independent Samples Test**

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% C I of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
at-task 1	Equal variances assumed	24.299	.000	-3.934	213	.000	-.9162	.2329	-1.3753	-.4571
	Equal variances not assumed			-4.207	194.132	.000	-.9162	.2178	-1.3457	-.4867
at-task 2	Equal variances assumed	1.319	.252	-2.120	219	.035	-.5048	.2381	-.9741	-.0355
	Equal variances not assumed			-2.152	216.926	.033	-.5048	.2346	-.9672	-.0424
at-task 3	Equal variances assumed	9.700	.002	-2.813	191	.005	-.7104	.2526	-1.2085	-.2122
	Equal variances not assumed			-2.962	186.743	.003	-.7104	.2399	-1.1835	-.2372
at-task 4	Equal variances assumed	17.719	.000	-2.547	221	.012	-.4235	.1663	-.7512	-.0959
	Equal variances not assumed			-2.788	167.899	.006	-.4235	.1519	-.7234	-.1236
at-task 5	Equal variances assumed	3.825	.052	-1.349	219	.179	-.2440	.1809	-.6005	.1125
	Equal variances not assumed			-1.414	213.944	.159	-.2440	.1725	-.5841	.0961
at-task 6	Equal variances assumed	.476	.491	-.646	219	.519	-.0879	.1361	-.3562	.1803
	Equal variances not assumed			-.647	209.107	.518	-.0879	.1359	-.3559	.1800

Gender **Contrast Tests**

		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
at-task behaviors 1	Assume equal variances	1	-.916	.2329	-3.934	213	.000
	Does not assume equal variances	1	-.916	.2178	-4.207	194.132	.000
at-task behaviors 2	Assume equal variances	1	-.505	.2381	-2.120	219	.035
	Does not assume equal variances	1	-.505	.2346	-2.152	216.926	.033
at-task behaviors 3	Assume equal variances	1	-.710	.2526	-2.813	191	.005
	Does not assume equal variances	1	-.710	.2399	-2.962	186.743	.003
at-task behaviors 4	Assume equal variances	1	-.424	.1663	-2.547	221	.012
	Does not assume equal variances	1	-.424	.1519	-2.788	167.899	.006
at-task behaviors 5	Assume equal variances	1	-.244	.1809	-1.349	219	.179
	Does not assume equal variances	1	-.244	.1725	-1.414	213.944	.159
at-task behaviors 6	Assume equal variances	1	-.088	.1361	-.646	219	.519
	Does not assume equal variances	1	-.088	.1359	-.647	209.107	.518

ONEWAY ANOVA

use1 use2 use3 use4 use5 use6 ***BY Ethnicity***

ONE-WAY ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
at-task behaviors 1	Between Groups	10.897	3	3.632	1.189	.315
	Within Groups	644.796	211	3.056		
	Total	655.693	214			
at-task behaviors 2	Between Groups	2.871	3	.957	.302	.824
	Within Groups	688.287	217	3.172		
	Total	691.158	220			
at-task behaviors 3	Between Groups	18.683	3	6.228	2.018	.113
	Within Groups	583.193	189	3.086		
	Total	601.876	192			
at-task behaviors 4	Between Groups	.918	3	.306	.195	.900
	Within Groups	344.508	219	1.573		
	Total	345.426	222			
at-task behaviors 5	Between Groups	17.507	3	5.836	3.370	.019
	Within Groups	375.742	217	1.732		
	Total	393.249	220			
at-task behaviors 6	Between Groups	3.244	3	1.081	1.074	.361
	Within Groups	218.457	217	1.007		
	Total	221.701	220			

Appendix D

Interactive Whiteboard Attitude Survey Results

Subject responses to each of twenty-three survey questions were made on a 1 to 4 scale. A response of 1 indicated that the student strongly disagreed with the statement, 2 signified disagreement, 3 agreement, and 4 strong agreement.

Question **Interactive Whiteboard Attitude Survey**	Mean	Std. Dev.
1. I enjoy classroom instruction using the IWB	3.58	.64
2. I am (not)tired of technology use in the classroom	3.68	.65
3. I will be able to get a good job if I know how to use an IWB	2.96	.76
4. I can concentrate better on the lesson with the IWB	3.45	.70
5. I would work harder if the IWB were used more	3.23	.83
6. I know that the IWB gives me more opportunities tolearn new things	3.34	.75
7. I understand the lesson better when the IWB is used	3.37	.73
8. I believe that if more teachers used the IWB, I would enjoy school more	3.42	.82
9. I believe that it is important for me to be able to use technologies such as the computer and the IWB	3.43	.66
10. I can learn new things when the IWB is used	3.41	.68
11. I feel comfortable using the IWB	3.40	.75
12.I think lessons take longer using the IWB	3.13	.83
13. Using the IWB (does) not scare me	3.47	.76
14. Using the IWB does not make me nervous	3.42	.81
15. Using the IWB is (not) difficult	3.33	.80
16. I can (not) learn more from books than the IWB	3.19	.87
17. I (do not) want to work with technology whenever I can	3.38	.76
18. I (do not) work very hard on my schoolwork	3.33	.75
19. I (do) not try hard in school	3.46	.76
20. I (do not) pay attention in class	3.30	.69
21. When I am in class, I just act as if I'm working	2.95	1.03
22. It is important to do my best in school	3.62	.65
23. I always try to complete my assignments	3.53	.68
Total	3.36	.75

*The scoring scale for questions 2, 13, 15, 16, 17, 18, 19, and 20 was reversed. The reversed form of the question is in parenthesis.

Appendix E

Comparison of Student IWB Use Computer Attitude Survey Means with Observed At-Task Behavior Means

AA	Survey M	M Obs. 1,2,3	M Obs. 4,5,6	AB	Survey M	M Obs. 1,2,3	M Obs. 4,5,6	BC	Survey M	M Obs. 1,2,3	M Obs. 4,5,6
Stud.				Stud.				Stud.			
111	1.2	5.7	7.5	313	3.0	7.3	8.0	211	3.7	6.0	8.0
112	3.8	7.0	7.3	315	2.4	2.7	4.0	212	3.3	7.0	7.3
113	3.2	5.7	7.0	322	3.7	7.7	8.0	213	2.9	6.7	7.7
114	3.6	6.3	7.7	323	2.6	2.7	7.7	214	3.0	5.3	8.0
121	3.5	5.3	7.5	332	3.3	7.7	7.7	215	3.4	7.0	8.0
122	3.7	4.7	7.3	333	3.6	6.3	8.0	221	3.3	6.3	8.0
123	3.3	7.0	8.0	334	3.7	A	7.5	222	3.3	7.7	8.0
124	3.4	4.7	7.3	341	3.7	5.7	8.0	223	3.9	8.0	8.0
125	3.0	6.0	8.0	342	3.0	6.7	8.0	224	3.1	3.3	8.0
131	3.6	7.0	7.7	343	3.2	6.0	8.0	225	3.6	7.3	8.0
132	3.7	6.3	8.0	344	3.1	4.7	7.3	231	3.5	7.7	8.0
133	3.5	6.3	8.0	351	3.3	7.0	7.7	233	3.8	7.0	8.0
141	3.6	7.0	8.0	352	3.2	6.0	8.0	234	2.9	7.7	7.7
142	3.7	5.0	8.0	353	2.8	8.0	8.0	235	A	7.7	8.0
143	3.6	6.0	7.7	354	3.3	7.7	8.0	241	3.0	3.5	8.0
151	3.1	6.7	7.0	361	3.4	7.0	8.0	242	3.2	7.0	8.0
152	1.5	6.7	7.7	362	3.4	6.0	8.0	243	3.4	6.3	8.0
153	3.8	6.0	7.5	363	3.4	7.0	7.0	244	3.8	6.0	8.0
154	3.9	7.3	8.0	364	2.8	4.0	7.0	245	3.3	8.0	8.0
155	A	6.0	7.7	512	2.9	7.7	7.7	251	3.7	5.7	7.0
161	3.9	7.7	7.0	513	3.2	7.7	8.0	252	3.9	6.7	7.7
162	3.9	6.7	7.7	514	3.8	6.3	7.3	253	3.5	6.7	7.0
163	3.7	7.0	8.0	522	3.1	7.0	8.0	254	3.1	8.0	8.0
164	3.5	4.7	7.0	523	3.4	5.3	7.7	261	3.0	7.0	8.0
165	2.7	6.0	7.7	532	2.6	6.7	7.3	262	3.8	5.5	7.0
211	3.7	7.0	8.0	533	3.1	7.7	8.0	263	3.9	5.0	8.0
212	3.3	7.7	8.0	534	3.3	7.5	6.7	311	3.3	6.3	8.0
221	A	7.3	7.7	541	3.3	7.3	7.7	312	4.0	4.0	8.0
222	3.5	7.3	7.7	542	2.9	6.7	8.0	313	3.7	5.7	7.7
223	3.8	7.7	7.3	543	3.0	7.7	7.7	314	4.0	6.7	8.0
224	3.2	8.0	8.0	544	3.8	6.0	8.0	315	3.6	7.0	7.5
231	3.6	8.0	8.0	545	3.3	7.0	7.7	321	3.9	6.0	8.0
232	2.8	7.3	8.0	551	1.4	5.0	7.0	322	4.0	7.0	8.0
233	2.9	6.7	8.0	552	3.7	7.0	7.3	323	3.0	7.3	8.0
241	3.9	6.7	8.0	553	3.1	6.7	7.3	324	2.9	5.3	6.3
242	3.7	7.3	7.7	554	2.8	5.3	6.3	332	4.0	4.3	7.7
243	3.9	7.0	7.3	555	3.2	7.3	7.7	333	3.7	7.7	8.0
251	3.2	7.7	8.0	561	2.9	4.0	7.7	334	A	6.5	7.0
252	3.6	7.3	7.3	562	3.7	7.0	8.0	335	A	5.3	7.7
253	3.6	5.7	6.3	563	2.7	8.0	7.7	341	3.9	7.3	7.3
254	2.8	6.0	7.5	564	3.4	6.0	7.3	342	3.9	7.0	8.0

255	3.8	5.0	8.0	565	3.0	6.0	7.0	343	4.0	7.5	8.0
261	3.4	6.7	7.3	612	3.9	7.3	7.0	344	3.3	7.5	8.0
262	3.8	7.3	8.0	613	3.4	5.0	8.0	351	A	6.5	7.7
263	3.0	6.3	7.7	614	2.4	6.5	8.0	352	1.4	6.7	8.0
264	3.4	8.0	7.3	622	3.2	8.0	8.0	353	3.3	7.3	7.7
265	3.4	7.3	6.3	623	3.7	8.0	7.5	354	2.4	6.5	-
266	3.5	5.7	7.3	624	2.6	8.0	6.7	355	3.2	6.0	-
411	3.5	6.7	8.0	625	2.7	5.0	6.5	361	3.8	A	-
412	3.1	6.3	7.7	632	3.3	7.0	7.7	411	4.0	6.0	7.0
413	2.6	6.0	7.0	633	2.3	8.0	8.0	413	.7 Inc	4.7	7.7
414	4.0	6.0	8.0	634	2.8	4.0	7.3	414	3.9	6.7	8.0
415	3.3	7.0	7.0	641	2.9	6.5	8.0	415	3.9	6.7	8.0
421	3.2	8.0	8.0	642	3.3	7.0	7.7	421	3.6	7.0	8.0
422	4.0	7.0	7.7	643	3.1	6.5	7.7	422	3.5	5.0	8.0
423	3.8	6.7	7.7	644	3.3	7.5	8.0	423	3.8	6.7	7.7
424	3.0	6.3	8.0	645	3.2	3.5	6.7	424	A	6.7	8.0
425	3.2	7.7	8.0	651	2.8	4.5	7.7	425	3.0	6.0	7.3
431	2.4	7.7	8.0	652	2.8	8.0	8.0	432	3.8	5.7	7.3
432	A	6.3	7.3	653	3.5	5.0	5.7	433	3.5	6.7	8.0
433	3.6	5.3	8.0	654	2.3	4.0	8.0	434	4.0	7.0	8.0
441	3.0	6.7	7.7	655	A	5.5	7.3	435	A	8.0	8.0
442	3.4	7.0	8.0	661	2.5	6.5	8.0	441	3.0	7.0	8.0
443	3.6	6.3	6.3	662	3.1	6.5	8.0	442	4.0	6.5	8.0
451	2.8	8.0	7.7	663	3.3	7.5	7.0	443	3.1	7.7	8.0
452	3.3	7.7	8.0	664	3.1	4.0	7.0	444	3.3	5.0	7.3
453	3.0	6.3	8.0					511	3.5	7.7	8.0
454	2.6	6.3	8.0					512	3.6	7.3	8.0
455	3.6	7.7	6.7					513	3.8	7.7	8.0
456	2.9	7.0	7.7					514	4.0	7.3	8.0
461	2.8	7.3	8.0					515	4.0	7.3	7.7
462	3.7	8.0	7.7					521	A	5.0	8.0
463	3.2	7.0	7.7					522	3.6	7.3	7.3
464	3.1	7.0	7.7					523	3.2	7.7	8.0
465	3.5	7.0	7.3					524	4.0	6.7	8.0
466	A	6.5	8.0					525	4.0	7.3	8.0
								532	3.3	7.7	7.7
								533	3.8	7.7	8.0
								534	3.7	7.3	8.0
								535	3.6	7.3	7.7
								541	3.6	8.0	8.0
								542	3.8	6.7	8.0
								543	3.8	8.0	8.0
								544	3.8	7.0	7.7

* over 2.5 indicates agree to strongly agree

Appendix F

Qualitative Impromptu Student Comments

Excited student utterances overheard and recorded by the researcher when the IWB was in use included:

- "That thing is cool"
- "How does that thing work?"
- "That's cool!"
- "Whoa!"
- "Oh, wow!"
- "That's pretty cool!"
- "That's a real SMART Board!"
- "Are we using the SMART Board today? Sweet!"
- "Can I reset the SMART Board?"
- "That's so cool!"
- "I want to write on it"
- "Can I align the board?"
- "Dude!"
- "Awesome!"
- "Sweet!"
- "That's so cool!"

* Plus, a lot of smiles and general excitement when the IWB was set up for instructional use.