The Effects of SMART Board™ Interactive Whiteboard on High School Students with Special Needs in a Functional Mathematics Class

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Abstract

This comparative analysis study, using an ABAB design and student survey, explored the effects of using a SMART Board interactive whiteboard on the achievement of 11 students with special needs in a functional mathematics class. All students were seeking IEP (Individualized Education Program) Diplomas or Modified Standard Diplomas. The students received failing grades in standard high school mathematics courses and were currently receiving additional instruction in a resource classroom. The 24-week study consisted of four periods alternately using and withholding use of SMART Board interactive whiteboard technology. The means of data collection used in this study included test scores for each unit, a Learning Preferences Survey and six-week period grades. Students' test scores and six-week grades changed significantly with the use of the SMART Board interactive whiteboard. Across the study, students seeking an IEP diploma, when compared to students seeking a Modified Standard Diploma, made stronger grade gains. The Learning Preferences Survey results were mixed: a preference for the use of technology in the classroom and a preference for paper and pencil tests decreased across the survey period, whereas grades were more important to students at the end of the study than when the study was initiated.

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The Effects of the SMART Board Interactive Whiteboard on High School Students with Special Needs in a Functional Mathematics Class

Successful math teachers of students receiving special education services know that a variety of teaching tools and methods must be used to enhance student achievement. One such tool, technology, has become an essential part of the curriculum in the United States (Schwengler, 2001). The current study used a SMART Board interactive whiteboard to explore its effects on the mathematics achievement of high school students receiving support services.

Students learn well from using technology and from doing hands-on activities (Brown, Miller, & Robinson, 2002). Since students with disabilities have trouble learning abstract concepts, guided practice and a variety of teaching tools are needed to help students in the mathematics classroom. The tools used must be motivating and interesting (Brown, Miller, & Robinson, 2002). Hands-on, interactive activities are useful tools for students who are struggling learners.

Interactive whiteboards promote active student engagement in the learning process and have been described as being one of the most revolutionary and powerful teaching techniques using technology (Hawkins, 2001). The SMART Board interactive whiteboard is hooked to a computer and you use a stylus pen to write on the surface. The words that are written become translated into the electronics of the attached computer. The projector is the key to making this successful. The projector allows the hook-up to be complete by projecting light on the interactive whiteboard. This allows students to interact by using the stylus pens of various colors to write on the surface and it becomes visible. Without the projector, the stylus pens are not visible unless viewed on the computer screen itself. The projector also allows the interactive whiteboard to be touch-sensitive so that students can touch it and move items around (Hawkins, 2001). This interaction allows students to be more actively engaged in the learning process.

There are many different types of interactive whiteboards. An interactive whiteboard that is analog resistive is offered by SMART Technologies Inc. (Weiser, 2001). SMART offers a pen tray with styluses programmed for a certain color. Other interactive whiteboards do not offer the

capabilities featured by SMART. None of them are finger-touch sensitive. SMART Technologies has the feature of allowing students to touch items and move them about the interactive whiteboard whereas other companies only have the electronic capability.

Technology – if used properly – enhances teaching, but there are some key principles to consider when using technology in the classroom. Donna Baubach and Mary Bird, as described in *Strategies for teaching learners and special needs learners* (Polloway, 2001), created seven key principles for educators to consider when using technology to teach children. First, the educator needs to be proactive. There are barriers that need to be overcome and teachers must be resourceful in order to problem solve during the process. Second, the educator must be patient and work toward achieving specific student outcomes. Third, the educator must prioritize the student above the technology. Technology is the means to an end, not the end itself. Fourth, the educator needs to share what he or she has learned with other educators. Fifth, the teacher must work to first understand the technology before attempting to teach others to use it. Sixth, the educator must team with other experts, students and administrators to make sure resources are available and working properly. Finally, teachers must use common sense to assure that they do not overinvest and lose track of the bigger educational picture. These principles can help the educator use technology to maximize student learning.

The use of technology, as a tool for learning, has historically contributed to the education of humans (Frick, 1991). Technology has evolved and changed throughout history. Long ago, humans used a stick and drew in the sand, or used mimes and gestures to teach and pass on their knowledge. With the development of spoken language, stories and drama enhanced communication with and among children. Written language evolved from cave paintings to symbols, which were eventually written on clay tablets and stone. Students read the tablets. Parchment and papyrus and paper were created. More recently, ink was used to write on parchment or papyrus. The printing press then led to the publication of textbooks, and the advent of homework (Frick, 1991). Chalk and blackboards allowed teachers and students to share their work in front of the class. Television and video technology added the dimensions of

visual storytelling to the education process. Presently, whiteboards allow dry-erase markers to be used to create a colorful presentation. Overhead projectors allowed teachers to project information in an electronic manner. Technology has taken yet a further step with the introduction of interactive whiteboards.

While interactive whiteboards are similar to an overhead screen used with an overhead projector, they offer more capabilities. Overhead projectors allow information to be projected onto a screen or wall and interactive whiteboards do the same thing, only through a computer program instead of a hard copy of the material. Unlike the interactive whiteboards, an overhead projector can be oriented by focusing the projector and moving it to fit the screen; a SMART Board interactive whiteboard has to be oriented to make it touch sensitive for students to use. The interactive whiteboard runs PowerPoint presentations with movement and sound capabilities; with an overhead projector, one can only use slides as transparencies to make the presentation. Another advantage of the interactive whiteboard is that it projects a "surround" light, which allows more projection for the student than does a regular projector. With the SMART Board interactive whiteboard, a teacher presents a problem and the students get immediate feedback by touching the screen. With an overhead projector, the student waits for the teacher to put an overlay of the problem solution to see if it is correct. With the SMART Board interactive whiteboard, the teacher can save key information in a professionally presented manner for later use. Whatever is added to a traditional overhead during the teaching process must be retyped to give a professional appearance. The SMART Board interactive whiteboard also has the added advantage of being able to function as a standard whiteboard.

There are some advantages to using the SMART Board interactive whiteboard in non-projected mode. First, the interactive whiteboard can be connected to a computer and the teacher and students can write directly on the whiteboard using a dry erase marker. The information that is put onto the interactive whiteboard may then be transformed into a Notebook™ software file. Another benefit of the non-projected mode is that there can be a variety of colors used to highlight different features. SMART Board interactive whiteboard notes

will not "bleed" or get erased.

Multimedia projects can increase student achievement (Durkin, 1997). These projects give students a chance to learn some of the higher order thinking skills that are necessary in education. Multimedia creates a community of scholars including the teacher, parents, and the students (Unknown, n.d.). Multimedia that can be added to the classroom through the SMART Board interactive whiteboard include music clips, various sounds, interactivity and pictures. All students have different ways of learning and different ways of processing material. Students learn by seeing, hearing and/or by hands-on experiences (Durkin, 1997; Dunn, Griggs, Beasely, and Gorman, 1995). Therefore, students need to be taught using different methods. The SMART Board interactive whiteboard allows for all three of these learning modes to be experienced. Students create their own pathways and they work together to perform dynamic presentations in which all students benefit. Rather than passive learning, students are involved in the process and they are experiencing the curriculum. Through the SMART Board interactive whiteboard, students can access the Internet, making connections to real life and current mathematical issues (Simkins & Cole, 2002). To help students become more actively engaged in the process, they can be grouped into smaller groups by talent, expertise, topic interest or student choice, or grouped heterogeneously to maximize learning from each other. The teacher becomes a facilitator of learning when multimedia projects are incorporated into the curriculum. The teacher also becomes a project manager to support student ownership of the learning process (Simkins and Cole, 2002).

Not all experts support interactive whiteboard technology use in the classroom. Some critics note that students may still take a passive role in learning, depending on the teacher's control of initial presentations. How the technology is used may determine whether students will work passively or actively. Some students say the experience of the interactive whiteboard is like being in touch with math; seeing their work projected and gaining immediate feedback allows a continuous learning process (Hawkins, 2001).

Because interactive whiteboard technology is new to education, research in this area is

limited. A study conducted in a secondary school in the United Kingdom revealed that student motivation improved with interactive whiteboard use as reported by 78% of the students, but only 11% of the students in the study indicated that such technology was essential to mastering their assignments (SMART Board study, n.d.).

According to Hunt, special education professor at California State University, and Marshall, special education professor at the University of South Carolina (2002), there is a need to develop higher order thinking skills for students with learning disabilities. They note that technology is one tool that motivates special learners to use higher level thinking. For struggling learners, such technology must not be too distracting and must involve direct instruction for learners to succeed (Hunt & Marshall, 2002).

According to Heward (2003), co-author of numerous textbooks on disabilities, teachers need to choose multiple approaches to learning, including multimodal methods, and provide more explicit instruction in content areas. These two strategies are part of best practice for students with learning disabilities (Heward, 2003). The National Council of Teachers of Mathematics (NCTM) calls for an emphasis on hands-on learning and the use of calculators and computers to help students become investigators and verifiers of new information. The individual needs of students, and their learning preferences, must be addressed to successfully educate struggling learners (Durkin, 1997). New programs and new practices must be invented to improve the instructional climate (Canady, 1995). Students with disabilities need to have a curriculum that individually tailored from their first year in school until they graduate. Each content area specialist should evaluate the potential of interactive whiteboard use in their area.

Interactive whiteboard technology is especially appealing to math teachers. A teacher can use electronic pens or fingers to solve math problems and the answer is displayed on the computer as well as on the screen. Another color pen can be used to show a shortcut in solving the problem. The class notes can then be printed and given to a student that was absent or they can be e-mailed out. They can also be used for another year of work. Different points can be dropped and dragged to a different location. The teacher simply orients the interactive

whiteboard to make it touch sensitive (Weiser, 2001).

The SMART Board interactive whiteboard allows the instruction to be more student-centered and less teacher-centered (Cromwell, 1997). Classroom time can be focused on the children and students are more apt to participate because they can touch the interactive whiteboard. There is high visual impact and the students can receive more evaluative feedback. The teacher has the ability to program the computer to change screens when the student answers the question. The teacher can use the interactive whiteboard to teach individuals or the whole class. The National Numeracy Strategies report notes that class and individual instruction are both needed to increase mathematics facility (Smith, 2001).

Mathematics needs to be accessible and meaningful to students. Students need to know how to do computations and relate it to the context. Math needs to reflect real life and have a meaningful purpose in the eyes of the students. Math problems should thus be authentic in order to motivate student engagement. Experts recommend techniques such as visualization and manipulatives to help students understand concepts better (Author Unknown, 2003).

Successful math teachers present various problems to students and conduct brainstorming sessions to engage collaborative problem solving. These problems can be pasted into the whiteboard software and the students can print their ideas off of the interactive whiteboard and use them for small collaborative group discussions. Teachers and students can change all or part of the problem as they explore the process. Objects can be moved around and change places at any given moment, allowing manipulatives and symbols to be used in the learning process (Smith, 2001).

The purpose of this study was to answer the primary question: How does the SMART Board interactive whiteboard affect achievement of students with special needs enrolled in a functional mathematics class? The secondary questions include: Is there a difference in the effectiveness of SMART Board interactive whiteboards with students seeking IEP diplomas versus modified diplomas? Is there a difference in the effectiveness of SMART Board interactive whiteboards among students with differing disabilities? Can the SMART Board interactive

whiteboard be an effective grade booster and motivational technique?

Method

Participants

This research was completed in a suburban high school located in a mid-Atlantic state. The high school population was approximately 1,150 students in grades 9-12. Ten percent of the population received special education services. The eleven students in this study received services for Learning Disabilities, Emotional Disturbances, or Other Health Impaired (OHI) and were enrolled in a functional mathematics class entitled Personal Living and Finance.

The Personal Living and Finance class included eleven students who were receiving special education services. There were three females and eight males in the class, which consisted of one freshman, one repeating freshman, four sophomores, three juniors and two seniors. These students were seeking one of two diplomas: an Individualized Education Program (IEP) diploma or a Modified diploma. For an IEP Diploma, students must meet the goals outlined in their IEPs. These students did not have to pass the required state's standardized tests in order to graduate and they had not passed a course in Algebra I since they have been in the high school.

Of the eleven students, six were seeking a modified diploma. This means that those students had completed the first part of an Algebra I course, but had not completed the second year of the course. Because of the new state standards, this school division split Algebra I into a two-year course to help students with learning disabilities become more successful. The students on a standard diploma or advanced diploma enroll in Algebra I Part I and then enroll in Algebra I Part II or they take the course in one year. Standard diploma and advanced diploma students needed to take a Geometry course that to meet the needs required by the state. Students working on a modified diploma were not able to complete the requirements necessary to receive a standard diploma from the state because they did not pass one or more content areas of the standardized tests. The students that are on the modified diploma must successfully pass Algebra

I Part I, modified Geometry, and Personal Living and Finance for the three required math credits.

Each student in the class had an IEP (Individual Education Program). The IEP, a legal document created through the Individuals with Disabilities Education Act (IDEA), provides students with accommodations to assist them in both the regular education and the special education classroom. This document sets forth goals for the students to work on throughout the year as well as various types of transition services that the students can have access to and plan for their future.

Students with Other Health Impairments:

According to the Individuals with Disabilities Education Act (IDEA), Other Health Impaired (OHI) is defined as students who have limited vitality, strength, or alertness due to a chronic health problem. This health problem adversely affects the performance of the child's education (Heward, 2003). There was one student in the study receiving OHI services. This student, Student A, was receiving services in a self-contained English class as well as in resource room. This student needed learning support for Attention Deficit Disorder (ADD), which means that the child has developmentally inappropriate impulsivity and attention (Heward, 2003). This student successfully passed Algebra I Part I but was weak in the areas of attentiveness and math computation.

Students with Emotional Disabilities

According to IDEA, students with Emotional Disabilities (ED) have one or more behavioral characteristics affecting learning that cannot be explained by intellectual, sensory or other health factors. The have difficulty initiating and maintaining interpersonal relationships, and evidence inappropriate behaviors, depression or unhappiness, or fear of school or personal problems (Heward, 2003). There were two students in the study who received services for ED. Student B attended some regular classes and some classes in which a special education teacher was present. Student B passed Algebra I Part I but was experiencing success in Algebra I Part II.

Student K received services for a learning disability, but evidenced emotional disabilities as a secondary disability. This student recently transferred to the school and was working on a modified diploma.

Students with Learning Disabilities:

According to IDEA, students with learning disabilities (LD) have a disorder involving one or more psychological processes that affects spoken or written language use and is evidenced in difficulty speaking, listening, reading, writing, spelling, thinking or working math problems (Heward, 2003).

There were eight students receiving LD services. Student C was receiving LD services and also evidenced an anxiety disorder, as identified by her physician. Anxiety disorder means that there are maladaptive emotional behaviors that involve excessive or irrational fears and worries (Heward, 2003). This student struggled to express herself orally. Student C had not passed the eighth grade math standardized test necessary to graduate with a modified diploma at the time of the research.

Student D passed Algebra I Part I, but did not pass the eighth grade standardized math test which was necessary to qualify for a modified diploma. The student's weakness was in numerical operations and math reasoning.

Student E had difficulty with math reasoning and numerical operations. This student was seeking a modified diploma but had not passed the test necessary for graduation.

Student F transferred from another school and sought a modified diploma. This student showed strength in mathematics, but had weaknesses in other areas. This student transferred out of the school division later in the research study.

Student G had not passed Algebra I Part I. This student was seeking an IEP diploma.

Student H had strengths in the area of math computation and reasoning, but he was reading at a first grade level and therefore was seeking an IEP diploma.

Student I was seeking an IEP diploma because he had not met state requirements for a standard diploma. Student J sought an IEP diploma and was weak in math computation.

This course was team-taught. A secondary mathematics endorsed teacher was teaching this course with a special education endorsed teacher. The math instructor-researcher was a state licensed math teacher with four years of experience. This was her first year teaching the course. The instructor was seeking a Masters of Arts degree in education, in a curriculum and instruction track, with licensure in special education. The special education teacher had a Master's degree in special education and two years of teaching experience.

The math-endorsed teacher primarily led the instructional time while the special education teacher helped with small group instruction and independent work. The two teachers planned each unit together and discussed content and strategies before and after instruction. The special education teacher kept track of the days that IEP goals were addressed while the math-endorsed teacher maintained grades.

The Personal Living and Finance Class was collaboratively taught by a math teacher and a special education teacher. The special education teacher had several class members on her caseload. This was the first year that the Personal Living and Finance Class was taught in the school division. All students had had little or no success in the regular education mathematics classes. The students operated on a block schedule, meeting every other day for 95 minutes.

Apparatus

One piece of equipment used for the purpose of this research was the SMART Board interactive whiteboard (http://www.smarttech.com). The SMART Board interactive whiteboard was purchased from Audio Visual Innovations. It featured its own keyboard that could be displayed on the screen. The SMART Board interactive whiteboard was connected to a Belkin USB converter and attached to the instructor's HP Pavilion laptop. The laptop had an Intel® Pentium® processor with a two gigabyte hard drive. The primary program used on the laptop was Notebook™ software. Through the help of the school division, a connector, created by SMART Technologies, was used to connect the SMART Board interactive whiteboard with an iMac® computer that had more capabilities than the laptop. The instructor had the SMART Board interactive whiteboard attached to the stand so that it could be easily moved to various parts of

the classroom. The SMART Board interactive whiteboard, which could be used with or without an LCD projector, was used with an LJ2000 InFocus® projector. This allowed it to be interactive and the students wrote on the interactive whiteboard with a stylus pen that has electronic ink. When projected, the student wrote on the interactive whiteboard and it appeared both on the interactive whiteboard and on the computer screen. The information could be edited and erased as needed. Without a projector, the student wrote on it with a standard dry-erase marker and it registered on the computer.

The researcher also developed and utilized a Learning Preferences Survey. Administered at the beginning and again at the end of the study, the survey posed ten questions asking students about their ability to learn in math, the importance of grades, preferences regarding technology, the use of hands-on activities, motivation to learn real life mathematics, use of Internet in the classroom, getting notes from the time missed, preferences regarding paper/pencil tests, different types of assessment, and how much they enjoy coming to this class on a daily basis. This survey helped the students reflect upon what helps them learn and what motivates them to learn. The results of the pre-test survey, given at the beginning of the study, to provide the researcher with information about student preferences for learning, helped the teacher create ways to help struggling students.

The study included a unit on cars and how to purchase cars. This unit was followed with a unit on how to secure loans and how to figure the cost of loans. The next unit was a unit on writing consumer complaint and compliment letters to various companies. A geometry unit guided students to find the perimeter and area of figures. Another unit presented graphing and types of graphs used to show data. A different unit on geometry terms was given to see how much students knew about geometry. The final unit of the research was on rounding numbers to various place values. A pre-test and post-test was given for each unit. Homework and classwork was used to figure out the six-week grades.

Design & Procedures

This study used an ABAB design to assess the use of SMART Board interactive

whiteboard technology on student achievement in mathematics. The study was conducted over a 24-week period consisting of six-week periods alternately using and withholding use of a SMART Board interactive whiteboard. The only instructional difference between the six-week intervals was the use of the interactive whiteboard during the second and fourth six-week time frames. Each six-week period was followed by assessment.

There were three means of assessment: pre- and post-surveys (Learning Preferences Surveys), pre- and post-unit tests, and six-week grades. A pre-test before each unit assessed what the students knew before being instructed on the topics. After the students completed the unit, the test was re-issued to see if grades increased in the course of the testing. There were two to three units per six-week period. The six-week grades were used to see if the students' grades increased, decreased, or stayed the same. These grades consisted of test grades, participation grades, and homework/classwork grades. The content included how much students were participating in class and doing the given classwork projects and assignments, the post-test grades and how much classwork was completed. The various unit assessments on car purchases, loans, complaints, area and perimeter, graphing, geometry and rounding were used to assign the students' grades.

The researcher developed a system for helping students incorporate the SMART Board interactive whiteboard into the curriculum. The SMART Board interactive whiteboard was incorporated into the curriculum of the Personal Living and Finance class to enhance student achievement. The teacher utilized the SMART Board interactive whiteboard for writing notes because the lighting makes it easier for the students. Notebook software presentations were created to allow the teacher to get more interaction in the use of the SMART Board interactive whiteboard. The teacher would highlight the information without marking up the students' work. The instructor used the SMART Board interactive whiteboard in the following three ways: projected mode for problem solving, non-projected mode for students with absentee problems, and for assisting Notebook software presentations. The projected mode was used most frequently to give notes and provide various presentations. The non-projected mode was used

for letting students see the notes and then notes were printed off for them. The Notebook software was used to give presentations on notes, problems, and various activities with the worksheets.

The mathematics teacher designed the units and tests, which were reviewed and modified by the special education teacher, to align closely with individual student needs. Tests maintained a comparable form and care was taken to design units of equal difficulty. The following units were taught in the twenty-four-week period: financing a car, geometry, writing complaint and compliment letters, loans and percents, graphing, and rounding. The content of these units matched content outlined in the standards set forth by the state's Department of Education. A sample lesson plan integrating SMART Board interactive whiteboards is featured in Appendix B. A sample used when SMART Board interactive whiteboard was featured is included in Appendix C.

Within the non-SMART Board interactive whiteboard instructional time, students used a regular ELMO overheard to work out the math problems and the units. After this time without the SMART Board interactive whiteboard, the teacher worked with students using the interactive whiteboard. By using the SMART Board interactive whiteboard, the students viewed more presentations, and played math games with it. The math games were used to help students with critical thinking skills. The Internet was used as a group to help the students prepare to re-take the eighth grade math standardized test. The material covered was directly related to the curriculum in the Personal Living and Finance class, and based on standards set forth by the state in which the study was conducted. This AB sequence was repeated again to complete the ABAB format.

This course, taught as a basic functional math skills course, permitted student use of calculators as per their IEP content. Students enrolled in the class, as guided by their IEPs, to increase basic functional mathematics skills. This course was designed to assist students in learning how mathematics applied to real world situations. Ten units of instruction were used in the study. The first units presented addressed issues involving time management, and calculating

the amount of pay received based on the number of hours employed in a given time period. Using COIN3 (www.coin3.com), an Internet based program that allowed the students to take a vocational assessment; students were presented with a list of 20 careers. After choosing a career, information on that career was displayed. The student viewed the salary, educational needs, and job responsibilities in order to determine a career they wished to pursue. They also participated in a mock interview.

Results

Data were collected over a twenty-four-week time period comprised of four six-week sessions. No SMART Board (NSB) interactive whiteboard usage was available in the first and third six-week sessions (NSB1 and NSB2). The SMART Board (SB) interactive whiteboard was implemented during the second and fourth six week periods (SB1 and SB2). Table 1 presents this ABAB format. Each six weeks consisted of 15 days of class time. The class sessions were separated into various units, each with a pre- and a post-test to assess progress.

Table 1

ABAB Format

Format	Six Weeks	SMART Board interactive whiteboard Usage
A	1st six weeks	No SMART Board interactive whiteboard (NSB1)
B	2nd six weeks	SMART Board interactive whiteboard(SB1)
A	3rd six weeks	No SMART Board interactive whiteboard (NSB2)

B	4th six weeks	SMART Board interactive whiteboard (SB1)

Grades by Individual Students

Overall, the median changes in the range of the six weeks grades were positive for the six weeks periods in which the SMART Board interactive whiteboard was used but negative when the SMART Board interactive whiteboard was not in use. Table 2 features the student grades and the changes in their grade from one six weeks to another six weeks. The data collection began with the first six weeks where the SMART Board interactive whiteboard technology was not used.

Table 2

Class Six-Week Grades

Student	NSB1 to SB1	Change	SB1 to NSB2	Change	NSB2 to SB2	Change
A	71 - 71	0	71 - 52	-19	52 - 52	0
B	76 - 89	13	89 - 78	-11	78 - 88	10
C	61 - 72	11	72 - 98	27	98 - 93	-5
D	92 - 88	-4	88 - 96	8	96 - 88	-8
E	93 - 72	-21	72 - 81	9	81 - 94	13
F	94 - 96	2	96 - 96	0	-----	-----
G	98 - 86	-12	86 - 95	9	95 - 91	-4
H	82 - 91	9	91 - 80	-11	80 - 97	17
I	73 - 80	7	80 - 72	-8	-----	------
J	64 - 78	14	78 - 26	-52	26 - 72	46
K	N/A - 69	-----	69 - 25	-44	25 - 74	49

The grades (recorded in percentages) during this period ranged from 61 to 98. This was a 37-point range in grades. The SMART Board interactive whiteboard was implemented for the second six weeks (SB1). During this time, the grades ranged from 69 to 96. This was a 27-point range in grades. The SMART Board interactive whiteboard was taken away during NSB2. The range for this time period was 25 to 98. This was a 73-point range in grades. The SMART Board interactive whiteboard was re-implemented into the curriculum during SB2 of the study. The grades ranged from 52 to 97, which is a 45-point range in grades. It is noted that the ranges were lower for the six-week periods where the SMART Board interactive whiteboard was present.

The median change in six-week grades from NSB1 to SB1 was +4.5 points. This means that the middle of the data represented a change of grades where the students' grades increased 4.5 points. The median change from the SB1 to NSB2 was -8. This shows that the median of the student grades decreased 12.5 points between the periods. One student had a 21-point drop in grades and another student had a 14-point increase during NSB1 to SB1. The median change of the student grades for the NSB2 to SB2 was +10. This is an 18-point jump from the previous six weeks of data. One student had a 52-point grade decrease and another student's grade increased 27 points. The last six weeks was when the SMART Board interactive whiteboard technology was used in the classroom. The student evidencing the most change from NSB2 to SB2 experienced a 49-point increase, while the student who experienced the greatest decrease in grades showed an 8-point drop.

Six-Week Grades by Disability

Table 3 breaks the six-week grades and changes split by disability. The three disability groups that are featured are OHI, ED, and LD. The biggest changes occurred with the ED group. The OHI student made only one negative change, which was without the use of the SMART Board interactive whiteboard. The largest group of students is the LD group. There were eight students in that LD group.

Table3

Student Six-Week Grades by Disability

Student	NSB1 to SB1	Change	SB1 to NSB2	Change	NSB2 to SB2	Change
OHI						
A	71 - 71	0	71 - 52	-19	52 - 52	0
ED						
B	76 - 89	13	89 - 78	-11	78 - 88	10
K	N/A - 69	------	69 - 25	-44	25 - 74	49
LD						
C	61 - 72	11	72 - 98	27	98 - 93	-5
D	92 - 88	-4	88 - 96	8	96 - 88	-8
E	93 - 72	-21	72 - 81	9	81 - 94	13
F	94 - 96	2	96 - 96	0	-----	-----
G	98 - 86	-12	86 - 95	9	95 - 91	-4
H	82 - 91	9	91 - 80	-11	80 - 94	14
I	73 - 80	7	80 - 72	-8	------	-------
J	64 - 78	14	78 - 26	-52	26 - 72	46

During NSB1 to SB1, the median change for the OHI person was zero. In the SB1 to NSB2, the median change was -19. By NSB2 to SB2, the change was back at zero. For the ED group, the median change for NSB1 to SB1 was not calculable because student K was not enrolled in the class until the SB1 period. In the ED group, the median change for SB1 to NSB2

was -27.5. That was a large drop in grades for this six weeks. The median change for NSB2 to SB2 was +29.5. This was another large jump in grade changes. For the LD group, the median change in grades for NSB1 to SB1 was +4.5 points. For SB1 to NSB2, the median change for this group was +4. For NSB2 to SB2, the median change was +5.5. All of the changes in the LD group were close to each other.

The SMART Board interactive whiteboard was implemented during the SB1 and SB2 six weeks. All groups experienced positive grade changes during those six weeks. There were no negative grade changes during NSB2. The largest increase was in the ED group. This increase, +29.5 points, was a huge jump and a huge difference between the ED group and the LD and OHI groups. Even though the LD group had positive changes during each six-week period, the highest changes occurred during the SB1 and SB2 six-week periods, which were the six-week periods where the SMART Board interactive whiteboard was in the curriculum.

Six-Week Grades by Diploma Option

Table 4 represents the six-week grades as separated by the diploma option that the students were seeking. Overall, the biggest changes occurred for the IEP diploma students. The median change was better for modified diploma students at the beginning, but better for IEP diploma students in the other two six-week periods. Six students were seeking an IEP diploma and five students were seeking a modified standard diploma. Student I and student F were not enrolled in the school division the last six weeks that the data was collected.

For students on an IEP diploma, the median change for the second six weeks was +3.5 points. When it came to NSB2, the median change was -9.5 points. During SB2, the median change for IEP diploma students was +13. The negative change was when the SMART Board interactive whiteboard was not used in the curriculum.

Table 4

Student Six-Week Grades Based on Diploma Option

Students Seeking an IEP Diploma						
Student	3rd to 4th	Change	4th to 5th	Change	5th to 6th	Change
A	71 - 71	0	71 - 52	-19	52 - 52	0
E	93 - 72	-21	72 - 81	9	81 - 94	13
G	98 - 86	-12	86 - 95	9	95 - 91	-4
H	82 - 91	9	91 - 80	-11	80 - 97	17
I	73 - 80	7	80 - 72	-8	-----	-----
J	64 - 78	14	78 - 26	-52	26 - 72	46
Students Seeking a Modified Diploma						
B	76 - 89	13	89 - 78	-11	78 - 88	10
C	61 - 72	11	72 - 98	27	98 - 93	-5
D	92 - 88	-4	88 - 96	8	96 - 88	-8
F	94 - 96	2	96 - 96	0	-----	-------
K	N/A - 69	-----	69 - 25	-44	25 - 74	49

For students on a modified standard diploma, during SB1 the median change was +6.5 points. During the NSB2, the median change was zero for that group. The median change during SB2 for this group was +2.5 points.

For IEP diploma students, the average change in the medians was +2.3 points. For students that were on the modified diploma, the average change in the medians was +3 points. There was no change in the median during the third six-week period for modified standard

diplomas; however, their average median change was higher than the students on the IEP diplomas.

Unit Grades by Individuals

Table 5 has the unit grades for each unit taught from the second six-week period through the fourth six-week period. Those units that have an asterisk represent units that were taught using the SMART Board interactive whiteboard. The Complaint, Area/Perimeter and Graphing units were all presented during the third six-week period where the SMART Board interactive whiteboard was not in the curriculum. Each unit was of the same difficulty. The car and loan units were both presented in the second six-week period. During the third six-week period, the Geometry and Rounding units were presented.

The first number in each individual cell represents the pre-test score and the second score represents the post-test score. The same tests were distributed for pre- and post-tests. The blanks in this table represent where the student was not in school for the entire unit and had to make up all of the work. Students C and D, both on modified standard diplomas, were pulled out during those times to help review for the standardized test for eighth grade math. In each case, except for student K in the geometry unit, had increased their scores from pre- to post-test results. The car unit and loan units were both in SB1. The unit on consumer complaints, Area/Perimeter unit, and graphing unit were part of NSB2 and the Geometry and rounding units were part of the SB2. The units in the NSB1 were not used in the data collection because there were no pre- and post-tests given.

Table 5

Unit Grades based by Total Group

Student	*Car Unit	*Loan Unit	Complaint	Area/Per.	Graphing	*Geometry	*Rounding
	100 total	100 total	100 total	100 total	100 total	100 total	100 total
A	n/a ; 78	10 ; 60	80 ; 100	-------	67 ; 100	0 ; 0	0 ; 0

B	20 ; 100	30 ; 85	80 ; 100	20 ; 70	0 ; 73	40 ; 86	13 ; 93
C	40 ; 56	0 ; 90	-----	------	------	-------	0 ; 87
D	35 ; 102	50 ; 75	-----	------	-----	-------	33 ; 73
E	10 ; 59	0 ; 85	80 ; 100	10 ; 70	100 ; 100	63 ; 100	33 ; 93
F	45 ; 105	70 ; 95	80 ; 100	40 ; 90	100 ; 100	80 ; n/a	------
G	15 ; 78	40 ; 80	80 ; 100	10 ; 90	53 ; 93	53 ; 100	53 ; 100
H	40 ; 102	n/a ; 80	80 ; 100	10 ; 70	100 ; 100	60 ; 93	60 ; 86
I	15 ; 102	80 ; 85	80 ; 100	10 ; 60	86 ; ----	-------	-------
J	45 ; 83	70 ; 85	80 ; 100	------	0 ; 100	40 ; 100	49 ; 73
K	35 ; 83	0 ; 60	80 ; 100	n/a ; 30	0 ; 100	100 ; 93	67 ; 93

The highest individual student grade change in the car unit was 87 points and the highest individual student grade change in the loan unit was 90 points. When looking at units where the SMART Board interactive whiteboard was not used, the complaint unit change was 20 points, the area unit had an 80-point change, and the graphing unit had a 100-point change. Students that had the 100- point jump tried and missed every question on the test. For SB2, the geometry unit had its highest change at 60 points and it was 80 points in the rounding unit. When doing an average change for NSB1 to SB1, the average change was 88.5 in the highest changes. In SB1 to NSB2, the average of the highest changes in test scores was 66.7. In NSB2 to SB2, the average of the highest changes was 70 points. When the SMART Board interactive whiteboard was being used, the changes between pre- and post-tests were higher.

Unit Grades by Disability

Table 6 features unit grades results by disability. In most cases, students had a jump in grades. In the OHI category, the highest change from one test to the next was in the loan unit and it was a 50 point increase. In the ED category, the highest change from one test to the next was in the graphing unit and it was a 100-point change. This unit was not a unit used on the

SMART Board interactive whiteboard. In the LD category, the highest change was a 100-point change and it was the same unit (graphing).

The lowest changes were in the complaint units where everyone's grades changed by 20 points. This was across all three of the disability categories. There was one student in the ED category that actually experienced a negative grade change. This was in the geometry unit.

Unit Grades by Diploma Option

Table 7 features the unit grade results by diploma option. Out of the students seeking modified diplomas, two were pulled out and a lot of the data is missing because they were pulled out for remediation purposes in the testing. The students' grades varied greatly in the pre- and post-test scores. The students in both diploma options were given the same test. For students on modified diplomas, the highest change was 100 points in the loan unit and the lowest change was a -7 point change in the Geometry unit. For students on IEP diplomas, the highest change was in the graphing unit which was a 100 point change. The lowest change in the IEP group was a 20 point change on the complaint unit.

Table 6

Unit Grades by Disability

Student	*Car Unit	*Loan Unit	Complaint	Area/Per.	Graphing	*Geometry	*Rounding
	100 total	100 total	100 total	100 total	15 total	15 total	10 total
OHI							
A	n/a ; 78	10 ; 60	80 ; 100	----------	67 ; 100	0 ; 0	0 ; 0
ED							
B	20 ; 100	30 ; 85	80 ; 100	20 ; 70	0 ; 73	40 ; 86	13 ; 93
K	35 ; 83	0 ; 60	80 ; 100	n/a ; 30	0 ; 100	100 ; 93	67 ; 93

LD

C	40 ; 56	0 ; 90	----------	--------	-----	------	0 ; 87
D	35 ; 102	50 ; 75	--------	--------	-----	------	33 ; 73
E	10 ; 59	0 ; 85	80 ; 100	10 ; 70	100 ; 100	63 ; 100	33 ; 93
F	45 ; 105	70 ; 95	80 ; 100	40 ; 90	100 ; 100	80 ; n/a	------
G	15 ; 78	40 ; 80	80 ; 100	10 ; 90	53 ; 93	53 ; 100	53 ; 100
H	40 ; 102	n/a ; 80	80 ; 100	10 ; 70	100 ; 100	60 ; 93	60 ; 86
I	15 ; 102	80 ; 85	80 ; 100	10 ; 60	86 ; n/a	------	-------
J	45 ; 83	70 ; 85	80 ; 100	--------	0 ; 100	40 ; 100	49 ; 73

Table 7
Unit Grades By Diploma Option

Students on IEP Diplomas

			Complaint				
Student	*Car Unit	*Loan Unit		Area/Per.	Graphing	*Geometry	*Rounding
	100 total	100 total	100 total	100 total	100 total	100 total	100 total
A	n/a ; 78	10 ; 60	80 ; 100	----------	67 ; 100	0 ; 0	0 ; 0
E	10 ; 59	0 ; 85	80 ; 100	10 ; 70	100 ; 100	63 ; 100	33 ; 93
G	15 ; 78	40 ; 80	80 ; 100	10 ; 90	53 ; 93	53 ; 100	53 ; 100
H	40 ; 102	n/a ; 80	80 ; 100	10 ; 70	100 ; 100	60 ; 93	60 ; 86
I	15 ; 102	80 ; 85	80 ; 100	10 ; 60	86 ; n/a	----------	-------
J	45 ; 83	70 ; 85	80 ; 100	---------	0 ; 100	40 ; 100	49 ; 73

Students on Modified Diplomas

B	20 ; 100	30 ; 85	80 ; 100	20 ; 70	0 ; 73	40 ; 86	13 ; 93
C	40 ; 56	0 ; 90	---------	----------	-----	------	0 ; 87
D	35 ; 102	50 ; 75	---------	----------	-----	------	33 ; 73
F	45 ; 105	70 ; 95	80 ; 100	40 ; 90	100 ; 100	80 ; n/a	------
K	35 ; 83	0 ; 60	80 ; 100	n/a ; 30	0 ; 100	100 ; 93	67 ; 93

Student Absences by Six-Week Period

Table 8 features the student absences by six-week period. The two students that missed 15 days are two students that were not present for SB2 due to leaving the school division. Student absences were very high during SB2. The mean of absences was about five per person for the SB2. During NSB2, the mean of absences was about three per person. During SB1, the mean of absences was about 1.5 per student. During NSB1, the mean of absences was about 1.6 per student. When students were in class, the grades were higher for at least 50% of the students that were in this study. Student K was not enrolled in this school during the second six weeks; therefore, the data for that student is not presented.

Table 8

Student Absences by Six Weeks

Student	NSB1	SB1	NSB2	SB2
A	3	2	7	10
B	0	1	1	1
C	4	1	3	4

D	0	0	1	1
E	3	0	1	2
F	0	0	1	15
G	1	2	1	2
H	0	0	1	2
I	0	3	1	15
J	5	2	9	7
K	-----	5	10	2

With these tables of information, the data show positive grade changes throughout the various six-week period with the SMART Board interactive whiteboard in the curriculum. Within the units, there was a great amount of fluctuation between the pre- and post-test scores that are featured with and without the use of the SMART Board interactive whiteboard. The tables presented include data by the whole class. It also shows the separation between disability as well as a separation amongst the diploma options.

Survey Results

The results in Table 9 are the results of the pre- and post- survey given to students at the end of the year. The pre-survey was given to students before the research began. Due to high absences throughout the last two weeks of school, only six students were able to complete the survey the second time; therefore, the same six students' data were used for the pre-survey. Two students moved out of this school division and the other three were not in attendance for the last two weeks of the fourth six-week period.

The first question dealt with the ability to learn. More people felt their ability to learn in mathematics was higher at the beginning of the research period than it was at the end of the research period. There were 33% of the students in the high category at the beginning and 17% in the high category on the second survey; however, in both the pre- and post-survey, 50% of the students were in the middle on their ability to learn. The second question, dealing with use of

hands-on activities, featured 83% of the class feeling the activities are highly important in the post survey while only 50% felt those activities were important during the pre-survey. No one felt that hands-on activities were of low importance in the post-survey but 17% felt the activities were not important. One comment that was made by a student was that the teacher did not use enough hands-on activities.

Table 9

Results of Survey with Pre and Post Survey Results

Question	high		medium		low	
	pre/post		pre/post		pre/post	
Ability to Learn (n = 6)	33%	17%	50%	50%	0%	33%
Use of Hands on (n = 6)	50%	83%	33%	17%	17%	0%
Learn more with Technology (n=6)	67%	0%	33%	50%	0%	50%
Motivated/Real Life (n=6)	50%	50%	0%	0%	50%	50%
Internet in Math (n=6)	17%	0%	33%	33%	50%	67%
Get notes from missed days (n=6)	67%	83%	17%	17%	17%	0%
Importance of grade (n=6)	87%	100%	0%	0%	17%	0%
Paper/Pencil Tests (n = 6)	50%	0%	0%	0%	50%	100%
Different types of test (n=6)	83%	67%	17%	17%	0%	17%
Attending math class (n = 6)	67%	67%	17%	17%	17%	17%

The third question dealt with technology. When the first survey was given, 67% of the students felt technology was highly important, while 0% felt that technology was important in the post-survey. In the post-survey, 50% of the students felt that technology was of low importance.

The fourth question dealt with learning real-life mathematics. In both surveys, three people or 50% agreed that learning real-life mathematics is highly important. Also, in both

surveys, noone or 0% were in moderate agreement. In both surveys, 50% of the students felt that they were not highly motivated to learn real-life mathematics.

The fifth question dealt with Internet in math. The first time the survey was given, one person or 17% of the population felt it was highly important, while the second time, zero people or 0% felt it was important. There were 67% that felt the Internet was of low importance in the post-survey.

With the sixth question, getting notes from missed days, five out of six or 87% felt it was important in the post-survey while only 67% considered it highly important in the pre-survey. In the post-survey, 0% felt that getting the notes was of low importance.

The seventh question dealing with importance of grades, 100% felt that grades were important on the post-survey while 87% of the group thought grades were important at the beginning of the research.

When asked about paper and pencil tests, the results were quite different. The first time the survey was given, 50% felt tests were of low importance while 100% the second time felt these types of tests were not important; however, in the pre-survey, 50% of the students thought that paper/pencil tests were highly important. The next question dealt with different types of tests. In the pre-survey, 83% of the students felt that different tests were important; however, in the post-survey only 67% of the students felt that different types of tests were highly important. The final questions dealt with attending this particular math class. In both surveys, the numbers remained the same. In both the pre- and post-survey, 67% of the students were highly motivated to attend the class, 17% fell in the middle and 17% were not highly motivated to attend this math class.

Overall, it seemed that the opinions were slightly changed from the beginning of the research to the end of the 24-week period of research. Student comments on the use of technology varied. Some liked the technology while other students did not like the technology at all. One component that was added to the research was using the Internet to play "Who Wants to be a Millionaire." Most students enjoyed that, but it seems like they did not consider that part

of the Internet based on the results of the second survey.

Discussion

This research was completed in a twenty-four-week time frame based on four six-week periods. The third and fifth six-week periods did not feature the use of the SMART Board interactive whiteboard. The fourth and sixth six-week periods did feature the use of the SMART Board interactive whiteboard.

Six-Week Grades by Individuals

The six-week grades varied among individuals and among grading periods. Grades could have differed because during one no SMART Board interactive whiteboard use period, absences were lower. The highest median change in grades, during the last six weeks of the research study, was unique. There were no exams that students had to worry about and absences tended to be higher because there was no reason to be in school for exam reviews.

Six-Weeks Grades by Disability

The most significant changes occurred in the group of ED students. There were two ED students in the class. When the SMART Board interactive whiteboard was in use, their attention fell on the interactive whiteboard, not on the other students in the class. Some of the activities we did during the SMART Board interactive whiteboard period were more attractive to this group of students because they could work together. The OHI student had a high absentee rate, which could have resulted in the lower grades. This student was also experiencing some medical difficulties.

Six-Week Grades by Diploma Option

One student from each diploma option left the class and entered another school division. Two students seeking an IEP diploma failed the course for the year due to high absentee rates and not making up the assignments. It was hard for students on IEP diplomas to miss time and make up the assignments when there was no SMART Board interactive whiteboard because the students using it were able to pick up the material easier given that the notes were easily

accessible on Notebook software. When the overhead was used, it was more difficult because the teacher could not flip the overheads and still be working with the group that was present the lesson before. Students had notes that could be printed off of the SMART Board interactive whiteboard to assist them when they were absent. This is a possibility with overheads, but the copier is not as close as the printer. Sometimes with copiers, there is a twenty-four-hour turnaround and it is much easier to give students the notes directly from the printer.

Unit Grades by Total Group

The units taught were initially considered to be of comparable difficulty. The area/perimeter unit, graphing unit, and geometry units were all chosen based on the eighth grade standardized tests given in the state. These units produced higher results than most of the other units as evidenced by the grade changes in test scores. There were units where scores were even across students. One such unit, the complaint theme, resulted in the same grade for every student. This may have occurred because every student had the same type of assignments to complete and the writing skills were already within their repertoires.

Unit Grades Results by Disability

One of the ED students was the only student that achieved a lower grade during the use of the SMART Board interactive whiteboard. This is because the student was very knowledgeable in geometry, but missed a single question when the post-test was given. Two LD students were pulled out for work with the testing and that is why there are numerous blanks on those rows.

Unit Grade Results by Diploma Options

Students who are seeking modified diplomas must pass the state's eighth grade math test. Therefore some students in the class were pulled out to work and concentrate on specific testing areas, and thus missed class. The students that were on IEP diplomas had lower scores than the students with modified diplomas, perhaps because the latter group of students are in more regular education courses than students on IEP diplomas. These students are more used to having tests and taking pre- and post-tests than students seeking an IEP diploma.

Student Absences

Student A had quite a large number of absences because of personal reasons. This student tended to have lower grades and ended up not passing the last two grading periods of this research. Student J also had numerous absences. Both of these students were on IEP diplomas. Both students were seniors and did not need to pass this course to graduate because they had met their goals as set forth by their IEPs. Student K missed a lot of school due to health and discipline reasons during the fifth six-week period. This caused a tremendous drop in grades. Students F and I both left the school division during the last six-week period. Attendance was a major problem during the last six weeks. Some students in the class had jobs that they were required to report to. During the last two weeks of school, the school day schedule was altered due to state testing and did not allow the students to be in classes.

Survey Results

The survey was given to the same group of six students so that the data would not be skewed too far in either direction. The six students that took it were receiving ED and LD services. Both ED students completed the second survey and four of the LD students completed it. Throughout the research period, students were more concerned about their grades because something new was being added to the curriculum. Change is not always good for students. The students' attitudes about attending class did not change at all. This was in part because the students were achieving success and saw that they could be successful in the math classroom. In the past, very few of these students have experienced success in the math classroom. Those that were successful in passing Algebra I Part I did not have an easy road to get there. It took a lot of hard work and teacher help to get there.

According to survey results and teacher observation, students indicated mixed feelings concerning the use of the SMART Board interactive whiteboard; some enjoyed the new tool while others felt it was boring. One student repeatedly said, "Are we using that again? I hate that thing!" This student initially was excited by the introduction of the SMART Board interactive whiteboard. One activity that I did with the students was playing "Who Wants to be a Millionaire"

on the SMART Board interactive whiteboard. This made it so that the keyboard and mouse did not need to be used. The students were in charge of the SMART Board interactive whiteboard during the game. The student that complained about the interactive whiteboard was one of the first ones to volunteer to come up and use it to choose answers to the questions. Another student made the comment that the projector shadow made her look fat; however, this student also volunteered to come up and play "Who Wants to be a Millionaire." Most students mentioned that they felt like they paid more attention to the lesson when we were using the SMART Board interactive whiteboard. Some students even asked when we were going to use the SMART Board interactive whiteboard again.

The students were very excited to get to write on the SMART Board interactive whiteboard, as shown by their increase in class participation as observed by the instructors. Students were participating more in class and were more in tune with what was going on. The students were allowed to use the pens or their fingers. Most students preferred to use their fingers because it was easier to write. During geometry and graphing unit instruction, the students showed enthusiasm for using the interactive whiteboard to graph lines and draw lines and rays.

The students enjoyed doing quizzes/tests on the SMART Board interactive whiteboard rather than using the overhead projector, as evidenced by the pre- and post-test scores. When students did the unit on Rounding, the interactive whiteboard was used; however, on the units where it was not used, all of the quizzes/tests were done on the SMART Board interactive whiteboard. The colors and lighting are more vivid on the SMART Board interactive whiteboard than on the overhead and the chalkboard. The notes can be saved to the computer and students can pick up the notes when they missed a day of class. Most students liked that because they knew that if their SPED teacher did not get the notes copied, they could access them.

Overall, the six-week grades of students increased significantly throughout the six-week periods when the SMART Board interactive whiteboard was used. The students were more attentive to what was going on in class when they could view the SMART Board interactive

whiteboard. The students were watching the interactive whiteboard to see what the researcher was doing. The students were working with each other in activities and paying attention as their classmates were at the SMART Board interactive whiteboard answering the different questions from the worksheets. Midway through the research period, the computers were switched from a laptop to an iMac. Through this switch, the students became more in tune because the Internet became part of the curriculum at that time. Various Web sites were accessed for students to learn material and the kids played as a class to try and win one million dollars on the game. Those students who never paid attention were watching the interactive whiteboard and trying to answer the questions correctly. The students were very proud to reach the $500,000 mark. That was something that none of them could have done without each other and it became very competitive.

Limitations and Implications

There was a short period of time for the research study (24 weeks) and the class met every other day. The class schedules were on an odd/even rotation. The class met for 95 minutes every other day. This meant that the class only met a maximum of 15 times per six weeks due to the schedule at the high school and the factor of weather related school closings. The time of the year that this study was taking place cannot be controlled. Some periods of time during the six-week periods were interrupted due to weather issues or sporting events or school assemblies as well as state standardized testing.

Another limitation was that students frequently missed this class and they missed some of the content being taught in each unit. It is hard for students receiving special education services to miss a class period and then try to retain some of that information without hearing the information presented to them.

There was no true control group. A small group of students made it harder to generalize beyond the particular students involved. The amount of students was rather small compared to a more general population. Attendance varied from day to day due to field trips, illnesses, motivation, and health issues. Although the group had periods of time when the interactive

whiteboard was not used, any differences in achievement could be caused by other factors, such as a variation in motivation due to holidays, weather, etc.

The content may have differed in difficulty during the ABAB sequence. Therefore, progress or lack of it may be due to the nature of the content rather than use or non-use of the interactive whiteboard technology. To some students, the material in the different units was more difficult to them then they expected. Future studies need to test the difficulty level of units.

Some drawbacks to the SMART Board interactivity included cost, sensitivity of the product, lighting, and availability. The SMART Board interactive whiteboard costs around $1,500. A stand for mounting is additional, and while the SMART Board interactive whiteboard could be mounted to the wall, it would then be hard to adjust to the necessary classroom environment and space. One drawback, sensitivity, caused by someone kicking it or pushing it, required the teacher to re-orient the board. The orientation was thrown off balance, and it was hard for the students and/or the teacher to write on the interactive whiteboard. Another drawback was lighting in the room. Lights must be dim enough so that the students can see the projector shining on the SMART Board interactive whiteboard; however, it needs to be light enough to keep the students engaged. The interactive whiteboard produced quite a bit of light with the projector, but the lighting would vary depending on the classroom. This teacher did not have an outside window to adjust lighting. Another drawback was availability of the projector. A projector costs about one to two thousand dollars, and, due to the cost, there are very few of them in the building that a teacher can access. This may dissipate as a drawback as technology grants are becoming more and more available to get these pieces of technology.

There are many implications of this study for math and special education teachers. First, students are curious about new technology and the novelty effect can motivate them to both attend and participate in math class activities. Students who do not experience success in math come to "hate" it. Novel ways of working with the subject matter can sometimes override this aversion and prompt greater motivation. Second, technology standards are part of the state requirement for teachers. The teachers can use the skills that are learned and apply them to

helping students be successful. For the math and special education departments, the SMART Board interactive whiteboard is a new, multimodal teaching tool that can be matched to their learning preferences. Third, because achievement increased with SMART Board interactive whiteboard use, teachers and administrators may be more likely to purchase these products for use in other classrooms. Fourth, this research can be used by the company that produced the technology to encourage other teachers and supervisors to purchase the product.

The SMART Board interactive whiteboard appears to be a useful tool for helping students who receive special education services. This research focused on a small number of students who had a variety of disabilities ranging from LD to ED to OHI. These students were willing to participate in the research study. Students had to adapt to being given pre- and post-tests for each unit administered throughout the research period. Most students enjoyed using the SMART Board interactive whiteboard because they liked to experiment with new technology. They could write on it using a stylus pen, a dry-erase marker, or their finger. Most students chose the finger option, perhaps because of the tactile nature or the novelty of this method. Although students who have disabilities do not always adapt well to change, the students in this study appeared, at least initially, to be intrigued by the multimodal nature of the SMART Board interactive whiteboard activities. The SMART Board interactive whiteboard was a change in the daily routine of the math class. This change was a good change for most students as evidenced by the change in six-week grades and the changes in pre- and post-test results. Most students in this class liked the SMART Board interactive whiteboard even though they did not like having to get up in front of the classroom.

In summary, the SMART Board interactive whiteboard produced positive grade changes from six-week to six-week period as well as from unit to unit. Use of the SMART Board interactive whiteboard appears to be a positive tool for assisting functional math achievement with struggling learners. Care must be taken not to overuse the interactive whiteboard strategy or use it inappropriately in a given content area.

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APPENDIX A

LEARNING PREFERENCES SURVEY

For each question, use the scale of 1-5 with 1 being "low", 3 being "medium" and 5 being "high" to answer each question.

1. What is your ability to learn in a mathematics classroom?
   1 2 3 4 5

2. How important is the use of hands-on activities to your learning needs?
   1 2 3 4 5

3. If teachers are using technology to teach a lesson, how much more do you learn?
   1 2 3 4 5

4. How motivated are you to learn real life mathematics?
   1 2 3 4 5

5. How important is it to have use of the Internet in a mathematics classroom?
   1 2 3 4 5

6. How important is it that you get the notes from the class time that you missed?
   1 2 3 4 5

7. How important are grades to you?
   1 2 3 4 5

8. How much do you like paper pencil tests?
   1 2 3 4 5

9. Are different types of assessment beneficial to you?
   1 2 3 4 5

10. How much do you enjoy attending this mathematics class on a daily basis?
    1 2 3 4 5

APPENDIX B

LESSON PLAN USING TECHNOLOGY

Class: Personal Living and Finance – With SB Use
Teacher: Meredith L. Zirkle

Objectives:

Given an example of payment and interest, the learner will demonstrate the ability to find a car that might fit his or her budget by researching various car dealerships with at least 90% accuracy.

Given a chosen car, the learner will demonstrate the ability to calculate a monthly payment by using the given price and average interest rate with at least 90% accuracy.

Materials:

1. SMART Board interactive whiteboard
2. HP Pavilion laptop computer
3. Various Ads from local dealers
4. Calculators
5. Paper and Pencil

Warm-up:

Student will be given the following questions to work out before beginning the lesson on cars. These warm-up questions will be used to review with students the mathematical operation of multiplying decimals and figuring wages. Students have had previous instruction in budgeting, calculating interest rates and figuring weekly wages.

Figure each person's weekly wage.

1. Tom worked 40 hours at $6.90 an hour.
2. Toucan Sam makes $1280 per production. He has 12 productions in January.
3. Joe Bob works 32 hours at $7.70 an hour.
4. Sam makes $13.63 an hour and works 48 hours a week.

Lesson:

The teacher will have the SMART Board interactive whiteboard hooked up to the Internet. The teacher will go to various Web sites and allow the students to look at the different dealerships that sell automobiles. Together the class will work through selecting a car based on a given budget. The dealerships that are in the local areas will be the first ones to be considered. The teacher will then allow each student to choose the car that they would like to "purchase" and determine if their budget can allow the car that they want to buy. By using the SMART Board interactive whiteboard, the students can see the colors of the cars and more details that are in the car (such as spoilers and alloy wheels).

After each student has picked out the car that they would like to purchase, the students will determine the interest rates and the amount of time by which they would like to pay the loan off. The teacher can access the calculator from the computer and use the calculator to determine the various loan payments per each month. The calculator that the computer has is similar to the calculator that they students are using in class for their basic functional math. The students will be able to see the screen of the SMART Board interactive whiteboard and be able to see the screen of the calculator that is on the computer. Students will each have a calculator at their desks to use. We will also do the loan payments for each of the student's cars in the class. The

students will also receive instruction on how to computer interest payments. The formula that the students will be using in I=Prt which will calculate the amount of interest that will be on the loan as well as on the total purchase of the car.

Closing/Assessment:
The students will use the calculations that they have made to determine if it is possible to pay that based on the budget that they were given at the beginning of the year. The students will also do research from newspapers to find if there is a car that they would rather have over the one that they chose.

Homework:
Students will list 10 reasons for choosing the car that they chose and list options desired on the car.

Lesson Plan Summary:
The first lesson plan presented shows a plan in which the SMART Board interactive whiteboard would be used to assist the student's learning of cars and making car payments. The students can look at the calculator and work through the problems as the teacher works on them. The students will be able to see what the teacher is entering in the calculator and the calculator is similar to the calculators that the students use during the class. The students can also come to the SMART Board interactive whiteboard and do their own calculations on it to show their peers how they can do things.

APPENDIX C

LESSON PLAN WITHOUT SMART BOARD INTERACTIVE WHITEBOARD TECHNOLOGY

Class: Personal Living and Finance – Without SMART Board interactive whiteboard use
Teacher: Meredith L. Zirkle

Objectives:

Given instruction on car insurance rates and liability variables, the learner will demonstrate the ability to determine the amount of car insurance needed by looking at various types of insurance with at least 85% accuracy.

Given descriptions of different car insurance company rates and liability variables, the learner will demonstrate the ability to determine how much the car insurance will cost and what is needed by the state law by researching the various insurance types and using insurance calculators to compute insurance.

Materials:

1. Computer Lab (I-Mac)
2. Calculators
3. Various insurance types
4. Insurance Applications
5. Paper and Pencil

Warm-up:

The students will answer the following questions based on previous lessons about finding car payments.

Compute the interest for each of the following:

1. Borrow 1,000 at 5% for 2 years.
2. Borrow 3,000 at 8.5% for 3 years.
3. Borrow 28,000 at 8% for 6 years.
4. Borrow 10,000 at 6% for 5 year.

Lesson:

The teacher will have students log onto the Internet and have them check out some different insurance Web sites. The teacher will discuss the different types of insurance that is available on cars and determine what is available. The students hear about the reason why some insurance is higher for various ages and for different sexes. The students will work towards determining the best insurance for the money and how it can benefit in the long run.

The students will have the opportunity to look at the different "insurance calculators" to see if they can afford the insurance for the car that they chose. The more sporty cars are more expensive to carry insurance on as well as the more expensive the car, the more the insurance will cost.

Closing/Assessment:

Students will choose an insurance plan and know the cost per month of the insurance plan.

Homework:

Students will figure out the yearly car insurance cost and the cost of one of the other insurance plans that were presented in class.

Lesson Plan Summary

The second lesson plan presented shows a plan in which the SMART Board interactive whiteboard would not be used. The students would be using their individual computers to see the types of insurance. Students can get easily lost and confused even though there are two teachers present to help the students in keeping control of where students are. The levels of reading are low and it might be difficult for students to read and understand the information that they are reading.