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The effects of using a whiteboard interactively in a middle school mathematics classroom

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THE EFFECTS OF USING A WHITEBOARD INTERACTIVELY IN A MIDDLE SCHOOL MATHEMATICS CLASSROOM

by

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Abstract

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The purpose of this study was to further examine the effects of using Interactive Whiteboards interactively versus as a glorified whiteboard. The experimental group consisted of seven eighth grade general education students and six eighth grade special education students. The experimental group was taught with lessons created to promote interactivity and student involvement and covered the five lessons in a unit on three-dimensional geometry. Baseline data was collected by using the mean of the students' recent test scores. The post-test was then compared to the students' baseline scores to show the effectiveness of the intervention. To further data analysis, baseline mean scores and post-test scores from the 26 other students in eighth grade math were analyzed and compared to the experimental group. Overall, the results showed the intervention was successful. Both the special education students and the general education students of the experimental group showed significant growth over their baseline data. Although the control group also showed growth from their baseline to the post-test, the growth was not as significant and a much higher percentage of students either showed very little growth or exhibited a lower score on their post-test than baseline.

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Chapter 1

Introduction

The use of appropriate technology to educate the students of today who rely extensively on technology in all aspects of their lives, education, as a collective, is slipping behind. The infusion of technology in the classroom contrasts dramatically in comparison to what students experience outside of a classroom setting.

In the beginning of the millennium, the introduction of interactive whiteboards (IWB) was groundbreaking for a field that relied heavily on the typical routine of chalk, lecture, and pencil-and-paper. The Interactive whiteboards were used as an interactive and motivation tool, and students of all ability levels thrived, regardless of classification.

Since my student teaching in 2003, I have noticed that as technology outside of the classroom has grown exponentially, with the invention of iPads, tablet computers, and smartphones, students' excitement about interactive whiteboards has dissipated. Whereas ten years ago, I observed that technology in the classroom was innovative and interesting, the real-world has caught up and surpassed the realm of education in my eyes. My own impression from working with dozens of teachers is that the use of technology is increasing rapidly, although not as quickly as any of us think it should be.

Initial implementation of interactive whiteboards was adopted by many teachers as well as was the transition from chalkboards to dry erase boards. However, many teachers do not utilize its capabilities beyond "enhancing the traditional 'write-on-the-board' strategy for a lesson" (Wolfe, 2010). Teachers relied on the new technology's basic features such as the ability to write in different colors with an electronic 'pen' and

erase with an electronic 'eraser.' Many teachers relied on what they understood, which lost its luster for motivating students as students grew accustomed to the technology.

For older students, it becomes more difficult to engage them with the interactivity of the touchscreen whiteboards. As a seventh grade Special Education teacher, I taught an out-of-class resource group of seven boys with various disabilities. My observation has been that the focus of these boys was directly related to the amount of interactivity within each lesson on the Smart Board. When the interactive whiteboard was used primarily as a replacement to a chalkboard, their motivations dwindled and their focus was elsewhere. However, when the Smart Board was used to its capability- moving shapes, disappearing answers, and randomly selecting students to work- the students showed much higher levels of focus and motivation. The students also shared their joy in learning as interactively as possible, and likened it to playing video games, their passion.

Research Question

Given this background, the research question for this study is: Does the innovative use of interactive technology have a positive effect on learning outcomes of students, specifically students with disabilities?

Sub-Questions

1. Does using interactive whiteboard technology as an interactive tool for learning, beyond the traditional "write-on-the-board" strategy result in greater learning outcomes?
2. Do students show greater observed extrinsic motivation when utilizing technology in learning?

3. Does use of the interactive whiteboard improve the academic performance of students with disabilities?

Implications

In speaking with colleagues, most express their use of technology resides within their comfort level and applications which they understand. Showing the positive effects of utilizing interactive whiteboards interactively will show educators the great possibilities given the focus, extrinsic motivation, and assessment results. Through the utilization of interactive strategies in using the interactive whiteboards, middle school students will show academic progress on a unit assessment due to improvement of their focus and motivation to participate. The focused and motivated student has a better chance to score higher on an assessment.

Summary

Through the years many educators have taken the possibilities that technology provides for granted. As our students live under a barrage of technology and information, their attention becomes harder to hold in the classroom. Many teachers resort to "old" techniques, such as board writing, only utilizing interactive whiteboards, instead of capturing middle school students with the interactivity which they thirst for and receive the second they exit the building. By adding interactivity to middle school lessons, students will show a greater focus and a greater motivation for learning, this will result in higher attentiveness and therefore a more profound academic result.

I hypothesize that when an interactive smart board is used appropriately, and to its potential, student motivation and focus will improve. Thus, in turn, will increase student achievement.

Chapter 2

Literature Review

The effect of interactive whiteboards on student learning is shown through many studies. Regardless of subject matter, grade level, or socioeconomic status, the results trend in a positive direction. These devices act as a catalyst in learning, primarily through student engagement. Due to its motivational factor, studies also show that interactive whiteboards are a factor in increasing student attendance. Due to these positive results, the prevalence of interactive whiteboards has grown exponentially in classrooms since the turn of the century.

The History of Interactive Whiteboards in Public Education

The first interactive whiteboard (IWB) was manufactured by SMART Technologies in 1991. As synonymous as Apple and the iPad are with tablet technologies, SMART and the Smart Board are just as synonymous with IWB technology. Although SMART Technologies did not have a specific audience in mind for their interactive whiteboard, they explain "Educators were the first people to recognize the interactive whiteboard's potential as a tool for collaboration, improving student learning outcomes and streamlining lesson planning" (SMART Technologies, p.1).

Along with SMART Technologies introducing the SMART Board in 1991, there are a series of benchmarks in the history of IWB (as shown in figure 1)

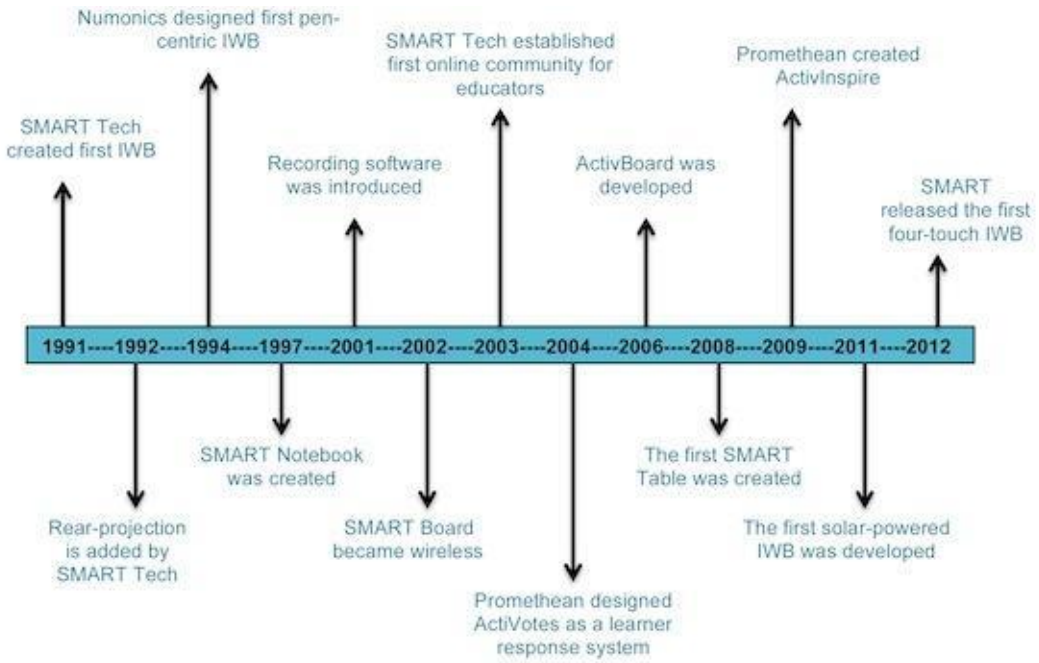

Figure 1. Implementation Timeline of Interactive Whiteboards

In addition to the SMART board technology, the company realized that an accompanying program was needed to assist teachers in getting the most interactivity and learning experience out of their smart board, so they introduced SMART Notebook, a companion application in 1997. IN 2003, they followed up with an online collaborative community for educators named

SMARTExchange Between 2004 and 2006 SMART developed competition from Promethean and Activboard, two companies with similar conceptual interactive whiteboards.

According to a published document by the National Education Association (www.neamb.com), Newsweek reported that as of 2008 approximately 70% of primary and secondary schools in the United Kingdom were using interactive whiteboards, while only 16% of primary and secondary schools in the United States. SMART Technologies claims to currently have SMART Boards in over three million classrooms worldwide.

Transition from Chalkboards to Whiteboards

Many of the early observations of the transitions from chalkboards and dry erase boards towards interactive whiteboards showed growth in motivation, school attendance, attitude towards technology in the classroom, and most importantly academic achievement. Many early studies and early implementations were focused on primary grades, where interaction is more commonplace in the classroom.

In a 2010 study involving upper elementary students, Torff and Tirotta showed that "the use of interactive whiteboard technology (IWB) was associated with upper elementary students' self-reported motivation in mathematics" (Torff and Tirotta, p. 379). Torff and Tirotta used a qualitative research study to evaluate student and teacher impressions of the integration and use of the interactive whiteboards. Many of the questions asked showed that upper level students no longer need the extrinsic motivation of interactivity. This is shown by the questions asked to students regarding their motivation towards the interactive whiteboards, as well as a question asked towards

teachers regarding the apparent student motivation towards interactive smart boards. In conclusion, the report explains that the actual effect of the student motivation was "extremely weak."

Conversely, a study conducted involving 50 sophomore Elementary Education students. 25 students were taught only utilizing a projector and a screen, however the experimental group was taught utilizing an interactive whiteboard. The research showed a much larger difference in self-reported motivation between the control group to the experimental group.

The motivational factor when utilizing interactive whiteboards is student interaction. As explained by Mandy McIntyre in her research syntheses titled *The Effects Interactive Whiteboards Have on Student Motivation* (2006), "Interactive whiteboards have a positive influence on student motivation to learn. However, it is only when students are given the opportunity to interact with the board that true increases in motivation can be measured." Some of the important necessities for increasing student motivation that she concluded from her study were: the necessity of students to have multiple chances to interact with the IWB, the utilization of a variety of different effects for visual stimulation, reviewing and incorporating student work, and to build a curriculum based on the use of the IWB. Ms. McIntyre conducted an analysis of eight research studies regarding the motivating factors in utilizing interactive whiteboards, and concluded that all but one of the eight showed motivation as a great factor in learning.

Most students prefer the interactive whiteboards to rote learning or chalkboard learning; however, attitudes differ. A study conducted by Balta and Duran (2010) of

students in Turkey returned some interesting conclusions that make sense when working with middle schools' students. The researchers concluded that when the students get older, their motivation towards using the interactive smartboards diminish. Balta and Duran also concluded that students also prefer the use of IWB's in their core academic classes as opposed to their elective courses.

It has now been generally accepted that upon the first introduction of the interactive whiteboard revolution, the influence of interactive whiteboards created higher academic achievement when interactive whiteboards were used. A study (Smith,2016) found an increase in motivation, focus, and a level of interactivity not found in chalk and board learning. Due to the overwhelmingly positive results from the original introduction of interactive whiteboards over fifteen years ago, there has been a complete paradigm shift in education, especially at the primary level.

It is difficult to find a study in which interactive whiteboards are found as a detriment to a child's academic progress. However, a literature review by DiGregorio and Sobel-Lojeski (2009), examined the reasoning behind instances where success levels are not as far reaching. In their review, they suggest that one of the main contributing factors of the ineffectiveness in utilizing interactive whiteboards were not the interactive whiteboards themselves. However, contextual factors, such as teacher training, teacher confidence, school culture, technical support, lesson preparation, and practice time.

Studies on the implementation of interactive whiteboards date back fifteen or twenty years, and are considered the primary reasoning for their popularity in the United States and the United Kingdom. More recently, other countries have conducted studies to provide reasoning for implementing whiteboards into their education system. Such a

study was done by Kimar and Oogarah (2013) in Mauritius, an African country who has implemented interactive whiteboards into every single public school. The study was divided into two parts, a quantitative study and a qualitative questionnaire. The quantitative study consisted of two groups of 40 students each. Both groups were taught about the solar system, one using traditional methods and one using the Interactive Whiteboard. Both groups took a pre-test and a post-test to determine effectiveness. This study did not show a huge improvement in the experimental group. The qualitative survey was distributed to 125 teachers among 13 schools across the country to gain their perspective of the value of interactive whiteboard implementation across the country. However, the researchers attributed this to teacher knowledge and training. Some of the suggestions of the study included collaboration efforts between teachers, teachers be identified that could be used as trainers for students to get the full potential of the IWB. Some of the detracting factors were low internet connections, non-technologically savvy teachers, as well as heads of schools who do not believe in the utilization of interactive whiteboards

Whiteboards Used Interactively

Many of the studies done involving interactive whiteboards were based in the "honeymoon" period when interactive whiteboards were new to students. Children of elementary, middle, and even high school age were originally enthralled by their ability to write on a screen and erase without chalk, dry-erase, or an eraser. Those times have worn off, and our students need the interaction offered by the interactive whiteboard, more than just a computer-based dry erase board.

"The way which teachers use and implement IWBs in the classroom affects the extent to which a student is engaged in the lesson" (McQuillan, p. 3) is one of the main points of emphasis now that interactive whiteboards have become abundant in many classrooms. A study conducted in Australia concluded that it is not merely the use of the interactive whiteboard in the classroom, but the way that the interactive whiteboard is being used. This article is based on a study of how interactive whiteboards were used in two Australian primary schools. The article states that the level of interaction that is being used in the classroom has three great effects: students' attitude towards the interactive whiteboard and the level of engagement that students possess during the lesson. The study also indicated that, although teachers generally have a positive attitude towards utilizing the interactive whiteboard in the classroom, the teachers who show a more positive attitude tend to be the teachers who use IWB more interactively.

A news article written in the United Kingdom surmises "Walk into any classroom in the UK today and it's likely you will see an interactive whiteboard (IWB) taking pride of place on the wall. It is also likely that you would see this expensive piece of technology being used as nothing more than a glorified projector" (Amass, 2014) It was this notion that spurned University of Cambridge researchers and classroom teachers to provide a learning resource for teachers that would improve their utilization of the interactive whiteboards as an actual interactive tool. Sara Hennessey (2007), one of the researchers was adamant about the necessity for training with these tools. Her explanation to British government was that "Policymakers need to realize that just simply plonking these powerful tools into the classroom won't change teaching by itself." This

group of researchers and teachers created a resource that teachers in the United Kingdom could use to enhance their lessons for positive interaction when using the whiteboards.

Attitudes Toward Use of Interactive Whiteboards

Through various qualitative studies (Ipek, Bahadur) the attitudes of both teachers and students towards the utilization of interactive whiteboards in the classroom has been found to be generally a positive one. Although the utilization is different and the motivating factors are different with regard to subject matter and grade level, most students and teachers see the benefit of IWBs in the classroom. Many of the responses given both by students and educators reiterate the notion that teacher training has a large effect on both teachers and student attitudes towards the utilization of interactive whiteboards.

Ipek and Sozcii (2016) questioned teachers regarding their experiences using interactive whiteboards and their feelings regarding IWBs in the classroom. The study included teachers of various levels of computer literacy, time of experience using interactive whiteboards, and usage characteristics of the interactive whiteboards. Using a Likert scale, over 80% of teachers answered with "Agree" or "Strongly Agree" to several statements:

- "Using IWB in teaching-learning process increases students' academic performance."
- "Presentations and explanations are more effective when I use IWB."
- "Students prefer teaching with IWB."
- "Students are more motivated when using IWB."

- "Interaction with IWB (touching, responding to visual stimulus) leads to active learning."
- "I believe that using IWB motivates learning."

These statements expand on the positive effects of using interactive whiteboards in the classroom. Motivation and active learning are positive precursors towards learning.

The research done by Ipek and Sozcii (2016) also interviewed students regarding their experiences with interactive whiteboards in their classrooms. The study states, "It can be seen that the participants in the study generally have positive attitudes towards IWB use. It is stated that the use of IWB gives students new opportunities in the class, facilitates their comprehension of the lessons and makes the lesson more entertaining. We can conclude that IWBs generally have positive contributions to students' success

Most of the responses that the students' provided were typically middle of the road responses. However, the most positive responses were regarding the statements, "I like lessons with the IWB." and "I like to use the IWB in the front of the class." The most negatively responded statement, "My teacher doesn't use IWB effectively." (Ipek and Sozcii , p. 179) shows students understand the possibilities of the IWB and can evaluate their teacher's prowess. Although the interactivity of interactive whiteboards may seem more suited for children of elementary level, the research concluded that "Students in all grades have positive attitudes in their classes for the use of IWBs." Pertaining to students who do not participate in a self-contained setting, the study suggests that "Students found the courses with IWB motivating and enjoyable"

Interactive Whiteboards in Special Education

The effect that interactive whiteboards has had on education also had the same profound effect on students with disabilities. Studies with a wide array of parameters, including age, level of cognitive ability, and physical disabilities, have proven the positive effects of interactive whiteboards for instruction of Special Education students. One of the studies showed the profound advantages of utilizing SMART boards for deaf students (Starkman, 2005). Another study of note showed the positive gains made during a qualitative study of students in a self-contained classroom (Amaker, 2014). The most comprehensive study utilized eight teachers over various grades, as well as pre-service teachers to qualitatively analyze teacher's evaluation of interactive whiteboards in classrooms throughout a year-long study (Allsopp et al, 2012).

Interactive whiteboards can be especially engaging when utilized in the right situation. At the Florida School for the Deaf and the Blind, two teachers, Susan Cooper and Sue Clark, co-authored a grant to utilize SMART interactive whiteboards in their "Manguage" class. Language is their combination of a Math and a Language Arts class.

As Neil Starkman (2005) explains in his article, he observes: "Susan Cooper is using the book *Holes* with her eighth-grade Language Arts class. At one point in the book, a character name Stanley is carrying a character named Zero up a hill. Cooper's not much of an artist, but she turned to her SMART Board interactive whiteboard and draws two stick people on an incline - one stick person cradling the other. She turns back to the class and asks, 'Where did Stanley carry Zero? Show me.' A girl comes up, places her finger on the stick people, and moves the figures up the hill exerting some pressure" (Starkman, p.1).

For the students at this school who are deaf, it adds a great interactive piece to the senses that they are able to use, vision and touch. The author points out various other uses for IWB in Special Education: Enabling students with motor disabilities to write on the interactive whiteboards using either their fingers or other instruments, with touches that don't have to be precise to get the intended effect. Allowing visually impaired students to take advantage of interactive whiteboard's enhanced visibility as well as integrated handwriting recognition features that convert annotated notes into typewritten text for easy reading. Providing a platform for lessons that are visually interactive and challenging for students with behavioral disorders such as ADD/ADHD. Promoting focused interactivity as well as multisensory experiences for students with learning disabilities (Starkman, 2005).

In a study entitled *Interactive Whiteboard Technology for Students with Disabilities: A Year Long Explorative Study*, researchers (Allsopp et al, 2012) from the University of South Florida utilized a qualitative research plan to understand how teachers used IWB technology when educating students with various disabilities. The teachers surveyed consisted of one pre-Kindergarten teacher, two middle school teachers, two high school teachers, two teachers of a class focusing on Autism Spectrum Disorders as well as two teachers who taught a class for students with Learning Disabilities/Emotional Behavioral Disorders.

Although the teachers were surveyed at the end of the year-long study, the study was also mainly based on field notes taken during classroom visits. Teacher actions were coded and the resulting student actions were also taken into consideration. "Each teacher action was also coded according to whether or not it corresponded to one of four

teaching practices: (1) modeling, (2) providing students with responsive opportunities, {3} providing feedback, and (4) monitoring progress" (Allsopp et al., p. 6). Without utilizing the interactive whiteboard, the teachers displayed these four teaching practices 100% of the time, with (1) providing students with response opportunities at 48%. Of the four teaching practices, the only practice whose occurrence increased when utilizing the interactive whiteboard was modeling, which increased from 19% to 28%. However, when utilizing the interactive whiteboards, the teachers only displayed these four teaching practices 81% of the time. The researchers state that "Overwhelmingly, the relatively few teacher actions related to modeling through *IWB* occurred when concepts and skills were shown visually through teacher-developed presentation slides (e.g., PowerPoint) projected on the whiteboard. When this occurred, teachers mostly used the pen or highlight tool as they modeled for emphasis" (Allsopp et al., p. 7).

Teachers were the most vocal about the interaction that students were having with the Interactive White Boards. The responses were specific to their benefits in their classroom, but showed a higher interest level from the students as well as a higher motivation level. An intern in an Autism Spectrum Disorders class explained their breakthrough, "So we want them to get away from carrying the communication books because at some point they may have laptops and things like that. So, the tabs [on the IWB] when you click on them they actually link to the pages [similar to the communication book] ... the reason why we do it that way is it is interactive instead of just turning the pages. On the board, it will click like a real screen on a laptop and that's why we do it" (Allsopp et al., p. 9).

The teachers were also surveyed how they use the IWB in other facets of teaching. Although answers were very different, all answers had the common theme of differentiation, from adjusting colors for different parts of speech to the board being large and bright. Teacher's comments also revolved around student focus and motivation. The two highlighted teacher comments were, "I think the value added is their interest and their being more actively involved rather than me being more traditional by giving them information" (Colucci, 2012), and "Engagement is so important for us because we have such young learnings. If we can get them excited and engaged, the sky's the limit." (Allsopp et al., p 9)

In a study involving fifth grade students in a Learning Disabilities Self-Contained classroom in rural South Carolina, interactive whiteboards were found as an effective tool in enhancing the learning of Learning Disabled Self-Contained student (Amaker, 2014). The results indicated a significant difference between the baseline and post-assessment scores. As students attending a public institution in the state of South Carolina, these students also participated in standardized testing. The standardized test given to public school students in the state of South Carolina is the PASS Assessment (Palmetto Assessment of State Standards). The experimental group was first taught utilizing a typical curriculum, and then followed by introducing the interactive whiteboard into the same classroom. Each hypothesis was supported by the study, most importantly, "The studies conducted supported the influence of the Interactive Whiteboard (IWB) in the development and performance of students particularly in the area of mathematics" (Amaker, p. 79). In this study, other hypotheses were supported, focusing on students' showing significant advances in Language Arts and writing. However, I thoroughly

agree with the researcher in her reasoning that "Although the Interactive Whiteboard's influence on academic performance was the basis of the study and the study indicated the instrument appears to be conducive to impacting performance, it is problematic to assume the technology alone contributed to the increase in student performance. It is likely that other variables such as teacher preparedness, instructional emphasis and institutional focus were also prevalent in causing the increase in scores. These limitations should be considered when generalizing the study results to other populations which may consist of differing populations and institutional demographics as well as other forms of summative examinations" (Amaker, p. 80).

A dissertation by Nicole Stanley (2016), examined the effects of interactive whiteboards on students diagnosed with an autism spectrum disorder at the elementary level. Using an A-B-A-B design, where the 'A' phase was instruction utilizing an interactive whiteboard, and the 'B' phase was a traditional pencil and paper instruction, the researcher carried out a quantitative research study. She also followed the quantitative study with a qualitative study, surveying students about their experience. For both the 'A' and 'B' parts of the study, students were given books and corresponding worksheets, but "During the IWB condition, each student read the books and completed the corresponding worksheets on the IWB." (Stanley, p. iii) In reporting the results, the researcher noticed that the intervention of the interactive whiteboard did not have much of a positive effect on the students. On one student, it actually caused a negative trend in his word count. In another student, the IWB intervention caused a significant negative effect on her comprehension. The researcher goes on to state that if interactive

whiteboard intervention would not create a "long standing increase in behavior" (Stanley, p. 90).

Stanley also utilized quantitative research, surveying the students. The students responded that they would rather learn reading while utilizing an interactive whiteboard. The students also showed greater motivation and interest level when utilizing the IWB, and vocalized as such.

Summary

Although many of the researched articles are from the earlier inception of the interactive whiteboards, most reveal similar results and observations. In comparison to rote chalkboard and pencil-and-paper teaching, students who utilized the interactive whiteboards in their classrooms showed improvement in focus, enthusiasm, and academic focus. In those studies that utilized a qualitative measurement tool surveying both teachers and students, the results indicated overwhelming positive attitude towards the interactive whiteboards. In regard to utilizing the interactive whiteboards for educating students with various disabilities, the results were mostly positive. Although some of the studies are almost ten years old, the effects of early implementation of IWB was very important to education.

Although the early perceptions and studies regarding interactive whiteboards showed positive correlations to academics, focus, and motivation, many of these studies were a decade old. However, with these studies showing the overall effectiveness of IWB came the widespread implementation of this technology throughout the United States. Some of the more recent studies involved countries outside the United States.

Studies were done prior to widespread implementation and also post-implementation to prove effectiveness.

In educating students with disabilities via the interactive whiteboard, all studies showed positive results. The utilization of the IWB seemed to enhance the specific skills needed in situations, like when used at the Florida School for the Deaf and Blind. Through qualitative research we have learned many observations that Special Educators had when utilizing the IWB in their classroom.

Many of the studies raised valid questions regarding appropriate teacher training. Even some of the teachers and students questioned in the qualitative studies came up with realizations regarding the knowledge and understanding level that the educators had regarding the utilization of the interactive technology.

Though the appropriate level of teacher training came up quite often in research, there was only one study which found an interactive whiteboard not to have a positive effect on academic outcomes. Although, some researchers also made an important observation regarding the appropriate level of interactivity being used regarding the IWB, this was no more than a minor conjecture in their analysis, or a thinking point.

Chapter 3

Methodology

Setting and Participants

This study will be completed at High Mountain School, in North Haledon, New Jersey. Both the study and control groups are part of an eighth-grade mathematics class. The first and second period class occurs between 8:30 and 9:54 am daily. The observed class is an in-class resource program where I act as the special education teacher. This class will be the "experimental" group, and the students in her other two classes will be referred to as the "control" group. The observed class contains fourteen students, eight girls and six boys, and all students are between thirteen and fifteen years old at the time of the study. Of the fourteen students in the "experimental" group, six are classified with an Individual Education Plan. All six students are diagnosed with a Specific Learning Disability. Of these diagnoses, one student is noted to have difficulty in mathematics computation and three are noted as having discrepancy around mathematics problem solving.

Procedure

The research and instruction will cover Chapter 9 of the Prentice Hall *Course 3 Mathematics Common Core* textbook. Chapter 9 is entitled "Geometry and Measurement" and covers the volume and surface area of three-dimensional solids. The chapter consists of 5 lessons: 9-1: Solids, 9-2: Volumes of Prisms and Cylinders, 9-3: Volume of Pyramids and Cones, 9-4: Spheres, and 9-5: Exploring Similar Figures.

Interactive lessons will be created on Smart Notebook, the companion software to the interactive whiteboard. These lessons will focus on student engagement, interactivity, and highest levels of visual stimulation. Each daily a SMART Notebook lesson will be written to involve students in the learning process. The classroom teacher will instruct all three classes, as per her normal routine. Also, as per the normal routine, I will continue to act as the inclusion teacher in the classroom. I will co-teach the class and aide Mrs. May in the utilization of the interactive lessons Her instruction of the other two classes will utilize the original, non-interactive, lesson.

The newly created interactive lessons revolved around interactive activities, specifically answer keys that will fade away to reveal the correct answer. In addition to these interactive and engaging features daily, each lesson will utilize specific interactions built especially for that lesson. One of the lessons was a vocabulary lesson. In this lesson, the students threw a "koosh" ball at the smart board to reveal a vocabulary word and the definition. After that, the student had another hidden box with the mathematical definition "In English please!" The students learned that the "In English please!" definition made much more sense to them. Another example of interactivity is when volume of prisms is being calculated, students drag two-dimensional shapes (triangles, parallelograms, circles, rectangles) on top of each other to create a three-dimensional shape that they can now calculate the volume of.

The day before the test all three classes will participate in the same review. The test will be taken from the teacher-provided tests in the textbook. To achieve equality in grading, the classroom teacher will grade all tests.

In assessing the effectiveness of the study, results from this assessment will be compared against previous assessments on an individual basis since January. The class average will also be compared with the class averages on assessments since January. In comparing to other classes, the class average will be compared to the other class averages. Due to the difference in topics of previous assessments, the mean scores of previous assessments for the other two classes will also be calculated.

Variables

The independent variable of this research study is the interactive use of the whiteboard. The level of interaction involving the Smart Board has been increased immensely compared to the lesson provided to the control group.

The dependent variable for the research study is the unit assessment that both groups will take, the Chapter 9 Test from the Course 3 Prentice Hall *Common Core Middle School Mathematics Series*.

Chapter 4

Results

Students in the experimental group were taught lessons 9-1 (Solids), 9-2 (Volume of Prisms and Cylinders), 9-3 (Volumes of Pyramids and Cones), 9-4 (Spheres) and 9-5 (Exploring Similar Solids) with an emphasis on interactive learning with the Smart Board. Each lesson used features such as show/hide and student choice links to focus and engage students in learning. The students in the two eighth grade mathematics classes were taught utilizing normal methods including basic utilization (e.g. to project the online textbook as well as used to complete problems as would be done on a dry-erase board. of the interactive whiteboard. Both the review session and assessment were given traditionally to both the experimental and control groups.

Due to the instructional nature of the research hypothesis, data was gathered through a single assessment after instruction. The intervention covered an entire chapter within the eighth-grade mathematics curriculum. Due to this, data was gathered using the chapter test at the end of Chapter 9. To set an appropriate baseline, test data was gathered from marking periods three and four.

The results for each group are shown in the table below. The Experimental group exhibited a mean baseline score of 80.2%. After the intervention, their post-test mean score was a 91.3%. This shows a significant growth of 11.1%. The Special Education students within the Experimental Group presented a baseline of 74.6%. After the intervention, their post-test mean score was 84.3%, thus leading to a difference of 9.7%.

In contrast, the control group began with a baseline score of 84.6%. Without the intervention, their mean post-test score was 89%. This shows a growth of 4.4%.

Table 1

Results for Each Group

Group	Baseline	Intervention	Difference
Experimental	**80.2%**	**91.3%**	**11.1%**
Experimental-Special Ed	**74.6%**	**84.3%**	**9.7%**
Control	**84.6%**	**89%**	**4.4%**

Individual Results

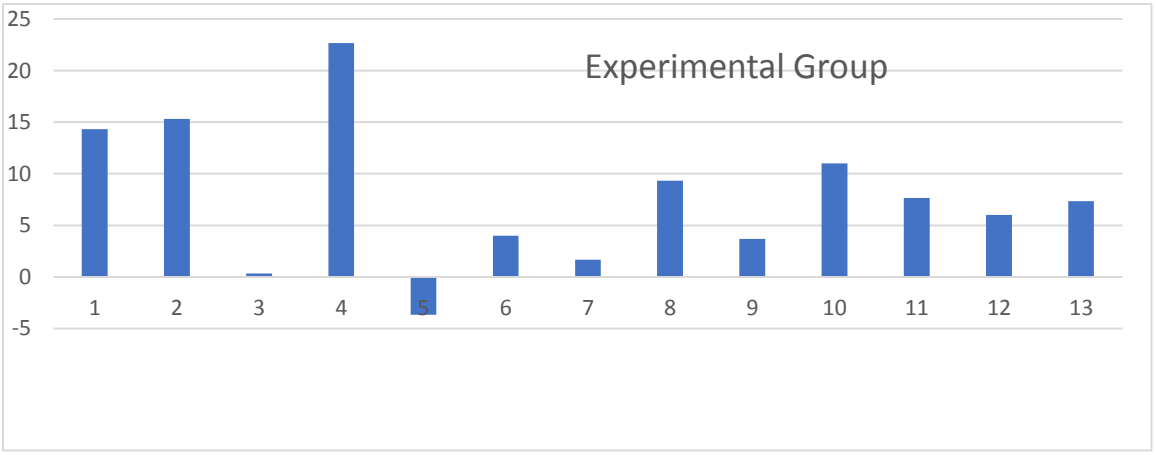

Figure 2. Growth of Experimental Group compared to mean assessment scores

As seen in Figure 2, all but one of the students in the experimental group showed growth over their mean test scores from the second and third marking period. This mean,

used as a baseline, was calculated from three other chapter assessments that were each provided by the publisher, Prentice Hall.

Several of the students showed significant increase in their score in comparison to their personal mean test score. While many of the students fell between an increase of 5% and 10%, three students showed increases of greater than 10 points. Conversely, four students had increased scores of less than five points and one student (5) showed a decrease of about 4% below her mean test score.

The experimental group consisted of seven general education students and six special education students. Figure 3 will show the growth of the students with disabilities.

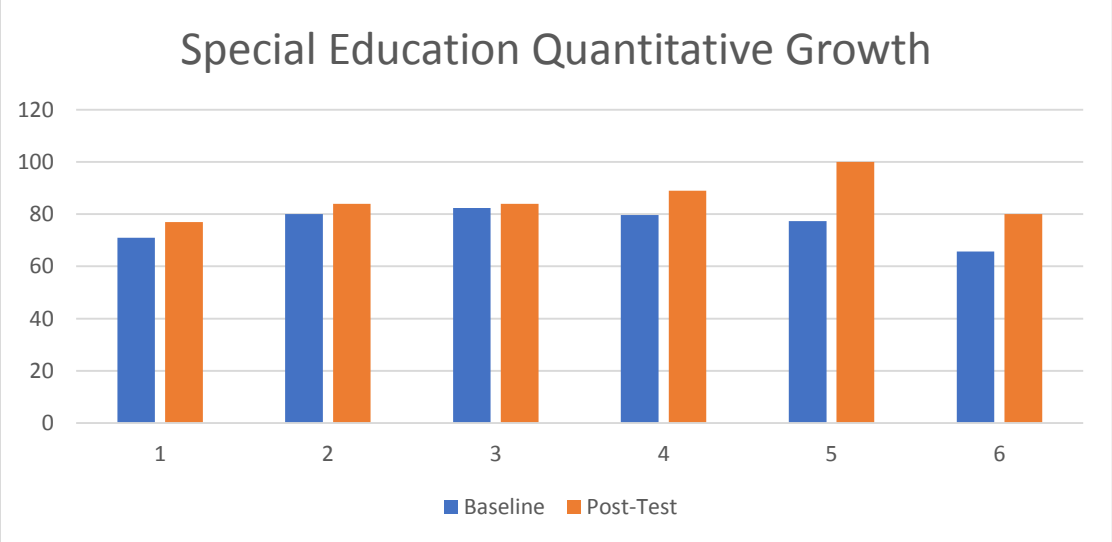

Figure 3. Special Education Students' Growth

As seen in Figure 3, every student with a documented disability showed an improvement versus their baseline score. The most significant growth shown were students 6, 14.33%, and student 5, 22.67%. Students 1, 2, and 4 showed improvement with increases of 6%, 4%, and 9.33% respectively. Although student 3 showed the least growth, at 1.66%, their mean test score was 82.33%, the highest baseline score in the group.

In order to compare the experimental group with another group of students, a control group was included consisting of the other students taking eighth grade mathematics. Figure 4 shows the growth of all control students compared to their mean test scores.

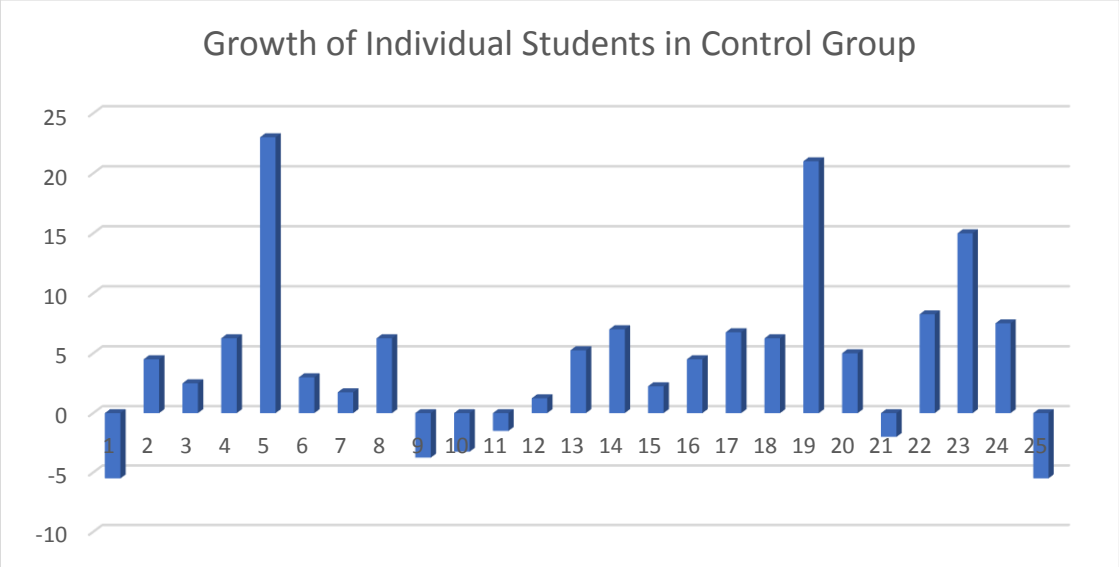

Figure 4. Individual Student Growth of Control Group

As seen in Figure 4, 6 out 26, 24% of students displayed a decrease in their test score compared to their baseline mean score. There were also five students whose growth was minimal, between 1% and 4%. Most of the students in the control group fell between 4% and 7% growth. Also identified in the table are three students who performed much higher than their mean baseline score. Student 5 increased their score by 23%, student 19 increased their score by 21% and student 23 increased their score by 15%.

Chapter 5

Discussion

As the implementation of technology grows within public schools and the push to make learning more interactive increases, we truly need to understand the educational impact this technology and interactivity push is having on our students. As students mature, classroom use of technology pales in comparison to the interactivity they receive outside of the classroom, particularly through cell phones, virtual reality goggles, and video games.

The goal of my research was to answer the question, "Does the innovative use of interactive technology have a positive effect on learning outcomes of students, specifically students with disabilities?" Based on a previous class of seven middle school boys, every one of which left school and immersed themselves in technology, I hypothesized that using the interactive whiteboards to their fullest interactive extent would definitely lead to an increase in their post-test scores.

In comparing the results of the, the students with special needs, and the typically developing student group, both groups showed a greater increase from their baseline test scores to their post-test scores than their general education counterparts in the control group. Although the control group showed a growth of 4,4% from their baseline, both experimental groups exhibited a growth of more than double the control group. The experimental group showed a growth of 11.1%, which was 2.5 times the growth of their general education counterparts in the control group.

Although the growth of the experimental group of 11.1% alone does not seem to show a significant change, the baseline scores were mostly in the range from 75%-85%, thus limiting possible growth to no more than 15%-25%.

In analyzing the data, many factors show the positive effect of the intervention. Six students out of the control group of 26 (23%) showed a decrease from their baseline score. Five students out of the control group (19%) exhibited a growth of less than three percent from their baseline score. Whereas, in the experimental group, one student out of thirteen (8%) showed a growth of less than 3%. The one student in the experimental group who showed a decrease from the baseline score was absent from school for three out of the five days that the intervention was performed, thus furthering the notion that the intervention was successful.

One of the major questions I was faced with originally was the motivation factor. Getting eighth grade students out of their seats to interact with a Smart Board was going to be met with hot or cold responses. The first lesson was designed to throw an object at the Smart Board, an activity which I have attempted for years. I have tried over and over to find the appropriate object that will interact with the whiteboard, but not break the whiteboard. When the activity was introduced, the motivation was high, as I asked 14-year-olds to throw something. However, when none of the objects created the desired effect, and I asked the students to pop the "balloon" themselves, their motivation to participate declined.

As explained previously, interactive activities involving throwing objects are one of the highest motivating factors for students in middle school. When first attempting this lesson, the students were eager to attempt to throw all three objects that I had brought

at the interactive whiteboard. Once the attempts failed, it was met with a groan when I asked them to, "Just go push it."

Although motivation to participate declined from the introduction of the first lesson, many students seemed more focused during segments of the lesson when students were interacting with the Smart Board. The students with special needs showed much greater focus and a higher level of work ethic because their attention was on the Smart Board and not around the classroom. Although these were observations made by myself and my co-teacher, I believe that the higher level of interactivity was responsible for the greater focus of both general education and special education students in the experimental group.

Previous Research

Much of the previous research done involving interactive whiteboard use in the classroom compared interactive whiteboards to dry-erase boards, pencil-and-paper, or chalkboards (Stanley, 2016; Bahadur, 2013; Torff & Tirotta, 2010). Nicole Stanley emphasized the difference in learning outcomes when learning via an interactive whiteboard was compared to "traditional pencil-and-paper learning." Interactive whiteboards show an immense impact when transitioning to technology, but there is no previous researched involving how interactively they are being used. To quote a seventh-grade student of mine, "It's a Smart Board! It's nothing special! We have used them in every class! Since first grade!"

The results of my research provide a much-needed extension to previous research involving interactive whiteboards. Truly, as most previous research shows, the

interactive whiteboards alone provide a higher level of motivation and a higher level of focus among students. However, when used interactively, my research shows that the value of the interactive whiteboards increase.

Many researchers commented on the availability and level of training for teachers as well as the teacher comfort level and level of understanding as reasons for lower levels of interactive use of the interactive whiteboard (Bahadur and &Oogarah, 2013; DiGregorio & Sobel-Lieske, 2009). Although these were not research questions or hypotheses postulated by researchers, this seemed to be a common reasoning when discussing results in many of the studies. My research extends their notion that the level of training and level of interactivity used when instructing with an interactive whiteboard has a great effect on educational and research results.

Limitations

As I found out throughout the implementation of the intervention, the limitations of the use of interactive whiteboards is the age and maturity of our students. As mentioned previously, one of the main comments that pushed me to research the effect of interactively using whiteboards was from an interim principal in November of 2016 who said, "I know I'm coming from the elementary level, but I have been in many of your classrooms, and it seems like you guys don't use the Smart Boards interactively. It seems like it is used as an overhead projector or just a whiteboard." As students mature, they are being taught less and less interactively. Many students find comfort in this, and would rather stay in their seat than get up, go to the whiteboard, and solve a problem.

Besides student motivation, the main limitation was mentioned before and noted in much of the previous research, teacher training and comfort level. The collaborating teacher was the perfect teacher to work with, as her understanding and comfort level with the interactive whiteboards was very low when we began working together. Throughout interaction, and my demonstration of techniques using the Smart Board, her comfort level rose and her understanding progressed. As with the collaborating teacher, students cannot be taught interactively if the teachers are not trained to this level of understanding with the interactive whiteboards. Through training and practice, teachers will become comfortable enough to effect students' learning outcomes through the interactive use of Smart Boards and all interactive whiteboards.

As interactive whiteboards become commonplace in many school districts, educators must utilize them for their interactive nature. My research study shows, even with the highest of elementary students, interactivity creates a more successful student. Besides higher statistical results, students were observed as more focused, and special education students especially were able to get out of their seat and the moving images kept their focus.

Implications

The main implication of this research study lies in the training and utilization of interactivity when teaching with the interactive whiteboards. For the most part, teachers cannot be expected to utilize the interactive whiteboards to their fullest extent without the training to understand and be comfortable with their lessons. Many teachers, such as myself, find themselves comfortable enough with technology to self-teach and create a level of comfort which results in interactive lessons.

For teachers like myself, who feel comfortable utilizing the technology, the implications lie in their infusion of interactivity into their lessons. Through this research it has been proven an effective use of lesson creation to evoke student interaction and focus. Eighth grade students are proven not to be too old to "play" with the Smart Board. Our middle school students live in a fast-moving, technological world, and if we put still images on a projected screen in front of them, we are asking them to lose focus.

Conclusion

My study opens the door for a larger scale research study. As many school districts, like mine, are utilizing SMART boards, as well as other interactive whiteboards, in almost every classroom daily, a large-scale study should be executed to validate the appropriate use of interactive whiteboards. This would involve rigorous and appropriate interactive teacher training. We must promote interactivity in teacher training in order to promote our teachers to teach interactively. These teachers, and their students would become the experimental group. This large-scale study could involve schools and districts, with the schools receiving training as the experimental group, and the schools not receiving training as the control group.

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