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Investigating SMARTBoard Technology for Mathematics Education to Improve the Learning of Digital Native Students

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by

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A Dissertation submitted to the Education Faculty of Lindenwood University
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Digital Native Students

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Dr. Bill Emrick, Dissertation Chair — Date 3-18-11

Dr. Vicki Hedges-Oldani, Committee Member — Date 3/18/11

Dr. John Oldani, Committee Member — Date 3/16/11

Declaration of Originality

I do hereby declare and attest to the fact that this is an original study based solely upon my own scholarly work here at Lindenwood University and that I have not submitted it for any other college or university course or degree here or elsewhere.

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Abstract

The SMARTBoard is a technology teaching tool that engages students in learning and enhances a mathematics curriculum. This study consisted of data from student and teacher surveys of technology items that are available and which can be used in the classroom, a personal self-interview conducted by the researcher to establish her technology journey, an item analysis of a diagnostic mathematics test to establish a base for measurement, and a seventh grade standarized mathematics test from the state of Missouri to complete a measurement of the effects of technology use on student achievement. The researcher compiled data from multiple sources, which verified that the use of technology in the classroom can enhance student learning.

The literature review contains research on the technological items available to both teacher and students with emphasis on iPods, video game systems, handheld video devices, and cell phones all of which are capable of and suitable for use in the classroom as teaching and learning tools. The researcher documented that some technological items students have available in their homes can easily be adapted for classroom use if educators are willing to restructure classrooms.

The SMARTBoard is a visual interactive presentation tool for teachers and students to use in the classroom. It is the focus of this study because of the availability of this technology to teachers in today's classrooms. The SMARTBoard is an interactive whiteboard, which becomes an interactive computer screen for students and teachers. The SMARTBoard is a technology tool that can increase student engagement in learning mathematics. This study shows the effects of a technology rich environment in one mathematics teacher's classroom as student achievement is measured by diagnostic test to a standardized state test after the use of an interactive whiteboard to teach mathematics.

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Chapter One: The Study

Introduction

When school district administrators understand that technology is playing a major role in the lives of their students, they are more likely to commit resources to technology in the classroom (Spears, 2009, p. 51). Twenty-first century students require highly developed critical thinking skills and the capability to sort through large amounts of information to decipher what is important. These skills students apply to current technology, especially through Web 2.0 tools. The SMARTBoard creates a classroom environment that integrates those needed skills and technology together as one (Manzo, 2009g). Teachers encourage students by developing lessons and units involving current technologies.

No longer do students win awards just for academics and sports. Technology contests, which include texting, boast national titles. Kate Moore, a 15 year old from Des Moines, IA, became the national texting champion on June 16, 2009. When reporters asked about her 14,000 texts each month, she declared she used texts as a skill to study for exams. Kate enjoyed studying through use of texting because she looked back at previous messages to review (Gross, 2009). Technology plays an important role in students' lives. The example provides support for implementing current technology into the classroom.

Educators want to help all students learn to their maximum potential. Digital Native students, those born after 1980, need multi-dimensional learning tools to help them gain complete understanding of important concepts (Spears, 2009, p. 51). Students growing up in a digital world accept digital technology as a major part of their lives

(Palfrey & Gasser, 2008). Students often learn in multiple ways simultaneously and thus require instruction in some of the major learning styles to grasp a concept. Technology offers a means to address student needs by providing multi-dimensional learning tools (Spears, 2009, p. 51). For students, technology enables them to do more and make better use of their time. Research varies as to the validity of this idea. Digital Natives may learn differently than their predecessors, but they are learning (Palfrey & Gasser).

Thomas Edison held a strong viewpoint about "technology" in the school setting. As early as 1913, Edison thought books would no longer play a role in the classroom. He believed learning would change through the technology of the motion picture. When the television was introduced into education, most teachers used it sparingly. Studies from 1970 to 1981 noted that 60 percent of high school teachers, 43 percent of junior high, and 13 percent of elementary teachers did not use technology at all in their classrooms (Cuban, 1986).

Schools in American Samoa have used television as a primary instructional source to cope with a teacher shortage. Many teachers used video lessons as the primary teaching tool, and assigned students to complete worksheets or take notes corresponding with the video. Television and worksheets filled the void for qualified teachers in the classroom. During a time of teacher shortages, this allowed for the required larger class sizes (Cuban,1986).

Collins and Halverson (2009) found that students growing up in the current digital century do not generally learn as well when presented with lectures and worksheets. Just as the Industrial Revolution played a major role in education, the Technology Information Knowledge revolution plays a major role today. The Technology

Information Knowledge revolution is energized by computers, the Internet, video games, iPods, MP3 players, MP4 players, and cell phones. Those who support technology in education recognize a changing world and the necessity to prepare students for that world. Schools should accept and embrace the capabilities that technology offers to educating learners and use technology as a means to reform education (Collins & Halverson).

Many teachers understand that students may be more engaged in learning when technology plays a vital role in the learning process. Morgan (2008) discovered that the use of the interactive whiteboard as an instructional tool demonstrated a beneficial effect on student engagement in classroom lessons and led to improved student behavior. When the behavior of students taught with an instructional whiteboard was compared with those not taught with an instructional whiteboard, the researcher noted a statistical difference; noting that students in the classroom with the technology were demonstrating more positive behavior characteristics. The students in Morgan's study were of the same ages as those in this research study.

Prensky (2007) supported the concept that students learned and used technology much faster than those who taught them. There are teachers who are afraid of technology, possibly due to the slower pace that they are able to learn the same technological skills that the students master. Students struggle to understand why their teachers are afraid of something students use daily. Michael Osit, a clinical psychologist, stated that teachers needed to join their students in the world of technology. He understood that many teachers do not learn the technology at a quicker rate than their students. He also

supported the role of the teacher as guiding students to what is appropriate (Edwards, 2009).

Teachers who embrace the knowledge their students offer provide a current learning environment for the students. However, the use of technology, like any instructional tool, should be appropriate to the lesson content.

Technology offers a wonderful tool for learning. The Internet especially provides a wealth of resources; however, safety remains a huge concern. Students and adults need training in safety on the Internet. There are six golden rules of Internet security that students and their teachers should know.

Table 1

Six Golden Rules of Internet Security

1	Never share personal information online
2	Ensure that anti-virus software has been installed
3	Create a firewall for the computer
4	Do not open attachments received via e-mail addresses that are unfamiliar
5	Log off the computer or any program
6	Back up the data

Note: Adapted from *Bringing Technology Into the Classroom* by G. Lewis in 2009 on page 21 and 22.

Every teacher, parent, and student needs to know and understand these rules. These rules are basic and easy to follow when the computers are configured properly. Tech support is vital for a working computer lab, teacher classroom computer, or home computer (Lewis, 2009).

Netiquette is another area of concern when adding technology into the classroom and is defined as the understood acceptable behavior to navigate online responsibly, safely, and productively (Manzo, 2009a). Students need to learn netiquette starting with the first time they interact with technology, and must practice proper behavior online. Proper online behavior allows schools to continue to utilize current technology and avoid

online disasters. Shawn Nutting, the technology director for the Trussville District in Alabama stated, “We are known in our district for technology, so I don’t see how you can teach kids 21st century values if you’re not teaching them digital citizenship and appropriate ways of sharing and using everything that’s available on the Web” (Manzo,K.K., 2009a, p. 11).

Students who were born after 1980 are Digital Natives, meaning they were born in a technological age (Palfrey & Gasser, 2008). Students of this generation do not remember a time without a computer, and those born after 1997 have never known a world without the Internet, cell phones, or e-mail. These students find it archaic when teachers spend the entire period using only a chalkboard or dry erase board, because they are not engaged in the learning process. Students desire more from their educational experience. Digital Natives are considered free agent learners; they want to learn on the go and multi-task in as many ways as possible (Palfrey & Gasser).

The need is not just the addition of technology in the classroom, but a new way of thinking. Heidi Hayes Jacobs stated, “Out-of-the-box- or no-box- thinkers should be valued as we begin drafting creative designs for our curriculum and our schools” (Jacobs, 2010, p. 17). Not all teacher education programs have prepared their students or future teachers in the field of technology or this type of “out-of-the-box” thinking.

This study examined many facets of student and teacher technology use. First, the researcher surveyed middle school students to determine their degree of technology usage at home. Second, the researcher surveyed teachers in the state of Missouri to determine their technology use inside the classroom. Third, the researcher, a middle school mathematics teacher at the time, conducted a personal interview with herself. Fourth, the

researcher, in collaboration with colleagues, developed a diagnostic test, conducted item analysis for each question, and compared the results of her students with the results of all the students in the district for the seventh grade level. Last, the researcher used the Missouri Assessment Program (MAP), state mandated test, Mathematics scores to compare those students taught with technology with those not taught with technology.

Definition of Terms

Auditory learners – Auditory learners prefer to learn through listening and are comfortable with music, which can invoke strong positive emotions during their listening process. They can identify background sounds and music from television, movies, and generally within their surrounding environment. (Advanogy.com, 2003-2007b).

Educational technology – Educational technology tools help in the advancement of student learning. The tools can be material products such as machines, hardware, or software. The tools can include systems, methods of organization, and techniques (Schrum & Levin, 2009).

eMINTS program – eMINTS, enhancing Missouri's Instructional Networked Teaching Strategies, is a program that was created by educators for educators.. The idea was to produce programs to inspire educators in using instructional strategies powered by technology, putting computer laptop labs in classrooms. The plan formed from a desire to engage students in the excitement of learning. Creators believed technology implementation in the classrooms would enrich teaching to improve student performance. University of Missouri participants, the Missouri Department of Elementary and Secondary Education, and the Missouri Department of Higher Education collaborated to produce this program based on research (eMINTS National Center, 2009).

Grade Level Expectations –GLE's are the expectations of what students are to demonstrate in a specific subject for a particular grade.

iLife – iLife is a software suite that allows a user to create digital movies and video podcasts, import, organize, edit, and share photos, create and record music and podcasts, create web pages, blogs, and podcast feeds, produce DVDs to store and share digital media projects. All programs interface with each other (Apple Inc., 2007).

Interactive whiteboard – An interactive whiteboard can be a free standing or wall mounted screen. Teachers are able to control the projected lessons from the front of class, as opposed to behind the computer as a teacher would do if only using a projector. They have the ability to use a variety of tools, such as Power Point, Word, the Internet, and any other application that is available on the computer (Hutchinson, 2007).

iPod – An iPod is an easy-to-use portable media player for storing and playing audio, images, and video. Another use for the iPod are is an external data storage device to store photos, notes, calendars, and contact files, as well as other files one might keep on a portable hard drive. It can also be connected to a TV or a projection device (with an added AV cable) to display files such as slide presentations. With the addition of a third party voice recorder, it can record any kind of audio file (Apple Inc., 2007).

iTunes – iTunes is an application available, for Macintosh and PC, for organizing and playing digital audio and video content (Apple Inc., 2007).

Kinesthetic learners – Kinesthetic learners use their bodies and sense of touch to learn about the world. These students tend to use large hand gestures and other body language to communicate. Additionally, kinesthetic learners tend to "jump-in" and play with the physical aspects of a new skill or problem to solve (Advanogy.com, 2003-2007a).

MAP Test – The Missouri Assessment Program, or MAP came as a response to Missouri's Outstanding Schools Act of 1993. The Missouri Outstanding Schools Act of 1993 required a new assessment system. When the No Child Left Behind Act of 2001 (NCLB) passed into law, Missouri's Department of Elementary and Secondary Education (DESE) began revisions of the MAP for compliance. The Missouri Outstanding Schools Act and NCLB are similarly designed to help raise student performance. The MAP assessments test students on their knowledge, as well as their ability to apply that knowledge. The MAP currently only assesses communication arts, math, and science. In previous years, the MAP also assessed social studies as well as health and physical education, but due to budget decreases, those tests were eliminated by the state. Students receive scores at four levels: advanced, proficient, basic, and below basic. Advanced means students have an in depth understanding and are able to show they completely understand the concepts. Proficient means students are able to show their understanding, but not in depth. Proficient students are working at grade level. Basic is for students who understand the concepts, but are not able to apply them. Below Basic are students who have minimal understanding and demonstrate low ability to apply their knowledge. Missouri desires all students to be at the proficient or advanced score rating (Practical Parenting Partnerships, 2009).

Podcasts – Podcasts are similar to a radio or TV show, however podcasts are not tied to a specific time. RSS, which stands for really simple syndication, contains any type of media, including audio, video, graphics, and more (Apple Inc., 2007).

SMARTBoard – The SMARTBoard is a specific type of interactive whiteboard that was used by the researcher. The model used was the 600i for educators. 600i combines an

interactive whiteboard with a projector (ULC, 2009). The SMARTBoard was originally created for office environments. The SMARTBoard represented new technology for the classroom at the time of this research. The device is a large, touch sensitive board that controls a computer connected to a digital projector (Smith, Higgins, Wall, & Miller, 2005). The SMARTBoard was the first and most widely used installed interactive whiteboard in the world. The company that created the SMARTBoard was founded in 1987, and in 1991 created the first interactive whiteboard. Though the SMARTBoard was created in 1991, it did not start making appearances in school settings until 2001 (Google, 2009).

Team – The middle school concept includes students being on the same team. Students who share a team at Sun Valley Middle School have the same five core teachers for the subjects of Math, Science, Social Studies, English, and Literature.

Traditional Math curriculum – A traditional math curriculum is taught from a traditional style textbook, and follows a basic order where one skill set is built on a preceding skill; a student needs previous skills to complete the math skills needed for the next set. A teacher presents lessons with the use of a chalkboard or dry erase board. Students take notes from the information the teacher writes.

Virtual School – A virtual school is a state sponsored program using online courses.

Visual learners – Visual learners prefer using images, pictures, colors and maps to organize information and communicate with others. They have good spatial sense and can easily visualize objects, plans and outcomes in their mind (Advanogy.com, 2003-2007c).

Wi-Fi – Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections. The Wi-Fi Alliance, the organization that owns the Wi-Fi (registered trademark) term, specifically defines Wi-Fi as any "wireless local area" (Webmedia Brands Inc., 2009).

Statement of Issue

Student engagement in learning could be increased if the technology used outside of school, such as the computer, video games, and iPods, were a regular part of the classroom environment (Prensky, 2006). Teachers should receive training in the use of current and future technologies and how to implement them in the classroom in order to better instruct students. The education paradigm needs modernization and appropriate changes implemented to ensure all students are prepared for their future. To better prepare students for the future, educators must incorporate current and future technologies in the classroom to enable students in the development of critical thinking and problem solving skills (Spears, 2009, p. 51).

A simple piece of technology many students already possess by the seventh grade is a cell phone. A study in 2007 of 1500 students ranging from age 10 through 17 discovered that one-third, or 500 of those students would give up video games, radio, or a trip to the mall before parting with their cell phones. Of that same study group, one-fifth, or 300 of those students would give up television (Kolb, 2008). Cell phones are an important social tool to students, as well as a tool to access the internet for information.

Even though there are neither federal nor state laws prohibiting cell phones, many school district leaders wrote and enforced policies against any use of cell phones in schools. If school leaders decided to change their policies to allow student use of cell

phones as educational tools, parents must be informed of guidelines. Students need lessons on cell phone etiquette and cell phone language, similar to the lessons needed on Internet safety. They must learn when it is appropriate to use and not use a cell phone. Students also need to be taught that cell phone language is not appropriate for other forms of communication, such as in a business community (Kolb, 2008).

The website Poll Everywhere allows students to use the texting feature on cell phones for classroom use. This website allows students to text their answer in multiple forms and graphs the answers live. A teacher could utilize this website for an assessment, an exit survey for feedback purposes, or an in-class question.

Another technological advancement affecting education incorporates changes in textbooks. No longer bound with paper, electronic texts can provide states with a cheaper option. California, Texas, Florida, and Indiana approved changes in the kinds of texts districts can purchase with state money (Manzo, 2009f). Keith Kruger, the chief executive officer of the Consortium for School Networking, supported states who allowed the spending of textbook money on any content. This new philosophy towards education funds provided school districts with a new way to present materials to students (Manzo, 2009f).

Rationale

A school district should develop an understanding of the importance of technology in the lives of students and ensure all teachers receive training on the technologies available to them. Often, professional development time is not spent training teachers for the technologies they have in the classroom, but on other topics such as new teaching strategies and techniques, literacy, poverty, and the achievement gap. While

these are necessary topics for professional development, the use of technology in the curriculum can easily be overlooked.

Another professional development issue is the lack of technology use by in-service presenters. Many presenters use basic Power Point slides for their information. Presenters could use other forms of presentation tools like Prezi, which is a free online presentation tool. Presenters also could use additional websites like Poll Everywhere to engage the teachers in the subject matter more intently. Just as students need to engage in the learning process, so do teachers. A study conducted by Walden University discovered that teachers do not feel they have adequate professional development in the area of technology (Walden University, 2010).

School districts need to budget for technologies such as iPods, interactive whiteboards, computers, cell phones, projectors, scanners, printers, copiers, digital cameras and camcorders. They also need to budget for the proper technical support, so teachers can receive training that is appropriate when they receive the technology. Teachers need to know how to troubleshoot when technological issues arise or where to turn to for additional assistance. Teachers do not integrate technology into their lessons if that technology does not work properly or consistently. Technology surrounds today's students and is their primary source of information outside of school. School districts must take this into consideration when they develop new technology based strategies and curriculum (Lewis, 2009).

One challenge for teachers is to determine how to integrate technology into their curriculum. According to Martha Stone Wiske, co-director of the Educational Technology Center at the Harvard Graduate School of Education, one of the challenges

of technology and education is that people tend to think of technology first, and education later, instead of finding the technology to match the educational objectives (Schacter, 1999). A teacher can lead students to work on computers and to use the Internet, but if the activities are not aligned to the objectives and curriculum, then the lessons will not accomplish the desired goal. One issue educators need to address is how to utilize technology in ways that allow students to take charge of the educational experience. When students exercise personal responsibility for their education, learning will become more valuable and engaging (Prensky, 2006).

According to Cuban (1986), one reason that technology has not reached its potential in education is the manner in which it has been introduced to teachers. Like many strategies in education, technology can be viewed as a top-down mandate from the administrative offices of a district. Teachers often feel the need to rebel when told that they must do something, especially if they do not receive the support they need. One way to promote technology integration in the classroom is to teach these skills to pre-service teachers. Teacher education programs need to help candidates learn how to address and incorporate technology appropriately and effectively into classroom learning.

Teachers often imitate the classroom environments they experienced as students. How does one teach a generation in a way differently than how one was taught? Some of the possible answers to this question include research, discussion with the Digital Natives, and acceptance that schools today are different from those in the past. Professors need to model how to integrate technology effectively in their classrooms, so that pre-service teachers have an example to follow. For this to happen, teacher education programs must have the technology available to professors. For technology to play its

deserved role, educators, parents and students have to understand there is more to learning than sitting at a desk with pencil and paper (Mehlinger & Powers, 2002).

While parents and educators may view technology, such as video games, as a distraction from learning, educators need to recognize that students who play video games are actively engaged in critical thinking and problem solving skills. An individual can learn many skills through games. Study Island is a web site that connects a specific state's grade level expectations (what students are expected to know at the end of a specific grade) to specific worksheets, quizzes, tests, and games. Study Island provides the teacher with instant feedback regarding the progress of the students. The game format engages students by requiring them to answer a question related to the grade level expectation the teacher or the student chose, and when they get the correct answer, the students get to play a short game (Prensky, 2006). Students can access this website at home as well as in school.

Interactive Whiteboards in the Classroom

There are few studies on the use of interactive whiteboards; the majority of existing studies were conducted in England. The former Secretary of State for Education and Skills in England, Charles Clarke stated, "Every school of the future will have an interactive whiteboard in every classroom, technology has already revolutionized learning" (Smith, Higgins, Wall, & Miller, 2005, p. 91). Chapter two of this dissertation discusses studies regarding interactive whiteboards. Many studies utilized data-based only interviews, surveys, or questionnaires as evidence that interactive whiteboards impacted the students' educational learning (Smith, Higgins, Wall, & Miller). This study

also investigated the effectiveness of SMARTBoards, a type of Interactive Whiteboard, but utilized quantitative measures.

Two connected categories regarding the interactive whiteboard are its use as a tool for teaching and a tool for learning. Researchers from the Association for ICT in Education (2001) completed a study in nursery schools in Birmingham, England and discovered that students who would not choose to do things on the computer would choose the interactive whiteboard. Students at this young age used an interactive whiteboard easily since it does not require the same fine-motor skills used to operate a computer with a mouse. In younger students, the use of the interactive whiteboard helped improve handwriting skills on paper (ACITT, 2001). A study in mathematics (school years 5 and 6 or ages 9 through 11) discovered many positives for the interactive whiteboard, "real-time movement such as rotation alongside visual cues such as highlighting, supported the teaching of fractions, measurement of angles, and a variety of transformations such as translation and tessellation" (Smith, Higgins, Wall, & Miller, 2005, p. 91). Interactive whiteboards represent an efficient way to present lessons to students. Developing a lesson may originally be time consuming; however, the teacher is able to use the developed lessons in future instruction.

An advantage to teaching with the interactive whiteboard is teacher proximity and face time with students. Teachers are able to face their students for the majority of the lesson, as opposed to facing the board to write. Teachers, as well as students are able to do everything at the board; the computer remains unused during the actual lesson. Teachers are not restricted to one location, are not in the way of students' views of the

board, and are able to include visual presentations attached to their objectives (Smith, Higgins, Wall, & Miller, 2005).

Purpose of Study

Teachers should constantly strive to improve instruction and seek ways to teach students critical and creative thinking skills. The added use of technology such as an interactive whiteboard assists students in the learning process. Students will be actively engaged in the learning process when they utilize the interactive whiteboard themselves, as well as when the teacher provides them with extra visualizations. Teachers are able to provide short video clips as well as still pictures to assist with lessons. Teachers can use video clips from websites, such as TeacherTube, to enhance lessons. They are able to download still pictures and mark on them to point out various geometrical terms and more.

In the field of mathematics, teachers are able to provide graphs for students to see. Teachers can produce multiple graphs in multiple colors in an easy-to-see visual for all students in the class. The multiple colors feature is a technology that earlier Texas Instrument calculator programs could not accomplish. In the primary investigator's middle school mathematics classroom, students engaged in online mathematics computer games, such as those found on Study Island, when they reviewed their Missouri grade level expectations to prepare for the state assessment in April 2009. In a computer lab, this would be an individual activity; however, with the interactive whiteboard, the teacher can involve the entire class in the activity.

These are only a few examples of technology integration in one specific classroom. Teachers need to learn about the new technologies available for classroom

use. Professional development should focus on the following topics: technology availability for to teachers, assistance in grant writing to obtain other resources, the National Educational Technology Standards (NETS) for students and teachers, and strategies to implement such standards into their classrooms. School districts should provide professional development so that teachers will then have strategies to apply technology in the classroom. Many teachers desire to know how to do something before they will use it in their classroom (Trim, 2009).

Teachers strive to improve strategies for teaching students. The added use of SMARTBoard technology in mathematics instruction may benefit today's Digital Native students. This study has a three-fold purpose: to determine the level of technology use among students and teachers, to describe a unique and innovative use of SMARTBoard technology in math instruction, and to determine if the unique and innovative use of SMARTBoard technology will affect student mathematics achievement.

Research Questions

This study will address the following research questions:

- What current technology tools do seventh grade students in one Missouri school district have available to them at home?
- What technology tools are Missouri teachers using in their classrooms?
- What technology tools are students using at home in comparison to those teachers are using in their classrooms?
- What are the innovative SMARTBoard technology mathematic instruction strategies developed by the primary investigator of this study?

- How will the use of innovative SMARTBoard technology affect student mathematics achievement?
- Does use of the SMARTBoard in a mathematics classroom increase students' learning according to the grade level expectations of the Missouri Assessment Program?

This researcher believes that the rationale for this study lies with the reality that educators may not be meeting the needs of Digital Natives who seem to expect technology to continue as a significant part of their everyday lives.

Variables and Hypotheses

The independent variable is the use of SMARTBoard interactive whiteboard teaching strategies applied daily for one complete school year in one middle school math classroom.

The dependent variables are the student MAP scores in mathematics and scores on a teacher created pre-test (aligned with Missouri Grade Level Expectations) administered on the second day of school, August 15, 2008. The post-test was administered to students at the end of the school year. Item analysis of every problem for each student was performed to determine student improvement during the 2008-2009 school year.

Alternate Hypothesis 1: The implementation of SMARTBoard strategies in seventh grade math will significantly affect student achievement as evidenced by higher average MAP scores for those students as compared with the average MAP scores for students who were taught seventh grade math in the same building using the same curriculum without the SMARTBoard strategies.

Alternate Hypothesis 2: Students in the seventh grade mathematics class who were taught using SMARTBoard strategies will evidence a measureable increase in their post-test scores compared to their pre-test scores. The pre-test and post-test were both created by the combined efforts of all the seventh grade mathematics teachers in the district.

Alternate Hypothesis 3: The proportion of teachers surveyed about technology usage in their classroom who said yes to utilization of specific technologies will be different from the proportion of students who said yes in a student survey to owning these same electronic devices (iPods/MP3 players, Cell Phones, and Video Game Systems).

Alternate Hypothesis 4: The proportion of students who scored proficient or advanced on the MAP test for Mrs. Technology will be different from the proportion of students who scored proficient or advanced for Mr. Dry Erase.

Alternate Hypothesis 5: The proportion of students who scored proficient or advanced on the MAP test for Mrs. Technology will be different from the proportion of students who scored proficient or advanced for Mrs. Overhead.

Alternate Hypothesis 6: The proportion of students who scored basic or below basic on the MAP test for Mrs. Technology will be different from the proportion of students who scored basic or below basic for Mr. Dry Erase.

Alternate Hypothesis 7: The proportion of students who scored basic or below basic on the MAP test for Mrs. Technology will be different from the proportion of students who scored basic or below basic for Mrs. Overhead.

Alternate Hypothesis 8: There is a direct relationship between the increase in student achievement indicated by scores on the pre-test and post-test and achievement on MAP indicated by students' raw scores.

Alternate Hypothesis 9: Students in the seventh grade math class who were taught using SMARTBoard strategies will evidence a measureable increase in frequency in correct responses when comparing questions from pre-test to post-test.

Limitations of Study

This section will appear in later chapters as it pertains to the specific components of the study. Technology is out of date the second it is created. Aspects of this study will be out of date when the dissertation is defended and published.

This dissertation was organized according to the components of this research. Chapter Two consists of the literature review. Chapters three through seven each cover a specific component of this research (Student Survey, Teacher Survey, Personal Interview, Diagnostic Test, and MAP data). Each component will include a data analysis section. Each of those chapters will include suggestions from the researcher's point of view for future studies, and include the importance of that component to education. Chapter Eight will provide the reader with a final summary of the research as a whole.

Summary

Today's students need technology to learn to their full potential. Twenty-first century students, who are Digital Natives, enjoy learning at a higher appreciation level when technology plays a role in the learning process, as seen in multiple studies (Morgan, 2008). Teachers should have technology available to assist them in their classroom and feel comfortable with the technology. School districts need to budget for new

technologies as well as the proper infrastructure upgrades. It is essential to have funding available to resolve the complications that will arise with technology integration.

Twenty-first century students will compete on a global scale, but educators must provide students with the skills required for them to compete. Steve Andrews, the manager of Intel U.S. Teach Program, stated,

> China, India, South Korea, and Japan have invested in making sure that their kids have access to the technology and the literacy skills that they see as a key to their economic future. But the U.S. has not given as much attention as the highest-performing countries around the world, which means our kids simply are not getting the opportunity to compete. (Manzo, 2009b, p.18)

It is essential for educators to consider the skills students must have to enhance the twenty-first century. Twenty-first century students live in a global society and must learn the needed skills to survive in that environment.

Educators think differently now during the Information Revolution. Twenty-first century students' first point of reference is to check information on the Internet, as opposed to looking in a book. Educators communicate differently now. Often it is easier to send an e-mail or a text message to someone, as opposed to speaking with that individual on the phone or meeting that individual in person. Using technology for communication allows the sender to get the information they need sent at a time convenient for the sender, and allows the receiver to read and return the information at a time that is convenient for the receiver (Collins & Halverson, 2009).

Anytime there is education reform or change, there will be those who oppose change. In 1815, one issue was changing from using slate and chalk, to students writing

on paper. Those who opposed the change wondered what students would do when they ran out of paper. People who resist change or reform in education do so for a variety of reasons; they no longer feel secure and actually feel threatened in their areas of security, they do not understand, someone is forcing them to change and their rebellious nature resists, or it is a change that makes sense in a specific culture but does not make sense in their culture (Cuban, 1986). Change and reform are needed in education, and technology will continue to play a role in that reform. Teachers need to be ready to embrace the new technologies; however, school districts must also see the need for and provide resources for effective professional development.

The researcher deemed this study necessary when she became aware of the small number of studies investigating the interactive whiteboard in any classroom, specifically in the mathematics classroom. This study investigated the teacher side through a survey to measure the amount of technological items they had available in their classroom. This study also took into account students' perspectives through a survey of electronic devices they possessed in their homes, as well as the time they spent using them. The study also examined scores from standardized as well as teacher-created tests administered during the school year.

This study was instituted due to the lack of research available on student learning through teacher use of interactive whiteboards. It compared the technology that students have available to them in their homes to the technology teachers have utilized in their classrooms. The main technological tool focused on in this research was the SMARTBoard, a specific brand of interactive whiteboard. Chapter Two will include the different research studies conducted on interactive whiteboards. Background information

on a variety of technology topics pertinent to this research is presented in the next chapter.

Chapter Two: Review of Literature

Students enjoy learning when lessons and presentations are new and different (Lewis, 2009). The traditional way of presenting a lesson, where all students sit quietly in their seats, is not ideal in today's classrooms. Students need to be active and have their brains engaged to learn and fully grasp concepts. When a teacher is utilizing an interactive educational website on an interactive whiteboard and seventh grade students are raisin their hands begging to play, excitement in learning is occurring. This enthusiastic, technology-infused style of learning could be occurring in every classroom, but it is not. Students are excited when games played in the classroom are a means of learning, and they are even more excited when technology is used. This is when learning is a natural outcome of student involvement. Heidi Hayes Jacobs stated in *Curriculum 21 essential education in a changing world*, "The concept of what a school is does not need reform – it needs new forms" (Jacobs, 2010, p. 9). Technology is ever-changing, so there is an element of newness to it at all times.

This chapter focused on the connection between technology and education. Questions studied were as follows: how is technology useful as a tool to enhance student learning, how has technology affected the teaching of mathematics, how did the interactive whiteboard evolve as an effective tool for teaching curriculum, and how can the use of the interactive whiteboard technology enable teachers to involve students in the process of learning mathematics? These questions were answered through the available research studies.

How is Technology Useful as a Tool to Enhance Student Learning?

Educational technology focuses on classrooms and the school environment. Educational technology has existed for many years, but within the last two decades it has grown at exponential rates. New technologies in the classroom created a need for a more educated and skilled workforce (Katz, 2008). Teachers must develop technology skills.

Educational technology continues to be a needed component in the classroom. The virtual education community concept is based on technology use in the classroom. Technology increases the number of tools that teachers have available to them. One of the major shifts resulting from technology is that the teacher has changed from the presenter of information to a facilitator for students. Teachers who use technology can help guide students along in their process of learning, not just present information to them. Technology creates an increase in communication among all associated with the school (Kent, 2008).

Technology makes communication quicker and more efficient through the use of e-mail. Teachers communicate with colleagues or principals more easily through e-mail. Because of e-mail, parents no longer have to wait for a teacher to return their phone call. Therefore, schedule conflicts are no longer an excuse for lack of communication. Technology, specifically the Internet, allows students to have digital pen pals anywhere in the world. Technology requires new skills for both teachers and students, though students are not primarily struggling with these new skills. Google, Wikipedia, and many websites and search engines have allowed students to gain information easily about anything they need to research for school (Kent, 2008).

The benefits of technology in the classroom often outweigh the costs of implementation. Time for the teacher to plan, assess, and work with students is one of the major benefits from technology. Technologies, especially the use of the interactive whiteboard, allow teachers to create more concise and focused lessons, as well as move forward and backward in their lessons with ease. Technology is almost limitless in what it can add to lessons. Teachers can use video clips, audio clips, interactive quizzes, and digital games to assist with lessons. They can use live video feeds from different places around the world. Because technology plays such a major role in their world, students are able to relate more to a teacher who uses technology in the classroom. Many students, or Digital Natives, would not know what to do if they were not able to use technology. Teachers are able to conduct quick reviews of entire lessons, as opposed to taking the time to rewrite the information on the board again the following day. With the use of the computer, the lesson is already there, so the teacher simply has to open up the document and review the information. Teachers can also send lessons via e-mail to the students or parents, if a student missed a class. Certain technology programs allow the teacher to provide instant feedback to the students (Kent, 2008).

Although educational technology is increasing at an exponential rate today, even in 1922 Thomas Edison believed the motion picture would change the U.S. educational system. Just like any other educational tool, the impact and effects of films in the classroom depended on how they were implemented. Students who have seen the events can gain a deeper understanding of what occurred. William Levenson, the director of the Cleveland public schools radio station, claimed in 1945 that radios would be the new

educational technology, even replacing the chalkboard (Oppenheimer, 2003). Educational tools continue to evolve.

Use of iPod in the Classroom

The days of carrying around a cassette player (Walkman™) or even a portable CD player are rapidly waning. Modern students are fully engaged in the iPod era (including MP3 and MP4 players). iPods have created a way to download music, podcasts, pictures, and video in an user-friendly and portable manner. The physical size is remarkable as is its versatility. They range in size from 2 by 4 inches to 1 by 3 inches. iPods were introduced in October 2001 with a 5 or 10 gigabyte (GB) capacity with the intention to use as a digital music player and external data storage. New iPods have capacities up to 160 GB capacity while being physically smaller. Initially, iPods were offered in one model, one color, and had a monochrome screen. Today, iPods have full color screens and the capability to show full-length movies. For the first two years, iPods could only connect to a Macintosh computer. However, in October 2003 Apple Inc. developed a Windows based version of iTunes allowing iPods to connect to Windows based computers (Cope, 2007).

With software from Apple Inc., teachers can create, organize, and distribute content and have it available via students' iPods. With iTunes, teachers can enhance audio by adding pictures and video; this addition helps the multi-learning style student achieve a greater depth of learning, meeting kinesthetic, auditory and visual learning needs. Students with visual or auditory impairments could greatly benefit from their lessons being on an iPod. For the student struggling to see the notes on the board, the teacher could type the notes and provide them in visual form with a larger font on the

iPod allowing the student to learn to their maximum potential. For the student with an auditory impairment, the lesson can be pre-recorded so the student is able to listen to it at the volume level he or she needs. These are some ways iPods allow teachers to individualize education for all students (Apple computers, 2007).

Many students who struggle with reading simply need more practice; audio books are another way to utilize the iPod in the classroom to develop reading skills. Students are able to listen and follow along in their book, creating a multi-dimensional learning activity. This provides struggling readers with the words pronounced correctly and fluently, as they are viewing the text. Any audio book purchased on CD or from the Internet can be downloaded into iTunes and synced to an iPod (Apple Inc., 2007).

Teachers can use iPods for their own organization in the classroom. Since the iPod is essentially a small computer, it can store documents and other files such as contact information and calendars, in addition to audio files. The iPod Touch can do much more due to the inclusion of Wi-Fi. The number of applications available for educational use become more every day. Students are able to study their multiplication facts, use digital flash cards for any math problems, and play games that have them practice their mathematics skills. There are programs available that can adapt the iPod to become a PDA, Personal Data Assistant (Cope, 2007).

The iPod is portable, giving students the ability to work through missed lessons later, visually and aurally. It provides extra assistance for students who may need it. The teacher can evaluate the student's language skills by using an iPod with a voice recorder. This is a strong method of evaluation, even stronger than the human ear would notice listening live to students. The teacher can listen to the recording to decipher any issues,

then save the file and use it again during the school year to track student progress. It is an easy way to share progress with the parents and students. One school found that special education students who needed text read aloud to them benefited from this system, allowing a paraprofessional to be used elsewhere (Apple Inc., 2007).

Podcasts are another way to get students learning a variety of subjects in new and different ways. Teachers can discover a wide variety of education related podcasts, ranging from curriculum presentations to professional development series where teachers share best practices. Students can learn foreign languages, tour museums, listen to current news, and more through podcasts (Apple Inc., 2007).

Students can not only watch podcasts but also create them using this technology. iPods enable students to make mobile presentations and share their creativity. Students can create presentations in Keynote or PowerPoint, and incorporate their photos, artwork, and other creative media. The newer iPods are able to be used as cameras or video cameras as well. By exporting the presentations in the QuickTime movie format, they are able to import it into iTunes and sync it to an iPod enabling other students to view the presentation via their iPod (Apple Inc., 2007). One device that can be added to the iPod is called a video headset. This device helps the user to view the screen as if they were viewing it on a large LCD screen TV. For students who might need the larger screen than the one on the iPod, this could be of great assistance (Cope, 2007).

Since many students are already well educated in the use of iPods, extensive lessons on their use may be optional. However, it may be useful for teachers to present lessons on how to use Garage Band and iTunes to utilize iPods. By setting up an administrator account, the teacher can ensure that a class set of iPods has the same

content. This ensures all students share the same iPhoto and iTunes libraries, which allows the teacher to check the content, clear out information and items no longer needed, and distribute new content. Multiple classes can use the same computer to sync their iPods but if different content is needed teachers would set up a separate account for each class. Using parental controls in iTunes, the teacher is able to limit what students are able to access (Apple Inc., 2007).

iPods provide a means to engage students in educational games. The availability of iPod games increased with the release of the iPod Touch. The iPod Touch includes a touch screen so the user is able to use it similar to how a teacher is able to use an interactive whiteboard. One example is the game iQuiz, a Trivial Pursuit style game with multiple-choice questions encompassing music, movies, and television. The game looks through the owner's music library and asks questions about it. Another option is the website quizmaker where teachers or students can create their own questions and sync them to their iPod (Poque, 2008).

Electronic Books

Electronic books (e-books) are a technology tool that will continue to grow (Barnett, 2002). iPods have the capability for the user to download a book and read it on the iPod screen. E-books were created as a replacement for the traditional textbook and were a part of the movement to change the learning process through technology. In 2008, because of technological innovations, California researched and then started an initiative to work with free online textbooks as a means to save money. Students have created and sold e-books. Open source digital textbooks are free; the material is shared easily with

teachers, and has a capability for easily adding information. One benefit of digital textbooks is the ability to be updated with current events (Platoni, 2009).

Students have a variety of devices for reading digital textbooks. Amazon created an e-book reader called the Kindle. Similar to the original iPod technology, the Kindle is monochrome and cost between $389 and $489 when first placed on the market, depending on the size chosen. The Kindle is limited to reading certain formats, thus only offers limited access to electronic books (Berndtson, 2009). If a student compared the price of a Kindle to a basic laptop, a student could purchase the laptop for less than the new Kindle DX, and the laptop offers many more uses (Roush, 2009); however, that is no longer the case in 2010. Students who prefer e-textbooks may already utilize websites like CourseSmart to get textbooks for half the cost of traditional books and can copy and paste parts of the book into a Word document during class for notes (Vaknin, 2009). Both Barnes and Noble and Borders have developed their own unique electronic book readers. Another electronic device that is able to perform more functions than the Kindle for digital textbooks is Apple's iPad. The iPad has a 9.7 inch touch screen, compared to the 3.5 inch touch screen on the iPod Touch. The iPod Touch has a 960-by-640-pixel resolution at 326 pixels per inch whereas the iPad has a 1024-by-768-pixel resolution at 132 pixels per inch (Apple Inc., 2011). One change that could occur with the use of the iPad or another tablet computer in the classroom with digital textbooks is a reduction in cost. Textbook companies could charge a rental or subscription fee that would be less than purchasing the books outright. In this case, when the rental fee expires, there is nothing to throw away or recycle (Reynolds, 2010). As of 2011, the iPad is a tool that costs as little as $500. This type of technology removes the need for students to carry a

book bag to school since all their textbooks can be on a Kindle, iPad, or other e-book reader.

Cell Phones in the Classroom

Cell phones are learning tools in many countries. In Japan there is a number that, when dialed, provides a short English or Japanese lesson. Some companies have created language games for their workers to learn English more efficiently. In Massachusetts, anyone can use a cell phone to have a guided tour of a National Park. A group in the U.K. found success with students using cell phones for exams, having students' voice prints as proof that it was truly the student taking the exam (Prensky, 2006). An English professor at Bay College in Michigan used the free online software program, Broadtexter, to send reminders to his students about their assignments. His philosophy was not to fight the students and the cell phones, but to find a way to use it for education (Parry, 2010).

Many teachers fear the idea of utilizing cell phone technology in the classroom because of what they assume students will do. Many students have cell phones, and know how to use them beyond making calls; it is imperative to find an educational use. College professors have discovered ways of implementing cell phones in their classes. One professor gave an open cell phone test, allowing students to use their cell phone. The professor discovered that providing students with multiple options to answer the questions allowed the professor to assign questions that were more difficult. Many phones with a GPS device are used by professors for directing students to go to certain coordinates to find information (Greifner, 2007). The website Poll Everywhere created a way for teachers to use cell phones as clickers in the classroom, and students can see real-time graphs of the answers.

Cell phones with a camera built in provide other educational opportunities. A teacher can take pictures of the dry erase board or chalkboard at the end of the day in order to document the lesson. Students can use the camera feature to take pictures of the teacher's documents to have an easy way to study the information at home. Teachers or students can take pictures of a reminder list and e-mail themselves the pictures of the information they need to remember. Additionally, the camera feature allows a teacher to document an incident that occurred in the classroom. For a science class or geometry lesson, students can utilize the camera feature of the phone to take pictures of nature (Edu Techie, 2007). Many adults use the texting and calendar features as a way to create reminders for when they need to do something. Students can use those same features to remind them of their assignments.

Video Games

Learning comes in all forms, even non-traditional forms. Some have viewed video games as mindless entertainment and not applicable to education. However, many educators are embracing the technologies that so many students already have at their fingertips. Nintendo has taken video games to a new learning level. Games like *Brain Age* and *Big Brain Academy*, played on the Nintendo Wii or Nintendo DS, engage the brain in ways the original style of video games never attempted. Many of these games will track the progress of the player; some even have a learning web to show brain strengths and weaknesses. Video games make learning fun and entertaining while gaining problem solving and critical thinking skills (Prensky, 2006).

In Japan, teachers utilize class sets of handheld Nintendo game systems (DS, DS lite, or DSi) with their students. The teacher is able to communicate in real time with the

students via the teacher's computer and Wi-Fi. Each student can send answers individually to the teacher, which allows the teacher to give feedback to students individually in real time. The teacher can assist students before they get behind. They are also able to chart their students' progress (Dillow, 2009). The system can hold 50 units, and because it is local, access to the Internet is not required. Students are able to take multiple choice or short answer tests, and the computer program will score and graph the scores for the teacher (Gantayat, 2009).

The Nintendo Wii has also been used in the classroom. One English as a second language (ESL) teacher used it as an end of the year reward. The teacher heard her students discuss, in English, how manipulating their wrist when using the controller gave them more success in the games. To a teacher who teaches the average eighth grader this would not be anything out of the ordinary; however, for students who are learning English this vocabulary is more complex. It takes complex words in the English language to describe the movement in the wrist while playing the Wii games (Horne, 2007).

With money donated by parents, a first grade teacher in Indiana purchased three Nintendo Wii consoles to use in his classroom. He used some Wii games and their online channels. He was able to utilize the Wii for lessons on weather and geography. He used the sports games for real life math activities. As the facilitator for his students, he used constant questions so all students were engaged. A kindergarten student, considered a reluctant student who stated he did not enjoy learning if work was involved, changed his attitude when the Wii was introduced into the classroom (Weir, 2008).

Prensky (2006) understood the value and benefit that video games can provide for children. He supports that video games actual help children and teach them how to

succeed in the 21st century. Video games provide children with problem solving and critical thinking skills. The complaint from many parents is their children spend too much time playing video games. The complaint from the teachers' perspective is that the students do not complete their homework, because they spend so much time playing video games. Children get frustrated because they have to deal with the adults in their lives telling them to spend more time studying. The question, are all books good for children to read, can be restated for video games; are they all bad? This is another instance where application of available technology will determine if it is useful for learning. Both literature and video games should be evaluated (Prensky).

Dr. James Rosser from Beth Israel Hospital claims the hand-eye coordination he uses in surgery is the same hand-eye coordination used in playing video games. Dr. Rosser, who is in charge of laparoscopic surgery training at his New York City hospital, found that doctors who played video games earlier in their lives, made nearly forty percent less mistakes in surgery than those who had not. He actually has his doctors warm up for surgery by playing video games for 30 minutes (Prensky, 2006). While there are other ways to improve hand-eye coordination skills, use of video games has support from this study.

The National Institutes of Health performed studies on children with asthma and diabetes. They gave children with diabetes a video game to play that taught them how to take care of their sickness. Other diabetic children played entertainment video games that had no learning connection to their diabetes. All children had the same access to the literature explaining their disease. At the end of the study the children who played the

video game that taught them skills to take care of their diabetes learned more and had less visits to the doctor, than those who did not play the diabetes video game (Prensky, 2006).

Video games can be a strategy to connect with the current generation, to get them interested in job opportunities. The United States Army created a video game to interest the current generation as well as educate those interested in the United States Army as a possible career (US ARMY, 2004-2009). Additionally, the United States Army uses flight simulators prior to flying a real aircraft. This provides the soldiers training in an environment that will not hinder equipment or hurt people (Smith, M.K., 2009).

Even though many studies demonstrate that playing video games is an effective way to learn, educators still resist. If educators understood that video games could be a resourceful tool for learning, parents could also be enlightened. One of the main reasons why parents and educators think poorly of video games is that they do not understand their complexity. Current video games are more complex, requiring many more hours to complete. There are numerous educational video games that do not have students shooting people, stealing cars, or conducting immoral or illegal activities. When asked why they continue to play, children's responses had to do with the challenge of the game and the knowledge that they were getting better. While children enjoy the graphics, it is the complexity of the game that keeps them playing. They experience true success when they complete a game. Many times children will return under a new character just to see if they can complete the game a second time (Prensky, 2006).

Online Schools and Classes

E-learning, or online courses, was originally created for advanced students because it was assumed that these students would have the personal drive and

organization to be successful with this style of learning. However, online courses can be successful with all types of students, including students with special needs. Parents and teachers must be aware that students submerged in virtual learning can miss the traditional social interaction with their peers. Online students still engage in social interaction, just in a different manner. Students must have the communication skills to explain what they are thinking through written text such as chatting, discussion boards, and blogs (Davis, 2009a).

Missouri implemented its first virtual school in the 2007 to 2008 school year. The state received positive marks, from both students and parents, on a survey that discussed the quality of the courses offered and the successes of students in the programs. Virtual courses were aligned with state and national standards; secondary education courses were considered by students to be challenging. The majority of the instructors did not have prior online teaching experience, but they were rated highly on the survey when it came to the assistance they offered as well as the feedback provided on questions. Elementary students enroll in the Missouri virtual school for their complete educational experience, whereas high school students only enroll in individual courses and remain in their local high school as students (Virtual School gets good marks, 2009).

Table 2

Statistical Information about the Missouri Virtual School

School Year	# of students in program	# of different semester courses	% of High School vs. Eementary	Ethnicities	Students with Special Needs
2007 - 2008	13,000	125	88% High School, 12% Elementary	80% Caucasian, 20% minority	8%

Note: Adapted from Missouri Department of Elementary and Secondary Education News Releases. Retrieved April 19 2009, from http://www.dese.mo.gov/news/2009/movipreport.htm

The eMints program organizes and runs the Missouri Virtual Instruction Program (MoVIP), which for the state of Missouri is located at the University of Missouri. These students take the standardized tests, or MAP, just like other students in the state of Missouri. The 2007 to 2008 statistics revealed that the MoVIP students' MAP scores did not differ statistically from the state averages. One of the challenges is keeping students in the virtual courses since it does not cost parents any money; therefore, many students drop out when they find the course too difficult. Many students and parents thought that virtual courses would be easier than the traditional courses (Missouri Department of Elementary and Secondary Education News Releases, 2009).

School districts across the country either have run virtual classes or have explored them as an option to meet students' needs. School district superintendents in Massachusetts met together to discuss online courses and how they could help with budget needs. Maryland offers Advanced Placement courses with online options and has found it to be cost effective, especially as a means to give students access to the higher-level courses in districts that do not have the funds to offer them (Ash, 2009a).

About 40 percent of high schools do not offer AP courses, so students who are on an accelerated college path find virtual courses a beneficial option. Virtual courses are a way to help schools that do not have the faculty, the knowledge base, or funding to offer advanced courses. Students can either take the courses via their computer at home or at school in a computer lab during their normal class schedule. Advanced Placement courses are taken seriously by most students due to the high expectations in those courses. The companies that offer these courses ensure they hire qualified individuals to

teach these courses. The students taking these courses as part of their schedule will need a coach or mentor on-site that has knowledge of online learning concepts (Davis, 2009a).

Poor online programming is a reality. In some situations, poor programs have statistical data that make them appear successful. One reason for students' success could be because the program was poorly designed, making it easier for students to do well. One of the main issues that hinders e-learning is the lack of proper training for teachers to be effective online educators. Different skills are required to be a good online educator. Traditional classroom teachers require solid presenting skills; however, online teachers must have solid written communication skills. Online educators do not always have the ability to explain the directions in person, so they must consider how to describe objectives to the students. "My online students tell me that I know more about them than any of their classroom teachers, but I've never even seen them" (Davis, 2009a, pp. 14-15). This quote is from a teacher who taught online courses in the areas of macro- and microeconomics. The concern is how can schools utilize online learning and not lose the positives that exist in the current education system (Davis, 2009a).

Higher education provides a variety of online learning options. It is a way to enroll more students in courses when universities and colleges do not have the additional classroom space. Online learning is an option for students who desire to obtain a higher degree, but whose work schedules conflict with a traditional class schedule or live far from a college campus. Online education at the college level is opening up doors for many people to obtain degrees and certifications they would not have been able to obtain in a traditional attendance environment (Ash, 2009b).

Online learning can be more affordable for large numbers of teachers to receive training without being in a classroom. Many web conferences are becoming available for teachers to learn new and current teaching strategies. This can also be a way for smaller districts to provide specific professional development needs without bearing the huge costs involved with traveling to a conference (Sawchuk, 2009).

"Research shows that virtual schooling can be as good as, or better than, classes taught in person in brick-and-mortar schools" (Viadero, 2009, p. 9). This statement originated within a variety of the research published in 2001 and 2004. However, such a statement based on only two years of research may not be valid. Online learning and virtual classes allow students who are much younger to take an advanced course they are ready for without the fear of ridicule. The opposite scenario is also true. Many students do not learn best in a pure auditory learning environment due to all the distractions. It is possible some students who are not successful in the traditional setting will succeed in the online learning environment simply because of a learning style (Viadero, 2009).

Social Networking

Facebook and MySpace are controversial in the education world for many reasons. "Digital social networks are now an essential part of the experience of everyone under the age of 20" (Jacobs, 2010, p. 85). While social networking has positive aspects, several well-publicized negative incidents may have clouded public perception. A common complaint is how much time students spend on either one of these networks. There are studies regarding Facebook and the amount of time students spend on the site, which hypothesized that lower grades are related to the amount of time spent on Facebook. One study found that there is a weak connection, but other studies, with larger

sample sizes, found there was no significant correlation (Marklein, 2009). The studies on the academic effects of social networking on students are limited at this time.

There are many positive uses for Facebook, such as the teacher technology survey conducted in this research. Other positive uses of these networks include the ability to communicate lesson plan ideas among teachers from many states. Facebook includes a University connection, which is another way higher education attempts to connect with Digital Native students. Professors have used Facebook to provide additional educational connections with their students.

> Since its launch in 2003, the popular online social networking community Facebook has grown to 200 million users worldwide. But even more impressive statistics reveal that this community has more than 24 million photos uploaded daily, and more than 6 million active user groups interact on the site. Many of these user groups are related to educational activities and formal learning institutions. (Jacobs, 2010, p. 86)

Technology in Schools

Technology alone cannot increase student learning. It is how the technology is implemented into the curriculum that causes changes in how students learn. Historically and even today, some maintain that money spent on technology is wasted. When money is spent for technology, assistance must be available when problems arise. A school district must also take into account the professional development that must be included to make technology a successful venture. Inappropriate uses of technology can affect student learning in a negative manner (Berkowitz, 1999).

Many schools and some states require students to take a keyboarding computer course, but this may not achieve computer literacy. Computer literacy has many definitions. To a computer programmer, computer literacy means that students understand and can create programs. To a computer instructor, computer literacy may mean that students are able to work with software like spreadsheets and word processing. Computer literacy may mean being able to troubleshoot problems. For many schools, computer literacy means gaining a passing grade in the required computer course (Cuban, 2001).

Another issue school districts must address is the area of funding for technology as well as choosing and supporting educational leaders in this specific area. According to *Education Week,* which retrieved the statistics from the National Center for Education Statistics, 58% of U.S. school districts maintained that funding for educational technology was not the amount it needed to be. Eighty-three percent said that teachers were interested in using technology in their lessons. Only half of the districts surveyed had someone in the district who was an educational technology leader, 32% had someone in that position part time, and 17% percent did not have anyone in that position. This survey was based on information from fall 2008 obtained from questionnaires. Ninety percent or 1440 of the 1600 public school districts responded (Ash, 2010).

According to a study conducted by the Richard W. Riley College of Education and Leadership at Walden University, published in June 2010, there are five myths in connection with educators, technology, and 21st century skills. They surveyed 783 classroom teachers and 274 building administrators. The findings from this study demonstrated that professional development may include the skills to operate new

equipment but not the strategies on how to integrate it into the curriculum for effective instruction (Walden University, 2010).

A myth exists that new teachers and those with greater access to technology are more likely to use it in their classroom. However, veteran teachers are just as likely to use technology and greater access to technology does not always equate to technology use in the classroom. Another myth proposed that teachers are prepared from their pre-service teacher training to integrate effectively technology into their classroom learning and to cultivate 21st century skills. Most teachers surveyed indicated that their pre-service training did not prepare them either with 21st century skills. (Walden University, 2010).

Survey results also challenged the myth that only those students who were high achievers benefited from the use of technology in the classroom. Respondents believed that all students benefited from technology used in the classrooms, including students with academic needs and English language learners. Another myth is that since students are so comfortable with technology it is not as important to their learning. The teachers surveyed found this to be false. Those teachers who taught with technology saw higher levels of learning and engagement in their students' learning due to the high comfort level of the students with technology (Walden University, 2010).

The idea that teachers and administrators have the same understanding about technology use in the classroom and 21st century skills is another myth. Administrators think that teachers use technology in their classrooms to assist with student learning more than teachers actually report they use it. This is a clear disconnect between teachers and administrators (Walden University, 2010).

How has Technology Affected the Teaching of Mathematics?

The NCTM (National Council of Teachers of Mathematics) takes the position that technology is an essential to for learning mathematics and that schools need to ensure that all students have the technology in their classrooms. Some of the many technology ideas a teacher can implement in their classroom are wikis, mathcasts, and the use of the Texas Instruments (TI) graphing calculators as student response systems (Besnoy & Clarke, 2010).

The use of a personal calculator in mathematics classrooms has been hotly debated for decades. Mathematics teachers have taken at least two different positions on the use of calculators in the classroom. One position is to promote the use of calculators; another is to de-emphasize calculator usage because of a belief that they interfere with student understanding of mathematics processes. The personal calculator entered the classroom in the mid 1970's but only allowed students to perform four functions (multiplication, division, addition, and subtraction). In 2010, it is affordable for any student to own a calculator, especially a four function instrument, since they are generally inexpensive (Besnoy & Clarke, 2010).

According to an article found on the website TwinCities, students in a local elementary school in St. Paul, MN were using iPod Touches in their classroom to study their math facts and vocabulary. They were much more excited to be learning in this manner than using the typical worksheet. Now teachers can purchase an iPod Touch lab for a classroom, which consists of storage and charging cart on wheels with dozens of units, as well as a laptop for use in downloading different applications for their classroom

use. The iPod Touch is not a replacement for a laptop, rather it is a technological tool that when used correctly, can be an educational tool for learning (Ojeda-Zapata, 2010).

Mathematics curriculums are including more about hands on projects to present the information. Digital cameras are being utilized in some of these mathematics school projects. Students have the capability to take pictures, download them onto a computer, use software to edit them, and then print them out as part of their project. A project idea is for mathematics students to create a geometric environment scrapbook. Students take pictures of geometric shapes they see in nature and the world around them and create a scrapbook. An idea for an elementary class project is in leaf classification. Students take pictures of leaves outside, download them on the computer, and classify them. If they find a leaf they are unfamiliar with, they can use the Internet to research and classify it. As a cross category lesson, the students can then identify the geometric shapes they discovered on the leaves (Carter, Sumrall, & Curry, 2006).

The same mathematics curriculums that are utilizing hands on projects, also are incorporating real life applications for the students. Cell phone plans can be a financial project every student could complete. Even if students do not personally own a cell phone, or come from a technologically savvy family with the resources at home, they could still complete this project by researching cell phone plans. Students could study and research multiple cell phone plans and determine which one provides the user with the best deal. Students could also look at their own individual cell phone plan, or their family plan, and determine if they have the right plan for them or their family (Kolb, 2008).

Educators should not fear the idea of electronic games in the classroom as a means for learning, but the educator just like a parent, must be knowledgeable as to what

games or interactive learning programs they choose for their students. Games make learning fun and games have been in classrooms for years. A math board race is definitely a game. The game "around the world" with math flashcards is often played in school (Kent, 2008).

To What Extent has the SMARTBoard Evolved to be an Effective Tool for Teaching Curriculum?

Interactive whiteboards are one of the first instructional electronic devices designed for use by teachers in the classroom to assist with student learning. The first SMARTBoard was sold to university professors in 1991. The board itself is not what makes the difference in education; rather, the teachers who utilize the board to its capacity have enhanced the learning process for the students in the classroom. Teachers who understand the uses of the board can create engaging, interesting, and interactive lessons that can capture the attention and imagination of the students. Teachers who have only used the interactive board as a simple electronic dry erase board have not utilized the full capacity of the board. Due to the possibilities of the Internet, there are many websites devoted to the use of the interactive whiteboard in the classroom and providing teachers with ideas for lesson plans (Betcher & Lee, 2009).

The popularity of Web 2.0 has increased the popularity of the interactive whiteboard. Web 2.0 is a term used to describe the changes that have occurred on the Internet. Blogs, podcasts, wikis, and social networking are the main examples of Web 2.0. The main idea of Web 2.0 is the interactivity that is available among multiple people who use the Internet. Teachers can use these tools to provide out of classroom learning for students (Evans & Coyle, 2010).

The interactive whiteboard technology was first used in the UK in 1991, and in many ways is still a new piece of technology equipment for the education system. The challenge with any new piece of technology is discovering its applications. Technology has affected education and the classroom, but not how teachers have taught. The interactive whiteboard challenges teachers to move beyond the traditional presentation methods using a chalkboard or dry erase board and to discover new ways to present lessons in a more creative and interactive way. Since the interactive whiteboard is a computerized teaching board, it has taken a tool that teachers use daily and invented many more ways to utilize it for teaching. Screen size is a reason the interactive whiteboard is more of a teaching tool than a computer alone. The interactive whiteboard provides teachers with all the benefits of a computer, but with a large screen, enabling large groups to view the information (Betcher & Lee, 2009).

With every piece of technology, there is the possibility of teachers not using it to its full potential. “So, those teachers who still think of IWBs as nothing more than expensive projector screens are probably not using them correctly!” (Betcher & Lee, 2009, p. 8). This statement seems to indicate the lack of professional development for teachers in the use of interactive whiteboards. Without adequate training on the use of interactive whiteboards, it is more likely the interactive whiteboards will be used as glorified chalkboards or overheads (Betcher & Lee, 2009).

Another way the interactive whiteboard has separated itself from other technology items in the classroom is that it was created for teachers as a primary tool for teaching. Because of this, companies that make interactive whiteboards altered the boards specifically to teachers’ technology needs. The software is easy to obtain, accessible on

multiple computers without additional fees, and software updates are free. Companies created interactive whiteboards with the hope that teachers would use it in the classroom, so they were designed to be easy for teachers to use (Betcher & Lee, 2009).

A common type of interactive whiteboard used in classrooms is from the company SMART Technologies Inc. This company manufactured the SMARTBoard used in this research. The interactive whiteboard with its software turns the computer and projector into an interactive educational tool. The projector places the visuals on the board, which then becomes a large touch screen able to control the computer. The board comes with four pens and an eraser in the pen tray. The system is designed so when a pen removed from its slot, the system identifies its color. Therefore, whether the pen or a finger is used on the board that color appears. The eraser works similarly; the cursor becomes the eraser when the eraser is out of its slot (Ballard, 2002).

Another style of interactive whiteboard is the Webster LT Interactive Whiteboard from Polyvision Corporation. This board, if used with a wireless network, will send the information from the interactive whiteboard directly to the students' laptops. This helps students pay close attention to the lesson because they do not have to take notes. Students are able to save the notes on their laptop and study them at home. Students who are kinesthetic learners are able to add to the notes easily, as opposed to focusing on writing the original notes (Media and Methods, 2002).

Clicker response systems allow teachers to assess students instantly, using handheld response clickers, which works with all types of interactive whiteboards. The teacher creates an assessment and the students provide an answer with their individual clicker when the question is on the screen. Students have a time limit to answer a

question. After students answer, the software has the capability to record the grades and graph the percentages of all the answer choices. The iPod Touch and the TI graphing calculator have an application to give students this same ability. The website Poll Everywhere provided the same clicker ability with cell phones.

How Can the Use of SMARTBoard Technology Enable Teachers to Involve Students in the Process of Learning Mathematics?

Interactive whiteboards can be used in many different curricular strategies. In physics classes, students take pictures of experiments with a digital camera, download them on the computer, and view them as a class on the interactive whiteboard. The students are able to label important data points with the use of different colors. In mathematics courses, interactive websites combined with an interactive whiteboard allow students to have hands on learning that assists and enhances the lessons. In biology classes, students can work through dissection labs using interactive websites or watch video from a digital microscope of cell mitosis and other processes (Ziolkowski, 2004).

The technology in a math classroom becomes interactive with the use of the SMARTBoard technology. A teacher can use a spreadsheet program to compute formulas. With the use of the SMARTBoard, all students can view the information and many are able to participate. There are programs available on the SMARTBoard that function as a graphing calculator. These allow a teacher to provide students with a visual electronic generated graph that all can see (Frei, Gammill, & Irons, 2007).

How do Learning Styles and Multiple Intelligences Connect with Technology and Digital Natives?

The interactive whiteboard can assist Digital Natives by providing them the availability to engage with the interactivity of the whiteboard. Kinesthetic learners reach their maximum potential when they are able to move and manipulate items in learning situations. These students desire to know how things work and might take things apart to reach their goal. According to the book *Your Child's Strengths*, the research showed that half of the students ages twelve through eighteen are kinesthetic learners and struggle in a traditional setting (Fox, 2008).

According to Fox (2008) in *Your Child's Strengths*, 40% of students, ages twelve through eighteen are visual learners. They have the ability to visualize things in their head when they recount events and learning situations (Fox). The interactive whiteboard can assist these students by providing a variety of colors and movement on the board, thus creating a visual of the information presented that is much easier for the visual learner to remember.

Auditory learners only make up ten percent of the middle school and high school students, even though auditory instruction is the primary teaching method. These students learn by listening and learn to their maximum potential by sitting in a desk. They thrive when it comes to rhythm in conversation, especially poems and songs (Fox, 2008). Students who have allergies or frequent middle-ear infections and primarily learn this way can struggle because the sound is distorted to them (Vail, 1992; 2002).

Table 3

Five Types of Learners

Type	Similar to	Enjoy
Eyes	Visual Learner	Watch movies, using eyes to learn
Ears	Auditory Learner	Listening to radio or lectures, using ears to learn
Order	Sequential Learner	Crossword Puzzles, Completing forms, working through math problems, other activities that require order, these learners need to do things in a specific order to learn
Images	Global Learner	Make pictures or designs to remember information
Doing	Kinesthetic Learner	Being active in learning, Movement

Note. Adapted from *How to Study*. (Wood, 2000)

Technology can add to all learning styles. Visual learners traditionally prefer books, pictures, diagrams, and observation of others. Technology can enhance their learning by providing those students with websites about the information they are learning: videos, graphics, and blogs. Auditory learners traditionally prefer lectures, songs, stories, and reading aloud. Technology can enhance their learning with the use of podcasts, videos, live experts, and online discussion groups. Kinesthetic learners traditionally prefer hands on projects, building and experimenting. Technology can enhance their learning with the use of digital whiteboards, educational software and video games (Kent, 2008).

As cited in the website Thinkexist, Glasser said that people remember 10% of what is read, 20% of what is heard, 30% of what is seen, 50% of what is seen and heard, 70% of what is discussed, 80% of what is experienced, and 95% of what people teach (Thinkexist.com, 2010). Bruce Hyland developed and later revised the Cone of Learning from material by Edgar Dale in 1969 (Metiri Group, 2008). This has provided examples as to what each of the categories may look like. The facts are that more is remembered when the brain and body are active in learning, not passive. Participation and

involvement are needed in tasks of performance for true learning to occur, and technology makes that type of involvement easier (Hyland, 1969).

How is Technology Connected to the 21st Century?

The New Commission on the Skills of the American Workforce issued a challenge to the U.S. educational system in their December, 2006 publication. The challenge was to find a way to teach students creatively and innovatively to prepare them for the future. The next generation will face increasing challenges requiring students to become thinkers who can solve problems in effective ways (Fox, 2008). Technology can enhance all learning styles. For example, technology can enhance visual learning by providing websites, videos, graphics, and blogs containing information. Teachers at the middle and high school level should discover ways to implement the technology of mobile devices and social networks as a part of their curriculum, enabling students to see a positive educational use of these tools (Manzo K. K., 2009d).

Heidi Hayes Jacobs, in the book *Curriculum 21 Essential Education for a Changing World*, asked a question about what educators are actually doing to prepare students for the future. Is technology only used in the classroom as an event, or is it a part of the daily environment? She supports the idea that if educators prepare students for 1980, their lack of motivation will be the result (Jacobs, 2010). Yong Zhao, the founding director of the Center for Teaching and Learning based at Michigan State University, stated that "schools need to think about how to tap students' enthusiasm for technology used to access media and apply that to education" (Davis, 2010). He also felt that schools do not engage students, as media does. He felt that students might be bored, uninspired,

and confused because they live in a world that is so different than the school world (Davis).

According to an article in *Transforming Education Through Technology Journal* multiple experts in technology predicted five trends to continue and grow in 2010. Students would only need to carry a notebook and their ebook reader to and from school. Students might already have this dream, but educators might not want this change to occur so soon. As the technology with the e-book readers continues to increase in flexibility, there might come a time that students will only need an e-book reader, as opposed to their many heavy textbooks. Education is not there yet, but it is likely that schools will implement e-books (McCrea, 2009).

The decrease in costs of netbooks caused technology experts to claim netbooks are going to continue to play a role in education. Netbooks are a small laptop computer with the initial focus to use it only for internet purposes. With prices ranging as low as $200 to $300, these technology items have evolved into a piece of equipment that most students need for their education. This would make the Internet more accessible to students. The interactive whiteboard encourages engaged learners. The education system must be ready to accept these as a replacement for the chalkboard, overhead projector, or dry erase board for every classroom. Teachers who once resisted these pieces of technology, once trained, can see the positive uses for them. Technology experts support the idea that personal devices, such as smart phones and iPods have infiltrated the classroom. As these items become affordable in price and provide even more opportunities to assist learning, it would make sense to incorporate them into classrooms (McCrea, 2009).

Summary

The researcher deemed this study necessary as she became aware of the small number of research studies on interactive whiteboards. Research studies on technology are more abundant when showing comparisons of teacher opinions on technology equipment. There are many different technological tools available to both students and teachers to use, and some teachers have discovered strategies and techniques to use them effectively in the classroom.

Chapter Three is the first of several chapters that describe the methodology used in this study. As described in Chapter One, this dissertation is not organized like many others. Chapter Three will include the methodology, the results, and the future implications only regarding the student technological survey that was given to seventh grade students at Sun Valley Middle School in the 2008 to 2009 school year. Further chapters will also include the methodology, results, and future educational implications for other specific components of this dissertation.

Chapter Three: The Digital Natives

Research Overview

There was one overarching question for this individual component, technology student survey, of this study. What current technology tools do students have available to them at home? The study used both quantitative and qualitative research methods to lead to an understanding of what technology was available to students at home and teachers in the classroom.

The student survey was one component of this mixed methods study. The study employed a triangulation design, also known as QUAN-QUAL, because it consisted of qualitative and quantitative data collected simultaneously. In QUAN-QUAL, the researcher compares and connects the results of both types of data and can base further research on the findings. The QUAN-QUAL design was employed throughout this study. Triangulation is a process of comparing information by evaluating the information obtained from numerous sources in an attempt to draw the same conclusions from each individual evaluation (Springer, 2010).

Procedures

Students today have multiple technology items available to them in their homes. Two science teachers at Sun Valley Middle School developed in their seventh grade classrooms a short survey over electronic items that students had available to them in their homes. They chose common electronic items which were not typically viewed as educationally applicable in a classroom setting. They chose MP3/iPods, Cell Phones, Texting on Cell Phones, Computers, Internet, and Video Game Systems. This researcher did not participate in the development of the survey.

The two teachers developed the survey for an in-class project on graphs. This was an in-class assignment, so all students were required to participate. Two-hundred seventy-four of 400 participated from within the Sun Valley Middle School and the entire district. For reasons unknown to this researcher, one seventh grade science teacher out of three teachers did not participate in this study. The teachers utilized a Google docs spreadsheet form, which allowed both classrooms to enter data simultaneously. This survey took the entire school day; since each student in every section of seventh grade science was required to enter his or her own data. Students entered data on the teacher's computer in one classroom and on class laptops in the other since it was an eMINTS classroom. The data was projected in the front of the classroom on the SMARTBoard. As other students entered their data, both classes could immediately view it. The following day in class, students used the data gathered to find the averages and create different graphs.

Population

Two hundred seventy four students participated in this part of the study who were twelve to fourteen years of age, in the seventh grade, during the school year 2008-2009. Students who participated were both male and female, 99 % Caucasian, and classified in a middle to low socioeconomic range. They resided in rural and suburban communities. The majority of studies found on similar topics did not study middle school students; most either studied elementary or high school age students.

A survey conducted during the 2009-2010 fall semester at Penn State University determined the current technology use and ownership trends of those college students. More than 90% of Penn State students who responded to the survey owned a laptop

computer. They were not just using them for e-mail, social networking, and games; 75% of these students used them to do course assignments. This study found that 57% of the Penn State college students started reading and sending e-mail at the same ages as students included in the research conducted with seventh graders, between 11 and 14 years of age. Ninety-two percent of the Penn State students owned a cell phone and used this for collaborating on assignments. This study differentiated MP3 Player use by 18% of students and the use of iPods by 72% of students, which seems to have totaled 90% of Penn State respondents who use some form of digital media player. The survey did not take into account the chance that students could own both an iPod and MP3 Player. One of the most intriguing aspects of this study to the researcher was that seven percent of students responded stating that they had participated in a course that used instructional games (Nordstrom & Williams, 2009).

Protection of Human Subjects

The school principal and the executive director of secondary education provided initial permission to the researcher for this study. No individual names were used in the collection of data, and the names of the school and district were changed. Data from the entire group of students were disaggregated by specific questions. The students involved in this part of the study were all from Sun Valley Middle School. All students were required to complete the work as an assignment in the seventh grade science class; and the activity was part of their class grade. This phase of the study examined the class assignment as secondary data to demonstrate the available technology to the study participants at their homes.

Development of the Instruments

Two seventh grade science teachers at Sun Valley Middle School created the survey. One of the teachers was an eMINTS teacher, so technology played a major role in that teacher's classroom all school year. The survey was tested as part of a class project with the teachers' students. The students entered their data individually on the teacher computer, while it was simultaneously projected on the SMARTBoard for the other class of students. The students were able to take advantage of the Google Docs' spreadsheet form, which allowed multiple people to work on the same document at the same time. The instrument consisted of the following two open-ended questions:

Question 1: What type of electronic devices do you have at home? MP3 Player, Computer, Internet Access, Cell phone, Texting on phone, Video Game System

Question 2: How much time on average per day do you spend on each item? MP3 Player, Computer, Internet Access, Cell phone, Texting on phone, Video Game System

Data Collection and Analysis

The data were collected and organized in a Microsoft Excel spreadsheet. Students typed in their own answers either at the teacher computer or on one of the laptops from the EMINTs classroom.

Two hundred seventy-four students in the seventh grade during the school year 2008 to 2009 in the Sun Valley School District were surveyed on their possession of the technology items as shown in Table 4. Almost all students reported access to a computer and video games. Out of 269 seventh graders who were surveyed in the spring of 2009 and responded, 198 owned a cell phone (74%) and 249 had a computer in their house (93%). Of those 249 students who had a computer in their house, 232 had Internet access

in their home (86%). Five students chose not to respond to the questions. Students have technologies in their homes and utilize them for various purposes. Sun Valley County has a strong public library system with advanced technology, so students who may not have the computer technology available in their homes have access at the public library.

Question 2 was not evaluated due to the open-ended style of the question. The students answers to this question varied and some answers were number values that could not be accurate due to the time students are in school and unable to utilize these technology items. The researcher chose only to focus on the accurate numbers of representing the numbers of electronic devices in the possession of students who had technology items in their house, as opposed to the large variety of responses for the time each student spent actively using the items.

Table 4

Student Technology Use Survey Results

	MP3/iPod Player	*Computer*	*Internet Access*	*Cell phone*	*Texting*	*Video Games*
Yes	*227*	*249*	*232*	*198*	*164*	*245*
No	*35*	*13*	*32*	*64*	*100*	*20*
% of students (yes)	*83%*	*91%*	*85%*	*72%*	*60%*	*89%*

Limitations

The researcher worked in the same building as the teachers who developed the survey. The study was conducted with students on the researcher's team and one additional seventh grade team during the school year of 2008-2009; however, it was not conducted in the researcher's class. The study surveyed just two of the three seventh

grade teams in the same school and district, because the third seventh grade science teacher chose not to participate. Because student responses were entered in real time, and thus viewed immediately by all students in both classes, some students may not have responded with complete honesty. The researcher was aware that some school districts have students entering middle school at the sixth grade level. The students at Sun Valley School District did not enter middle school until the seventh grade so this was the first time these students attended the same school with all other students of the same age.

Research Questions

There were one research question specific to this chapter. What current technology tools do students have available to them at home? The results from this component of the study provided evidence that technology plays a major role in the lives of students today. Since the SMARTBoard is a piece of technology designed for student interaction, this electronic survey for students supported the importance of the use of this type of technology in the classroom. This part of the study also demonstrated the need for multiple technologies in the classroom, evidenced by student access to technology at home. As shown in the study Penn State University conducted in 2009 with its college students (Nordstrom & Williams, 2009); students were using these same technological tools to aid them in their coursework. These technological tools are utilized in higher education thus reinforcing the need for using technology tools in the primary and secondary levels to ensure that students succeed.

Implications

The results from this survey demonstrated that students, no matter their socioeconomic status, have current technology available to them in their homes. The

students involved in this survey were classified as belonging to middle or lower economic groups and residing in rural to small suburban areas. Even if the students did not have a computer or Internet access in their homes, students in the Sun Valley School District had an excellent public library system with multiple locations and advanced technology. Three hundred thirty-nine students out of the 1002 total, or 34% of seventh and eighth graders at Sun Valley Middle School, qualified for a free or reduced lunch (Missouri Department of Secondary and Elementary Education, 2009). Residents in this area could obtain DSL internet service for as low as $14.95 a month for a basic plan, and only $40 a month for the elite service (AT&T, 2010).

Recommendations for Other Studies

For future studies, the researcher recommends surveying more students at different grade levels. This study component focused on seventh grade because this is often the age parents deem children as responsible enough to own a cell phone. Also, this is the age where students begin attending after school sports practices or other extracurricular activities. These students can be left alone at home without a caregiver. The researcher would also like to complete additional surveys with those same students to see if the percentages increased as the students grew older; however, since student participants have anonymity that aspect is not possible. The researcher also recommends expansion of this study to other school districts, particularly those with more diverse populations.

Discussion

Students who are Digital Natives, those born after 1980, and especially those who are in iGeneration, those born after 1990, need more technology in the classrooms to

mirror what they use at home. These students need to see technology appropriately used in the classroom for educational reasons. These students need to be taught how to utilize the technology they have for educational purposes as opposed to just for entertainment. Some students already use technology academically, but most teachers and parents do not recognize it as a tool. Students need someone to teach them when it is appropriate to use these electronic devices and help them to understand that these devices are tools for the 21st century.

Although this survey focused on middle school students' perceptions, the findings were consistent with a 2009 survey of Penn State University students. Ninety percent of the college students who responded owned a laptop, and 92% owned a cell phone. E-mail and texting were the major form of communication among these students, as well as the method to collaborate with fellow students for coursework. At the university level, technology usage is an expectation for completing course work. Since technological tools are used at the higher education level, the primary and secondary levels also need to consider this to prepare the students for their future (Nordstrom & Williams, 2009).

Conclusion

It is essential that educators take advantage of technology available in the home and implement it use into the classroom. This survey was administered to students to verify that the use of electronic devices in the classroom is not an equality issue because many students have the technology access in their home; rather the issue lies with teacher and school districts that are not implementing technology into their classrooms. Educators should strive to teach students how to utilize the technology they have available daily in an educational manner.

Chapter four contains results from a statewide teacher technology survey. The results indicate the types of technological tools teachers are utilizing in classrooms. The teacher technology survey results were compared with the results from the student technological survey.

Chapter Four: The Digital Immigrants

Research Overview

The research questions analyzed by the researcher in this component, the technology teacher survey, of the study were:

- What technology tools are teachers in the state of Missouri using in their classrooms?
- What technology tools are students using at home in comparison to those teachers are using in their classrooms?

The mixed methods of this study led to an understanding of the availability of technology for students and teachers.

Digital Immigrants are those who were born before technology was a way of life. Prensky (2001) coined the terms Digital Native and Digital Immigrant; Digital Immigrants are those born before 1980. They learned to adapt to digital society, but they might learn the new technology at a slower rate. One major difference between a Digital Immigrant and a Digital Native is how each utilizes the Internet. Digital Natives typically seek the Internet first to answer a question, while Digital Immigrants typically utilize the Internet as an additional, not primary, resource (Prensky, 2001). This component of the study compared the responses of Digital Natives, seventh grade students, to teachers, who are primarily Digital Immigrants.

Background of the Researcher

The researcher has taught in the K-12 public education system for over eight years. She taught mathematics for seven years and seventh grade science for one year. She is passionate for current technologies utilized in the classroom that engage students

in the process of learning. She believes that all students can learn if teachers are willing to think outside of the teaching strategies currently utilized in classrooms. The world today is a digital one, where technology is prevalent in society. The researcher is hopeful that school district officials will continue to realize the importance of technology in the learning process, thus making possible the addition of available technology for use by all educators. Later components of this study will discuss strategies the researcher used in her mathematics classroom and the achievement of her students compared to those taught without the use of technology.

Procedures

The researcher developed the first three survey questions from her own experience working in public schools at the secondary level. She had an interest to discover which technology teachers utilized in this state. These questions asked the teachers which technological tools they used in their classroom, how they used them, and how often they used them. The technological tools verified by students as widely used were listed in the teacher survey for choices as well as more traditional classroom technologies. Phase 2 was developed with the additional question regarding the teachers' observations of student behavior when technology was utilized after the researcher met with her University professors. The survey questions are listed in the Instrument Alignment section of this chapter. Phase 3 consisted of additional questions developed from research and focused more on teachers and their professional development.

Limitations

The researcher created the instrument. Teacher participation was sought using a variety of methods, so the sample was one of convenience, based upon those who

responded voluntarily. Participation was voluntary and anonymous. Participants completing the survey were self-selected, so they may have had an interest in the topic. Participants varied in the grade level they taught. No school or school district had the entire teacher population surveyed. The survey did not require teachers to state the specific school or school district where they taught. Some of the phases of the survey were conducted online, so only those who were comfortable with that technology may have completed the survey. This was a self-report survey, so the data was dependent on the complete honesty and accuracy of the teacher.

Population

The survey was made available to teachers throughout the state of Missouri through a variety of methods. The researcher e-mailed the survey to fellow educators across Missouri with whom she already had some contact before this research. The researcher asked graduate students at the university she attended to give the survey to teachers they worked with in the local public schools. After presenting at a business teachers' conference, many of the teachers in attendance completed the survey using Google Docs. The teachers who participated in this component of the study varied in the grade level they taught, ranging from preschool or early childhood through high school.

Development of the Instruments

The researcher developed the questions for the survey. In the beginning of the study, the researcher piloted survey questions through e-mail with educational colleagues. Later, university professors reviewed the survey questions during its. During Phase 2, an additional question was added at the recommendation of one of the professors, to ask what the reaction was from the students when technology was utilized in the classroom.

This was a positive addition to the survey and provided the researcher with excellent feedback regarding students' reactions to technology use in the classroom.

Participants answered the following questions:

Questions: Grade Level and Subject Taught

Question 1: What type of technology do you use to assist learning in the classroom?

Overhead SMARTBoard Digital Cameras Calculators

Cell Phones iPods Computer/Laptops

Game Systems (Nintendo Wii, Nintendo DS, Xbox, Sony Playstation)

Other (Please List)

Question 2: How often are they used?

Daily Once Weekly Twice Weekly 3 Times Weekly

Monthly One project a year

Other (Please explain)

Question 3: How are they used? (Please list below)

Question 4: How did the students react when technology was used?

Questions 5: What kind of school do you work at?

Question 6: How many years have you taught?

Question 7: What is the college degree you hold? Certifications?

Question 8: Have you received any professional development specifically in the area of technology?

Data Collection

In Phase 1, the researcher e-mailed the surveys to colleagues. In Phase 2, graduate level university students in the education department distributed the surveys to local

public school teachers. Some students used the available technology of Facebook and e-mail to send the surveys to teachers. In Phase 3, the surveys were sent electronically utilizing a Google Docs spreadsheet form.

Descriptive Statistics

Table 5

Teacher Survey Results Separated by Grade Level

Symbol	Grade Level	Total Number Responded
E	Elementary	119
E/M/H	Elementary/Middle School/High School	4
HS	High School	44
MS	Middle School	36
M/H	Middle School / High School	10
EE	Early Childhood/Preschool	42
EE/E	Early Childhood/Elementary	4
U	Unknown	7

Table 5 illustrates the total responses the researcher received from the teacher survey, separated by level. The researcher added additional combinations due to how some teachers responded. Some teachers circled more than one grade level, so the researcher added categories such as Middle/High School, Elementary/Middle/High School, and Early Childhood/Elementary. Since the surveys were distributed to teachers in urban, suburban, and rural areas, teachers could be placed in a position to teach more than one grade level.

Table 6

Teacher Survey Results on Specific Technological Items in the Classroom

Grade Level	Overhead	SMART Board	Digital Camera	Calculator	Cell Phone	iPod	Computers	Game Systems
E	78	48	42	47	4	5	108	0
E/M/H	2	2	2	2	0	0	4	0
HS	21	19	21	21	6	3	38	0
MS	19	6	16	14	0	1	30	0
M/H	3	5	2	2	0	1	5	0
EE	8	1	30	6	2	0	34	5
EE/E	1	1	2	2	0	0	4	0
U	2	0	2	2	1	0	3	0

Table 6 represents the totals of teachers who responded that they used the technological items in their classrooms.

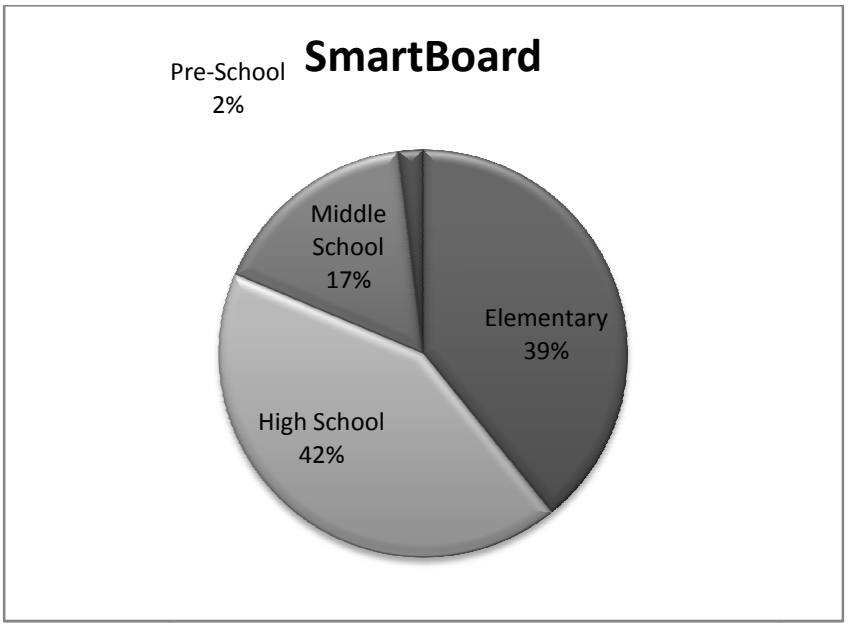

Figure 1. Teacher Survey Results Separated by Grade Level on SMARTBoards

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Figure 1 represents the percentages of teachers surveyed who responded that they use a SMARTBoard in their classroom. A total of 268 teachers responded, but the survey population was not evenly distributed across grade levels. As a result, percentages instead of the raw number of responses were used to visualize the data. As shown in table 6 and figure 1, high school and elementary teachers used the SMARTBoard more than middle school or preschool teachers.

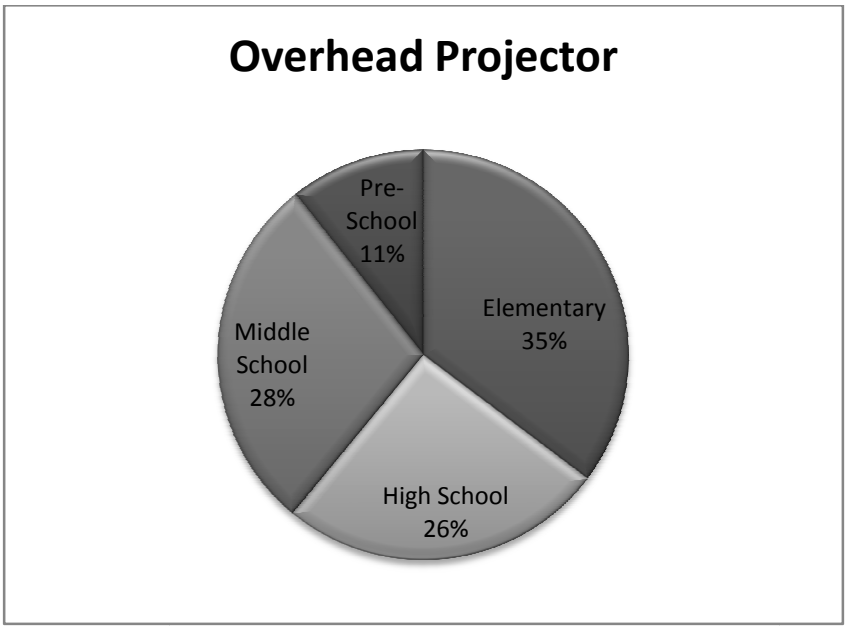

Figure 2. Teacher Survey Results Separated by Grade Level on Overhead Projectors

Figure 2 presents percentages by grade level of teachers surveyed who responded that they use an overhead projector in their classroom. As with the SMARTBoard data, the researcher calculated the percentage to provide a fair representation of the responses since they were not equally distributed across grade levels. Responses indicated preschool teachers used overhead projectors in creative ways where students used the light as a means of tracing, thus working on motor skills. Teachers representing other grade levels stated they used an overhead projector as a means for projecting information on the board for students to see. Even though this is an older piece of technology, it is still used by many teachers as the main source of projection equipment.

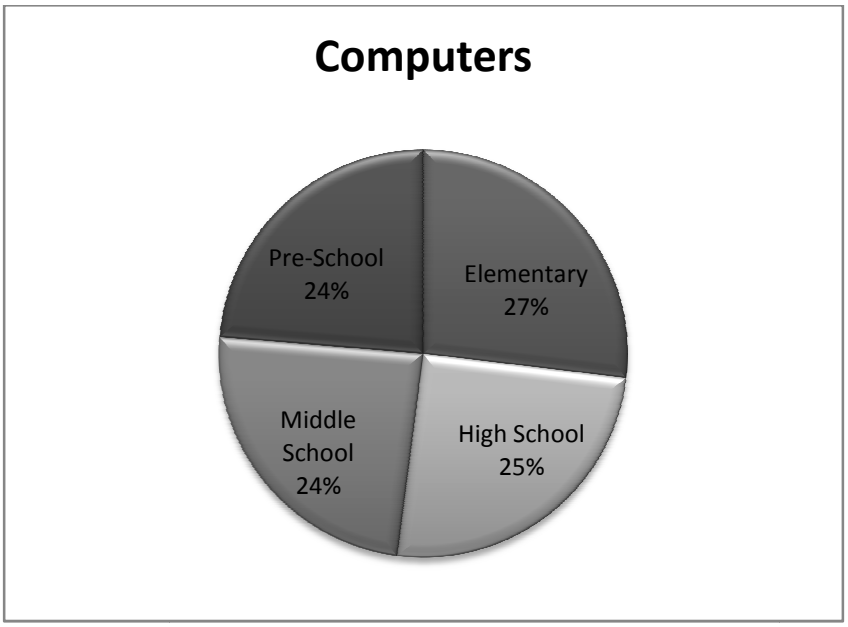

Figure 3. Teacher Survey Results Separated by Grade Level on Computers

As before, percentages of teachers in each grade level surveyed who said yes to the use of computers in their classroom instruction were used to analyze the data. All grade levels utilized computers in some way. Some classrooms had at least one or two computers for students to use as a means of extra practice on the topics covered in class. Preschool teachers used them primarily for educational games for students to play as an extracurricular recreational activity. Middle school and high school teachers both stated they used computers for the following: determining grades, preparing lesson plans, and e-mailing parents and colleagues. These teachers also stated they used computers with students for projects and reports.

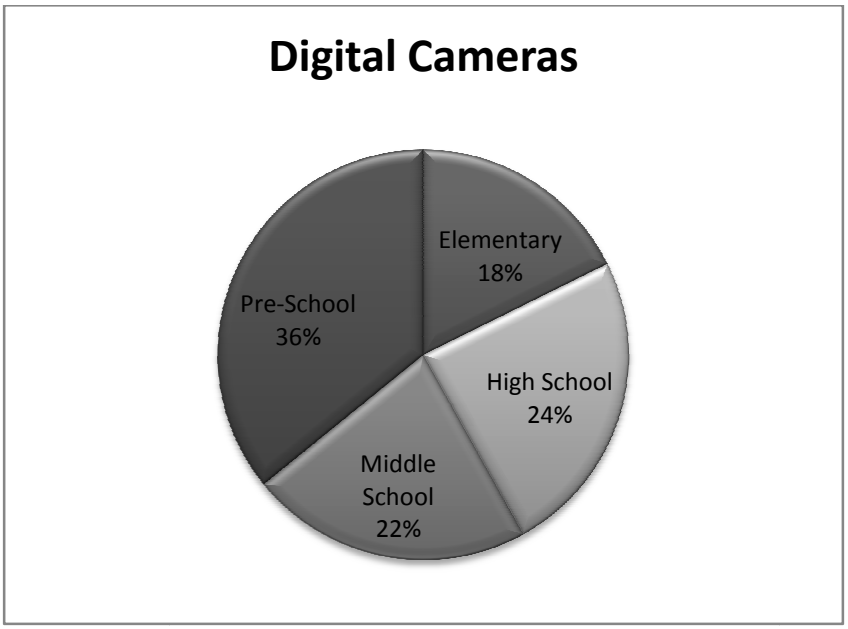

Figure 4. Teacher Survey Results Separated by Grade Level on Digital Cameras

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The researcher again compiled percentages of grade level responses in a visual format based on use of digital cameras in the classroom. Preschool teachers used the cameras extensively. They provided the following examples: pictures of students to share their growth during the year and pictures of students working on projects.

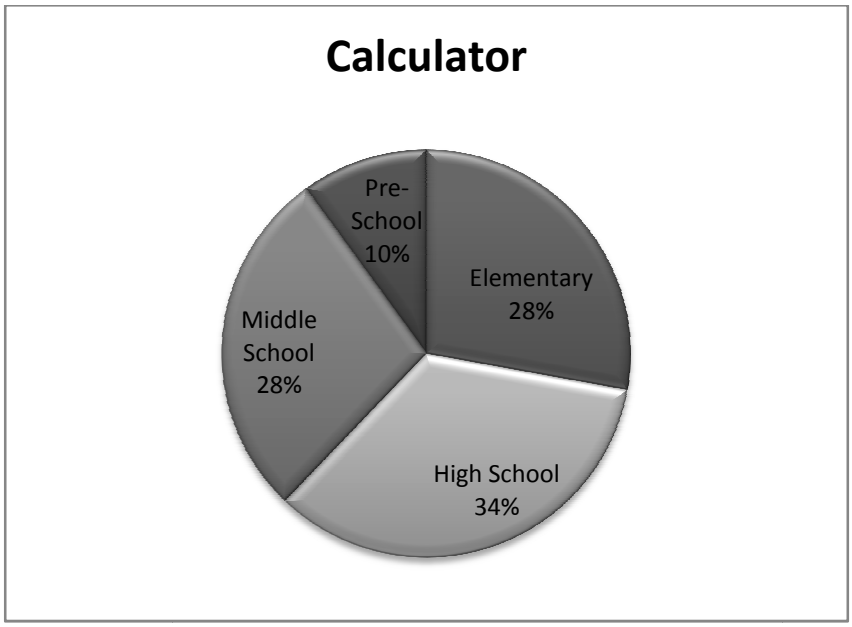

Figure 5. Teacher Survey Results Separated by Grade Level on Calculators

Percentages were again used to visualize the use of calculators in the classroom by grade level. Preschool teachers used calculators with students for number recognition. Other grade levels used calculators for typical mathematical purposes, such as arithmetic problem solving. The use of calculators in the mathematics classroom has been widely researched. In 1974, the National Council of Teachers of Mathematics (NCTM) took a bold stance by making a statement encouraging teachers to use calculators in their classrooms at all levels (Olson, Olson, & Schielack, 2002). NCTM specifically made the suggestion for primary grade students, preschool through second grade, to work with calculators (Carroll & Witherspoon, 2002).

Qualitative Survey Question Responses

One elementary teacher exclaimed on the survey, “The students love it! They are more focused and really like to take part and participate. I use my Promethean board (a specific type of interactive whiteboard) all day long.” Another elementary teacher stated, “Students enjoy the technology and get more out of class when it's used.” Many teachers made comments that students love technology and are more engaged. Another elementary teacher reported, “Response from students is usually positive. I find that presenting material visually clears up confusion and helps students grasp concepts more quickly.” Other teachers discovered that students focus better because it is more exciting than the chalkboard or dry erase board. Another elementary teacher responded, “The students enjoy using technology and are quick to learn new information, such as typing skills. The students are not intimidated at all, but rather eager to try new things and explore new areas on the computer.” Teachers stated that the students responded well to the technology, were more motivated to learn, and paid attention to the lesson when the interactive whiteboard was used, especially if they got to work at the board.

One teacher supported having a SMARTBoard in the classroom by stating, “They are enthusiastic and always want to participate. Even though I use the SMARTBoard every day, all day, they still act like it's a special treat.” An elementary teacher also noted a difference in students when using the SMARTBoard instead of traditional teaching methods and said, “The students get very excited! I can do the same lesson with the white board or orally and they act bored. However, if I put it on the SMARTBoard they are dying to participate.” Another elementary teacher stated that, “Students understand lessons more.”

Since time is always something teachers wish they had more of, this teacher said it best when commenting about the use of technology, “They LOVE the use of the projector. Due to power points and using all the resources on the Internet, I estimate I cover things 3x faster due to this technology. Every minute is used!!!” Some teachers found technology has positive effects on classroom behavior issues when transitioning between subjects, “They seem more engaged and it improves behavior because transition time is instantaneous (as opposed to using charts, posters, chalkboards, or sentence strips).”

Technology is not confined to the core content classroom; other classes can find a positive use for technology, “They love the use of technology. It’s a break from lecturing and books. The use of this technology in P.E. gives us a different way to model certain skills.” One teacher stated it best, “Students are engaged and seem to think they are playing. They are learning and playing together.” A high school business teacher stated, “My students enjoy using technology no matter what it is. I have found that they are more willing to learn the material and they retain the information much easier. I also feel that they work harder and put more time and effort into the project when they use technology.”

One issue teachers deal with is students not completing their homework or turning it in. This is where technology can be of assistance stated one teacher, “Students respond positively with technology. Fewer missing assignments, etc. because it is not a paper/pencil assignment (even when the paper/pencil was simply converted to an online assignment).” A high school English teacher who used cell phones with different ring

tones to introduce different literary terms stated, “Favorably most of the time, the only problems that ever arise are due to the lack of technology accessibility.”

Many educators argue against the educational value of video games. While many do not see the educational potential of video games, one teacher indicated that there are positive aspects with incorporating video games into the classroom, “They like it and are very good at it. They are very quick (maybe video games help their coordination). They sometimes surprise me with their findings!”

Digital Natives are students who need to be actively engaged to learn. One teacher supported that philosophy in relation to technology in the classroom: “The students enjoy using technology themselves and it strengthens their understanding. They respond better when they're ‘doing’ rather than watching someone else do.” A middle school math and science teacher agreed that students need to have their hands on technology while learning, “They respond best when they use it themselves. They enjoy it and respond better when we use technology.” A high school science teacher stated, “I feel my student’s level of interest in the subject matter is greatly increased through my use of technology.” A preschool teacher found the same result with student engagement: “Students tend to be more interested in the hands on approach. They become more engaged using the different technology. We, as teachers, get more participation from all students.”

Quantitative Statistics Results

Table 7

Student Survey versus Teacher Survey Results on Use of iPods or MP3 Players

iPods/MP3 Players	
274 Students Surveyed	268 Teachers Surveyed
227 Students Responded 83%	10 Teachers Responded 4%
	(5 Elementary, 3 High School, 2 Middle School)

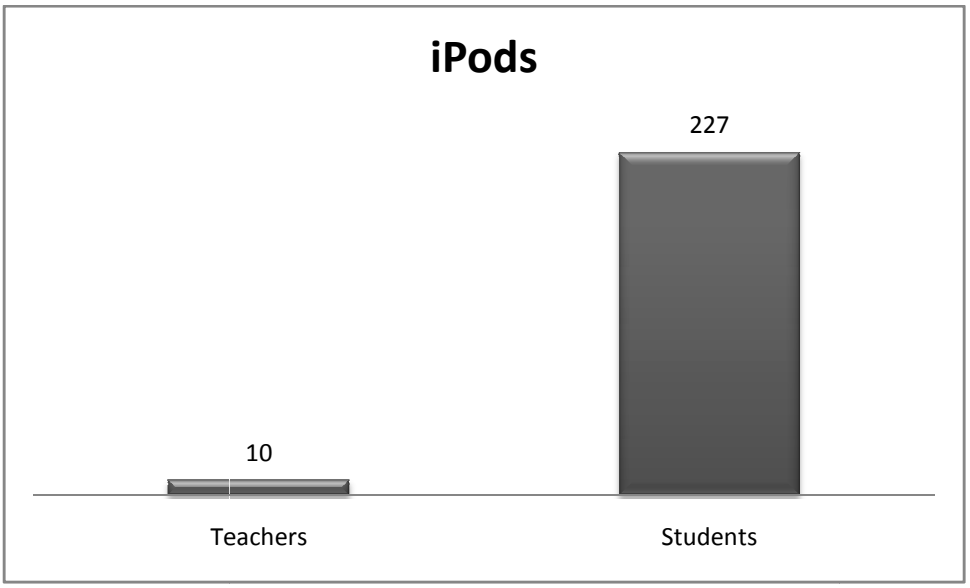

Figure 6. Teacher Survey Results versus Student Survey Results over iPods

Table 8

Student Survey versus Teacher Survey on Use of Cell Phones

Cell Phones	
274 Students Surveyed 198 Students Responded 72%	268 Teachers Surveyed 13 Teachers Responded 5% (6 High School, 4 Elementary, 2 Preschool, 1 Unknown)

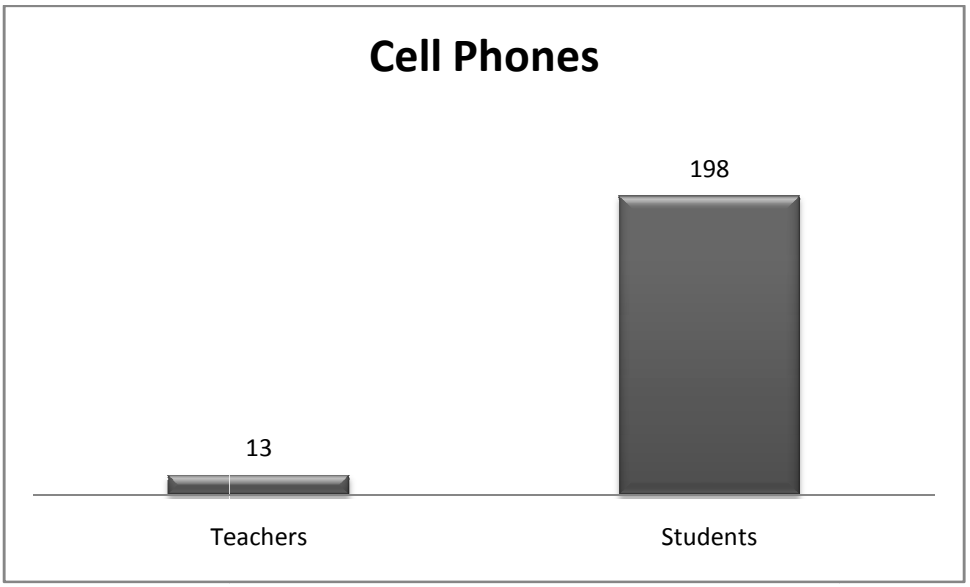

Figure 7. Teacher Survey Results versus Student Survey Results over Cell Phones

Table 9

Student Survey versus Teacher Survey on Use of Video Games

Video Games	
274 Students Surveyed	268 Teachers Surveyed
245 Students Responded 89%	5 Teachers Responded 2%
	(5 Preschool)

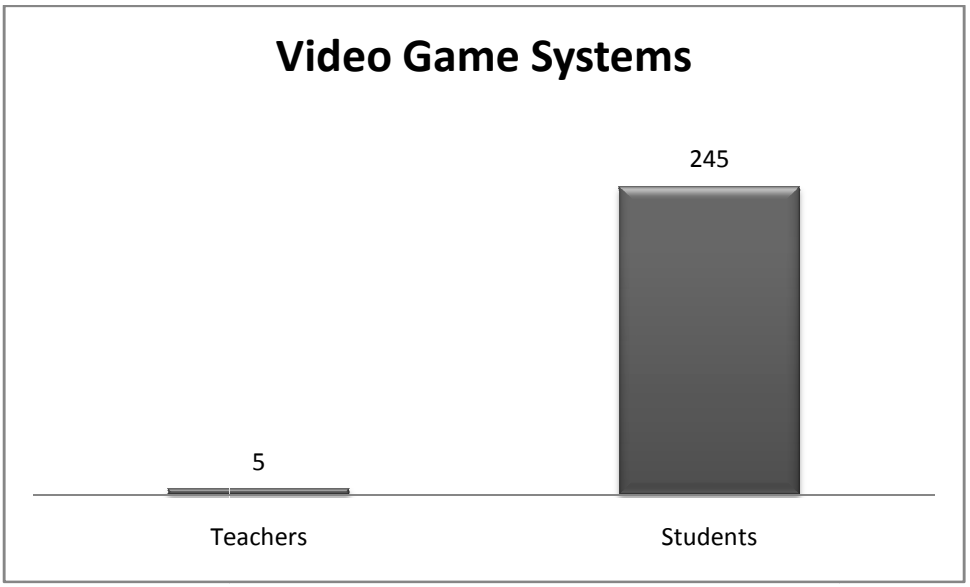

Figure 8. Teacher Survey Results versus Student Survey Results over Video Game Systems

Alternate Hypothesis 3

The proportion of teachers surveyed about technology usage in their classroom who said yes to utilization of specific technologies will be different from the proportion of students who said yes in a student survey to owning these same electronic devices (iPods/MP3 players, Cell Phones, and Video Game Systems).

Null Hypothesis 3

The proportion of teachers surveyed about technology usage in their classroom, who said yes to the utilization of specific technologies, is the same as the proportion of students who said yes, in a student survey, to owning these same electronic devices (iPods/MP3 players, Cell Phones, and Video Game Systems).

The Z-test for difference in proportions was applied with a 95% confidence interval (CI).

Table 10

z-test Results for Hypothesis 3

	Two-tailed *z*-test	*z* Value
iPods/MP3 players	95% Actual CI	18.479
Cell Phones	95% Actual CI	16.004
Video Game Systems	95% Actual CI	20.356

Note: Alpha 0.05, Critical Value 2.56

The result of the *z* tests for difference in proportions indicated a statistically significant difference in the usage of iPods/MP3 players, cell phones, and video game systems when comparing teacher responses to student responses. There is a statistically significant difference between the proportion of students who used the electronic devices at home compared to the proportion of teachers who utilized these same electronic devices in the classroom for education purposes. Null hypothesis 3 was rejected and

alternate hypothesis 3 was supported. There is a gap between the proportion of teachers who answered yes on the technology survey which stated they used specific electronic devices (iPods/MP3 players, cell phones, and video game systems) in their classroom compared to the yes responses that students gave which stated they owned those same electronic devices.

Implications

The educational implications of this study demonstrate to school district officials that more technology is necessary in classrooms. When question four was added to Phase 2 of the survey, asking how students react when technology is utilized in the classroom, qualitative responses provided data demonstrating that teachers perceived students to be more engaged and excited about learning. Professional development can be planned to assist teachers in becoming more educated in current technologies available to many of them.

Phase 3 was only conducted with a small number of surveys, however that phase asked the teachers about the professional development they had received connected to technology. Many of the teachers who responded to Phase 3 were high school business teachers, so computer technology plays a more important role in their training. There were 34 surveys completed that had Phase 3 questions. Since these teachers were business teachers and had all attended the MBEA (Missouri Business Educators Association) conference where the researcher presented, these teachers all were able to respond that they had received specific technology training at the MBEA conferences held twice a year. The reason these teachers were able to answer that they had received

specific technology training was due to their own interest to learn new technologies from being a member of this association and attending the conferences.

The only time the question was asked about school size, rural versus suburban, was in Phase 3, so only twenty-three teachers replied that they taught in a rural school out of twenty-seven who answered that question. The only weak conclusion that could be made from this data is that the size of school or district does not determine the ability to receive technology training, since there is technology training available outside of the school districts but still in the state.

Recommendations for Other Studies

The researcher recommends giving additional surveys to teachers in a more consistent manner. The researcher would provide the survey to all teachers in several schools and then do a comparison between schools. She would compare MAP results, or other standardized tests, between a school where the majority of teachers have SMARTBoards in their classrooms to a school where a majority do not.

Additional questions were developed in Phase 3, which requested more information from the teachers who completed that part of the survey. The researcher wanted to know: in what type of school they were teaching (ex. school size and rural vs suburban vs city), length of teaching career, college degree or certifications obtained, and what professional development they received on the technologies available to them. These questions developed as the data accumulated, due to questions the researcher had regarding technology and why teachers were integrating it, or why they were not. A small number of teachers were given this phase of the survey; however, for future studies the researcher would give the survey as it was in Phase 3 to gain additional pieces of

information in order to determine the effects of training on the amount and quality of teaching with technology. It would be an interesting question to add to the survey to discover what technological tools teachers use personally, to determine if those teachers who use these popular technological tools for personal reasons are more likely to use them in the classroom. One research interest would be to discover if teachers who are digital natives use technology more than those teachers who are digital immigrants.

Discussion

An interesting aspect to this study is the technology that students have readily available at home, such as cell phones and computers is not utilized or available in the classroom. As shown in the quantitative results, there were large differences in the number of students who owned technology items compared to the number of teachers who had used them in the classroom. A popular debate among adults and teenagers is the time spent playing video games and the implementation of them in the classroom. This study found only five (2%) teachers who used video games as an educational tool in their classroom, while 245 (89%) students played them at home. These teachers were all preschool teachers who utilized the video game systems. Many used them as a reward system. There are many educational video games that are attached to current curriculum for multiple grade levels, however many teachers do not see the value in them.

Student use of cell phones is a battle many schools face today. Most schools have a policy that bans the use of cell phones in the school building. One hundred ninety-eight (72%) of the seventh graders polled in this study had a cell phone, while only thirteen (5%) teachers found an educational use for them in their classrooms. MP3 players and iPods can be used as more than digital music players; however, only ten (4%) teachers

have used them in their classroom, while 227 (83%) students use them daily. The researcher is not sure how the students are utilizing the iPods and many students are probably using them to only listen to music.

The researcher understands the fear of technology and why teachers are hesitant to utilize technologies typically banned in schools. If a previously established policy bans iPods or cell phones in the school, most teachers will follow the policy. School district officials should be advised of the positive possibilities of these technologies in the classroom. Chapter 2 detailed many specific educational and curricular connected uses for each of the technological tools addressed in the survey. It is vital that technology is used purposefully such as for improving the curriculum, not simply used for technology's sake. Chapter 5 describes the researcher's use of many of these items in her own middle school mathematics classroom.

Conclusion

Digital Natives often experience in the classroom an attitude from teachers based on a belief that cell phones, iPods/MP3 players, and video games are to be considered as toys not tools for learning. However, adults utilize these same devices on a daily basis as more than toys. Students should be taught the educational utility of the technologies they use every day. Professional development should assist teachers to become more educated on the current technologies available to many of them. It is essential for school districts to budget for current technologies. Technologies important to students are not being used by most Missouri teachers, according to the survey results of this study.

Chapter Five includes the personal interview that the researcher conducted with herself which utilized a digital video camera and associated computer software. Since the

researcher was the participant who utilized the SMARTBoard strategies with her students, university professors felt it would be beneficial for this component to be added. The questions revolve around the SMARTBoard, how it was utilized in her classroom, and educational connections. Establishing the methods of her technology integration is essential to validating the results from the pre-test and post-test in chapter six and the comparison of standardized scores in chapter seven.

Chapter Five: Personal Interview

Research Overview

The purpose of this study was to investigate the impact of the use of interactive whiteboard, specifically the SMARTBoard, on students' learning of mathematics. There were two overarching questions of this component, the personal interview of the researcher, of the study. What are the unique and innovative SMARTBoard technology mathematic instruction strategies developed by the primary investigator of this study? How will the use of innovative SMARTBoard technology affect student mathematics achievement? The qualitative methods of measurement used in this study led to an understanding of what technology was available to students and teachers.

The personal interview focused on the researcher's personal reflections and recollections from teaching with the SMARTBoard and other technology. It was conducted before the researcher examined and analyzed the results of the teacher survey, or any of the data collected for this writing. At that point, the researcher was unaware of how teachers across the state were integrating technology into their curricula. Therefore, the researcher decided to conduct a self-interview, which caused her to examine her own experience as a middle school mathematics teacher who integrated technology into her curriculum. The interview was structured to answer the research questions of the study. She judged this data as essential to validate the fidelity of her use of classroom technology. The interview was designed to provide the knowledge which would ensure the validity of pre and post-test results and the standardized test scores comparisons within the study.

Development of the Instrument

The researcher developed some questions individually. She then collaborated with a current middle school educator, who currently teaches with a SMARTBoard, to develop questions that served to connect teaching strategies advocated by Robert Marzano (Marzano, Pickering, & Polluck, 2001) with SMARTBoard strategies. Marzano identified instructional strategies that data collected by the Mid-Continent Research Center for Education and Learning, showed as enhancing student achievement. They focus on nine different strategies: Identifying similarities and differences, summarizing and note taking, reinforcing effort and providing recognition, homework and practice, nonlinguistic representations, cooperative learning, setting objectives and providing feedback, generating and testing hypothesis, and questions, cues, and advance organizers (Marzano, Pickering, & Polluck, 2001). The questions were then evaluated and approved by university professors.

The development of this instrument was intended to examine the researcher's own experience as a teacher using technology and align her strategies with those proven to increase student achievement. Subsequent components of this study will determine if the researcher's seventh grade students' achievement increased in mathematics after daily use of a SMARTBoard, using pre and post-testing as well as a comparison group for two different types of assessments, state required test and national version.

Limitations

The researcher conducted a self-interview using a digital video camera. The interview was then converted to audio only. Also, this was only the second academic year the researcher had taught at the middle school and her first year of using SMARTBoard

technology. The interview required the researcher to recall previous events rather than collecting data by observation. However, the time elapsed allowed the researcher to reflect on her own practice before examining the student achievement data.

Population

The researcher is the only population for the study. Prior to the study, she taught mathematics on the secondary level in public education for seven years. She utilized a SMARTBoard during the academic year when the study occurred.

Data Collection

The data was collected through use of a digital video camera, specifically the Flip camera. The video was converted to audio format through the use of iMovie on an iMac computer. The audio was burned to a CD and saved to a flash drive. The audio portion of the interview was transcribed by a third party.

Data Analysis

1. Which strategies have been most effective through use of the SMARTBoard in mathematics?

   The SMARTBoard allows the teacher to create interactive lessons where the students are able to interact with the lesson by utilizing the SMARTBoard. The teacher is able to utilize different websites that are devoted specifically to interactive whiteboard lessons. The teacher can create presentations, or utilize those created by others, that allow the lessons to be in game format for the students to interact with using the SMARTBoard software. In mathematics specifically, the SMARTBoard software provides tools such as rulers, protractors, and graphing calculators that can be adapted to particular problems.

2. Which strategy has yielded the most learning by my students?

   The strategy most beneficial to students that I discovered through teaching with the SMARTBoard was having the students engaged in the lessons and excited about learning. Every day provided a fun learning environment for both the teacher and students. Since I was not trained to use SMARTBoard strategies I benefited from learning different techniques from my students.

3. How was I trained?

   I did not receive training on the use of the actual piece of expensive technology hanging on the wall in my classroom, or teaching strategies to utilize the SMARTBoard as more than a glorified overhead. Being a self-directed learner, I pursued others in the building who had already taught with a SMARTBoard to obtain their knowledge. I worked with the EMINTS teacher to gain the knowledge that she received through training. Most of my learning resulted from my experiences with students and practice in the classroom.

4. How did I begin using a SMARTBoard to teach?

   I convinced my principal that I needed a SMARTBoard with which to teach so I could complete my doctorate degree. In our building at the seventh grade level, each team except ours had at least two SMARTBoards. One of the goals for that building was to increase the number of SMARTBoards in the classroom each year. Our team was due to have one and, as team leader, I was chosen as the recipient. My personal teaching goals were always connected with technology and my intent to increase implementation of technology in the classroom with students. I did receive a SMARTBoard and devoted hours learning to use this

equipment and the accompanying teaching strategies that research defined as enhancing student learning.

5. Why did I want to teach using a SMARTBoard?

   My first experience with a SMARTBoard was in 2000 as an undergraduate student. I had not taught with one prior to the 2007 school year. I have been an advocate for utilizing and implementing technology in the classroom, and the SMARTBoard was the ultimate way I could integrate technology into mathematics. I knew there were multiple uses for one in the classroom, but needed one in my classroom to discover them. I did not understand why a teacher would not want to have one in their classroom.

6. How do SMARTBoard strategies assist students in the learning process?

   Research completed for my study uncovered multiple books and periodicals supporting teaching with technology. Marc Prensky writes in *Don't bother me mom I'm learning* that video games are a learning strategy for Digital Natives. *Toys to Tools*, another book, focuses on the use of the cell phone as a tool for learning. The SMARTBoard is a piece of technology equipment that can enhance learning for the visual and kinesthetic learners in the classroom. It is a way to bring learning to their needs. Students are able to interact with mathematics lessons in a fun way, possibly for the first time in their learning experiences. Digital Natives love technology and learn through its use. Mathematics is often a subject that is not a favorite for many students. Many teachers use worksheets and textbooks as their means for students' independent practice. SMARTBoard teaching strategies have the ability to enhance independent practice for students

and provide them with fun-filled experiences while gaining the desired knowledge.

7. What really are SMARTBoard strategies?

   The SMARTBoard strategies are aligned with different teaching strategies such as those presented by Marzano. The Marzano teaching strategies are: identifying similarities and differences, summarizing and note-taking, reinforcing effort and providing recognition, homework and practice, non-linguistic representation, cooperative learning, setting objectives, providing feedback, generating and testing hypothesis, questions, and advanced organizers. There is a book that connects the Marzano teaching strategies with technology. There are ways to utilize technology with all of these strategies, but the teacher needs professional development to learn how to do so.

8. What training is available?

   The training comes in different forms. There is training available from corporations like the SMARTBoard incorporated. Many school districts use teachers from their districts to train other teachers. There are school districts that provide professional development for content area teachers in how to integrate SMARTBoard technology into their lessons.

9. Which other teachers are using the SMARTBoard for more than just a glorified overhead or chalkboard? How did they get to that point?

   The goal of my research is to discover how teachers are utilizing SMARTBoards in the classroom. I want to find the teachers who are utilizing it as more than a glorified overhead for their students. I know there are teachers who are doing this

and that was what sparked the interest in this topic. I wanted to explore how they were able to become masters of technology integration in the classroom.

10. Describe the type of school in which I had the experience teaching mathematics using a SMARTBoard.

    The school in which I taught is located in a mixed suburban and rural geographic and population area. The students attend separated elementary schools and are not together in one school until they meet in seventh grade. During this study, the middle school housed seventh and eighth grade students. The school is part of a multi-building campus so students must walk outside for their physical education, encore, or other special classes as well as to the cafeteria for lunch. While this study was in progress the faculty was involved in the beginning of Professional Learning Communities (PLC). I served as the PLC facilitator for the seventh grade mathematics team, as well as facilitator for the eighth grade science team.

11. How was I able to enhance my teaching of mathematics using SMARTBoard strategies?

    During the year prior to this research study, I taught with a chalkboard. The physical space I had in the classroom provided room for the students' desks, classroom furniture, and a walking space for me at the chalkboard. Most of the lessons were taught with me at the chalkboard writing notes and example problems with students writing down the notes and example problems on their paper. Occasionally, students came to the chalkboard for limited activities. Chalkboards get more difficult to read as they obtain more chalk dust on them, so

I tried to limit the amount of chalk dust created, so my seventh hour class could still see the board.

When I taught with a SMARTBoard, the students were interacting with it daily in some way. They wanted to participate in the lessons and really enjoyed getting to write on the board or complete different activities. An example I used with the students was in a geometry lesson. I found different pictures of art from the internet and had the students identify the different geometric shapes and terms we had learned in class. They were able to come to the board and draw the geometric terms.

12. Why should teachers use a SMARTBoard in their classroom? What benefit is the SMARTBoard to the students?

    There are many ways a teacher can utilize a SMARTBoard in their classroom and new applications are created yearly. The SMARTBoard is a teaching tool that can be made available to teachers. Students are able to learn more because they love technology and are excited when technology is used in the classroom. It is easier for students to see the board, and much easier for presentations to be altered for specific students. Since the SMARTBoard is also a tool that can be used as a whiteboard, a teacher can print notes taken from a class discussion for students.

13. How can I enhance graphic organizers using the SMARTBoard?

    Through the use of the SMARTBoard, the teacher can make a graphic organizer come to life. Not only can color be used in the creation of graphic organizers, animation is a tool that is only possible through the use of technology like the

SMARTBoard. Technology provided by the SMARTBoard provided the flexibility to move forward and backward in a lesson with ease.

14. How is the visual learner addressed by using the SMARTBoard? How is the kinesthetic learner addressed by using the SMARTBoard?

    Students took a learning style assessment at the beginning of the school year to determine their dominant learning style. The majority of students were visual and kinesthetic learners. Class discussions centered on how each learning style could be best addressed to maximize student potential. For the kinesthetic learner, the SMARTBoard provided a way to interact with the lesson physically.

15. Has the SMARTBoard helped in assessing student knowledge?

    I do not have a good understanding of this question. The teacher is able to learn more about the student's knowledge due to the higher level of engagement in the lessons. There are ways the SMARTBoard could be used to assess the students through the use of clickers. Clickers allow the students to answer a question and provide the teacher with instant feedback, which allows the teacher to change the lesson as needed.

16. How has my effectiveness as a math teacher benefited from the Internet? SMARTBoard?

    My effectiveness as a math teacher benefited greatly from the SMARTBoard in the classroom. I was able to be a more creative teacher in my lesson planning. I was able to utilize different lessons and tools that others had created which allowed for more animated lessons and which fully engaged my students. The SMARTBoard provided a way for me to teach differently from the manner in

which I was taught, which is one of the greatest struggles for teachers, especially mathematics teachers.

I also benefitted as a math teacher from using the internet because it was where I was able to find the lessons and tools to create more animated lessons. As a technology proponent, I often found myself searching the internet for other possibilities and strategies to teach.

17. How has student learning increased with the use of the Internet? SMARTBoard?

    This is one of the components of this research study. I wanted to determine that the SMARTBoard and technology can be a cause for an increase in learning for students. I discovered that students were more engaged in lessons when taught with the SMARTBoard, as opposed to the previous year with a chalkboard. I do understand that my excitement level over the use of technology also supports the excitement in learning from students. I definitely found it more fun to teach with a SMARTBoard. Students were able to engage in the lesson more and interact in a different manner than previously.

18. What is the most interactive SMARTBoard tool?

    I am not sure what is the best interactive tool within the SMARTBoard, but I know that my student-teacher discovered a protractor website that was interactive and animated and which completely engaged students in the lesson. This also gave them the practice they needed to be able to apply these skills using a paper or plastic protractor. I think the answer to this question would vary based on the subject being taught.

19. What teaching techniques are enhanced with continued SMARTBoard use?

    One of the teaching techniques that could be greatly enhanced is identifying similarities and differences. This would be for any subject, because you could utilize multiple examples in a short manner of time and have the ability to mark on them. The teacher could easily pull items from the internet to use with the lesson presentation for comparison examples. The other techniques that could be enhanced are: summarizing and note-taking, reinforcing effort and providing recognition, non-linguistic representation, setting objectives, providing feedback, generating and testing hypothesis, and advanced organizers.

20. Which teaching techniques are enhanced by using the SMARTBoard? Why?

    One of the Marzano teaching strategies that could be minimized by using the SMARTBoard is that of homework and practice. This could also be interpreted as a philosophical difference as to the importance of doing homework in the traditional way. The traditional picture of homework in mathematics has students working problems out of the textbook or a worksheet. Technology can offer students a different way of working on the same type of problems through interactive games on the internet and other technological resources.

    Another teaching strategy that would be minimized through the use of the SMARTBoard is cooperative learning. Students would not be utilizing the SMARTBoard while they are in a cooperative learning environment.

21. How has student involvement increased with the addition of media-based instruction (MBI)?

    Students are more interested when media-based instruction occurs. Digital Native students thrive with technology because they desire to use it on a daily basis. One of the classes I taught the year of this research study had eight students. These students were each utilizing the SMARTBoard as much or more than I was, and they thrived academically because of it.

22. How has parent involvement increased with the addition of MBI?

    One of the ways parent involvement has increased due to MBI is through online grading. Parents are able to check their children's grades on a daily basis online and then contact the teachers if they are concerned. Technology provides both teachers and parents the ability to communicate easily and quickly through e-mail.

23. How could parent involvement increase even further?

    Technology can assist with parent involvement by providing more opportunities for parents in an online setting.

Background of the Researcher

The researcher taught mathematics in the public education secondary school system for over seven years. She has a passion for education and thrives to see students learn in the manner that works best for them. She has a working knowledge of technology and a desire to see more technology used in the classroom. She understands that current students are Digital Natives who grew up with technology and are engaged when technology is a part of the classroom instruction. She taught a course in Methods of Mathematics to undergraduates at the university level. Course objectives were centered

on preparing pre-service teachers to teach mathematics to their students. The researcher designed the Methods of Mathematics course with emphasis on the use of technology as an effective tool in the mathematics classroom.

Implications

Studies of interactive whiteboards, or specifically the SMARTBoard are small in number. Studies within the United States are almost non-existent. The researcher had a desire to use both quantitative and qualitative results to demonstrate the role technology, specifically the SMARTBoard, can have on student learning. When students are engaged in learning, which they are when different technology including the SMARTBoard is used, they learn more. Educators have a desire for their students to learn more and be engaged in the process. This component of the research was the researcher's perspective of how things occurred in the class with the use of the SMARTBoard.

Recommendations for Other Studies

The researcher found that her knowledge was limited to her experience. To complete a further study, she would interview other teachers who taught with a SMARTBoard for more than a year. She would also interview teachers who received professional development training on the SMARTBoard to learn what they developed for their classroom. Another component would be to observe teachers experiences with SMARTBoard strategies as they present their lessons to learn different strategies.

Discussion

Many teachers are willing to learn new technologies, yet others are resistant. Professional development needs to be geared towards the new technology that is placed in their classrooms. Teachers desire to use best practices in their classrooms, and

technology, specifically the SMARTBoard. The SMARTBoard is an electronic device that allows the teacher to do so much more. Teachers with a SMARTBoard in their classroom are able to utilize all the Internet applications and websites that are interactive whiteboard specific which allows learning to become more engaging.

The interview questions were developed using the Marzano teaching strategies. Marzano conducted research on best practices and instructional strategies. He discovered nine different strategies that teachers use in their classrooms for the greatest impact on student learning. The nine teaching strategies are as follows: identifying similarities and differences, summarizing and note taking, reinforcing effort and providing recognition, homework and practice, cooperative learning, nonlinguistic representations, setting objectives and providing feedback, generating and testing hypothesis, and cues, questions and advanced organizers (McRel, 2005).

Conclusion

The SMARTBoard is a wonderful technological teaching device. Every classroom should have one, which would allow the students to become more engaged in the lessons. Teachers who utilize SMARTBoards in their classrooms, enjoy them and realize that the ability to save and reuse lessons is a wonderful time saver.

Chapter Six evaluated the results of the diagnostic test given to the researcher's students at the beginning of the school year, as well as at the end of the school year. The students tested were in the researcher's classes. Chapter Seven contains MAP testing results along with comparison statistics connected to the diagnostic test.

Chapter Six: Diagnostic Test

Research Overview

The purpose of this study was to investigate the impact of the use of an interactive whiteboard, specifically the SMARTBoard, on students' learning of mathematics. There was one overarching question for this chapter of the study. Does use of the SMARTBoard in a mathematics classroom increase students' learning according to the grade level expectations of the Missouri Assessment Program? The quantitative methods employed in this study led to a comparison of the level of students' mathematical understanding from the beginning of a school year to its end based on the results of MAP testing and a teacher administered pre and post-test. The control and experimental groups were not randomly assigned, but were analyzed through use of a z-test for difference in proportions, which does not require randomization for this type of comparison; the researcher used the existing class groupings. She not only chose the students who took the test but also the location for testing, and when and how it was administered (McEwan & McEwan, 2003). This method provided the researcher with data showing that students' knowledge increased due to the use of the SMARTBoard as a teaching tool. The researcher developed a diagnostic test that the students took at the beginning of the school year and at the end of the school year for comparison of results.

While it cannot be certain the results were completely due to technology use, several studies recorded in chapter two supported the supposition that Digital Native students had a greater desire and ability to learn when technology was used. The researcher expanded her findings to provide further support for technology as a teaching tool in this generation of Digital Natives (Manzo, 2009d).

Procedures

The researcher met with three seventh grade mathematics teachers from Sun Valley Middle School to gain their approval to use the diagnostic test. This instrument was administered at the beginning of the school year to gain a valid assessment of the entering knowledge level in mathematics of seventh grade students. Two weeks after administration of the instrument, teachers were required to run an item analysis to determine the areas of strengths and weaknesses for their specific group of students. The item analyses were discussed at the PLC meeting, which consisted of the four seventh grade mathematics teachers and two special education teachers who worked in the mathematics classrooms. This instrument served as the first common assessment used in seventh grade mathematics at Sun Valley Middle School.

The school's administration established PLCs for the 2008-2009 school year, and teachers in the PLCs met every other week for one hour (DuFour, DuFour, Eaker, & Many, 2006). The head administrator from Sun Valley Middle School selected the researcher and trained her for the role of facilitator for the seventh grade mathematics group. The researcher attended a professional conference to learn the specifics of a model PLC. A major component in the development of professional learning communities was the requirement that each community develop common assessments each month based on the curriculum taught. Common assessments served to provide structure and organization in the curriculum by requiring teachers to focus on specific results. PLCs provided teachers with a collaborative environment to discuss the best practices for each topic.

The researcher selected the questions for this instrument from areas of deficiency identified from MAP test data and student performance in the preceding class. These

areas, and the testing tool, were discussed in a PLC meeting with the seventh grade mathematics teachers prior to the start of the 2008-2009 school year. Questions were taken from a mathematics textbook series test bank within the district, and were aligned to current Missouri GLEs; some were aligned to requirements below the seventh grade level. Since the test was given at the beginning of the school year, some of the questions were at the sixth grade GLE level.

The diagnostic test was administered on the second day of school, August 15, 2008 and again at the end of the school year on May 23, 2009 to compare the growth in mathematics knowledge and understanding of the students. Each testing session was a standard class period of 47 minutes during the school day. During the first test, on August 15, 2008, students were not allowed any technological assistance, including calculators. The test administered to the researcher's students on May 23, 2009, allowed them to use calculators as a mathematical technology tool. Calculators were allowed on the second test because one of the objectives of the school year was to learn to use calculators properly. All seventh grade students took the test on August 15, 2008; however, only the researcher's students took the test again on May 23, 2009. This part of the study concentrated on the growth of the researcher's students since they were taught with the focus of technology, predominantly through the use of the SMARTBoard. The other seventh grade mathematics teachers chose not to administer this test at the end of the school year. However, the next section of this study will compare the researcher's students to other students in the same school who were in a mathematics classroom where technology was not utilized on a daily basis.

Population

Eighty-eight seventh graders, ages twelve to fourteen, participated in this part of the study. These students, male and female, were primarily Caucasian (99%) and classified by family income within a middle-to-low socioeconomic range. They resided in rural and suburban communities. The school principal initially provided verbal permission. Later, the Executive Director of Secondary Education granted written permission. Names of individual participants, the school and the school district were not used in this study. No specific scores were used, nor were they attached to individual students in any manner. The researcher itemized data by questions specific to the entire group of students. The students involved in this part of the study were all in the researcher's mathematics classes. Each of the four seventh grade mathematics teachers required students to complete the August 2008 diagnostic test as a class assignment that was graded. In order to reduce test anxiety, students were told on day one they would be taking a test on day two. The researcher recorded the raw scores of her students based on a total of 30 points, not the normal 100 point value of a test, and informed her students of their August score when they took the test again in May 2009.

Limitations

The researcher worked in the same building in which she conducted the study. Her location in the building where the study occurred and her involvement in different district committees, such as the mathematics curriculum team and the district curriculum action team, allowed her to influence the seventh grade mathematics curriculum. Her involvement in the mathematics curriculum team could have had an impact on her students because of the extra knowledge she had gained through the development

process. She was involved in organizing the resources for the development of the new mathematics curriculum.

All students in the study attended the same school; this part of the study involved one of the three seventh grade teams. The students on the researcher's team had three teachers who taught utilizing SMARTBoard technologies, one in English and one in Science. This specific team consisted of young teachers who all had at least five years of experience. Teachers on this team were open to available new technologies and wanted to integrate them into their classroom instruction. The remaining two teams each had two teachers with classroom SMARTBoards.

This part of the study focused on the growth of the researcher's students taught with classroom technology, primarily with the use of a SMARTBoard. Each team in the school had a different mathematics teacher. Other teams might have had a similar increase in student achievement even though technology was not a prime component of instruction. For this reason, the researcher also used standardized test scores to compare the different teams. Another limitation to the study was the different times of day for student testing. Some students might test better in the morning, while others might test better in the afternoon. The students did not get to choose when they took the test, it was according to their schedule and when they were in the mathematics class.

All seventh grade students took the test on August 15, 2008, however, only the researcher's students took the test again on May 23, 2009. This part of the study was deliverately limited to examination of the growth of the researcher's students since they learned with a focus on technology predominantly through the use of the SMARTBoard.

Development of the Instruments

The instrument was developed to include seventh grade level math questions chosen from a test questions bank. Its intent was to diagnose students' levels of mathematics achievement so teachers could tailor lessons to meet the needs of their students. The questions were not in any specific order. As the researcher and the seventh grade teachers examined the MAP data from the previous year to discuss best practices, the teachers also evaluated the data from the diagnostic test. Each teacher was able to determine the specific areas of number sense where their students were weak, and they designed their lessons according to the needs of their students. The researcher secured an outside person, or third party to grade the test and complete item analyses for both objectively scored tests. The test was graded with no partial credit, thus purely objectively. She studied the test questions to explore areas of strength and weakness. She wanted to discover why students were answering problems incorrectly and presented some helpful strategies to the classes the following week to assist them in learning.

Instrument Alignment

Questions were selected from a mathematics textbook test bank and aligned by the researcher to specific GLEs, even when some of these were below the seventh grade level. The researcher knew that the test could not consist of all seventh grade components because it was given at the beginning of the school year. Through discussion, the seventh grade mathematics teachers determined specific areas to be tested. They matched identified weak areas students displayed in assessments from the previous school year.

Table 11

Diagnostic Test GLE Breakdown by Question

Questions	Grade Level	Topic	Number	Letter	Details
11 through 16	3 (to a much more difficult level)	Numbers and Operations	2 Understand meanings of operations and how they relate to one another	B Describe effects of operations	Describe the effects of adding and subtracting whole numbers as well as the relationship between the two operations
13, 16, 19, 22, 23, 26	5	Numbers and Operations	1 Understand numbers, ways of representing numbers, relationships among numbers and number systems	A Read, Write, and Compare Numbers	Read, write and compare whole numbers less than 1,000,000 unit fractions and decimals to hundredths (including location on the number line)
1 through 7	6	Numbers and Operations	1 Understand numbers, ways of representing numbers, relationships among numbers and number systems	A Read, Write, and Compare Numbers	Apply and understand whole numbers to millions, fractions and decimals to the thousandths (including location on the number line)
8 through 10	7	Numbers and Operations	1 Understand numbers, ways of representing numbers, relationships among numbers and number systems	A Read, Write, and Compare Numbers	Compare and Order Integers, positive rationals and percents, including finding their approximate location on a number line
17 through 30	7	Numbers and Operations	3 Compute fluency and make reasonable estimates	C Compute problems	Multiply and Divide Rational Numbers

Data Analysis

The tests were graded objectively, and no partial credit was given. One point was assigned for a correct answer; an incorrect answer did not receive a point. This is the same grading style used for the majority of questions on the MAP test. The researcher chose to use open-ended questions, as opposed to the multiple-choice format, so students could not guess an answer. She and the seventh grade mathematics teachers wanted to see what the students really knew, not what they could guess. The researcher then used an Excel spreadsheet to compute the item analysis for each question on the test for each student. Individual teachers could investigate and assess a student's mistakes in order to design specific lessons. There could be areas of weakness for a specific student, and with this information the teacher would be able to tailor their lessons. If an area of student weakness surfaced, the teacher could collaborate with the other seventh grade mathematics teachers to find a best practice to present the mathematical concept to their students.

Background of the Researcher

The researcher had taught mathematics in grades seven through twelve for almost eight years. She developed curriculum for seventh grade mathematics, as well as for multiple courses at the high school level. The researcher created and developed the curriculum for a brand new course to motivate students to complete four years of mathematics at high school and to better prepare them for college mathematics. She taught mathematics at the college level for four years as an adjunct professor. PLCs were established by the school's administration for the 2008-2009 school year, with an hour of

meeting time provided bi-weekly. The head administrator of the building selected and trained the researcher for the role of facilitator for the seventh grade mathematics group.

Results

Students evidenced a decrease in correctness for fifteen of the 38 questions. The researcher used 20 points as a significant number for comparison due to the standard deviations found for both of the tests (17.64, 20.22). Nine questions showed an increase or decrease of 20 or more students achieving the point. Table 13 displays these results.

Table 12

Diagnostic Test Large Increases or Decreases

Themes	Questions	Increase/Decrease	GLE classification
Theme 1	Question 14	Increase 20 pts	Numbers, Subtraction
Theme 2	Question 19	Increase 23 pts	Words, Multiplication
Theme 2	Question 22	Increase 36 pts	Words, Multiplication
Theme 2	Question 23	Increase 32 pts	Words, Multiplication
Theme 3	Question 20	Increase 28	Numbers, Multiplication
Theme 4	Question 25	Decrease 44	Numbers, Division
Theme 4	Question 29	Decrease 21	Numbers, Division
Theme 5	Question 30	Decrease 49	Words, Division
Theme 6	Question 27	Increase 42	Numbers, Division without remainder

The three questions that showed the greatest decrease in correctness were division problems with remainders. Students took the test in August without the use of a calculator. They used a calculator for the test in May, 2009, which may have been detrimental to their success for the three questions showing a significant decrease in correctness. The students who gave their answers in decimal form on these questions may have missed the intent of the questions; each division had a remainder that was to be

displayed in fraction form, which many students failed to do. All of the themes from the above chart showed a significant increase or decrease from the scores which compared pre-test to post-test.

Alternate Hypothesis 9

Students in the seventh grade math class who were taught using SMARTBoard strategies will evidence a measureable increase in frequency in correct responses when comparing questions from pre-test to post-test.

Null Hypothesis 9

Students in the seventh grade math class who were taught using SMARTBoard strategies will not evidence a measurable increase in frequency of correct responses when comparing questions from pre-test to post-test.

The researcher ran a one-tailed *z* test for difference in means to determine if there was any significant difference in frequency of correct responses to questions. There were 30 questions analyzed. Thirteen of those 30 were determined to indicate a significant increase in the number of students responding correctly. Thirteen of those 30 were also determined not to indicate significant improvement. Four questions demonstrated a decrease as opposed to the desired increase; however, the change in frequency was still statistically significant. They evidenced a decrease, which was not expected.

Table 13

Diagnostic Test Hypothesis 9

	Support Hypothesis	Support Null
Question Numbers	1,5,9,14,15,16,18,19,20,22,23,24,25,27,28, 29, 30	2,3,4,6,7,8,10,11,12,13,17,21,26

Alternate Hypothesis 2

Students in the seventh grade mathematics class who were taught using SMARTBoard strategies will evidence a measureable increase in their post-test scores compared to their pre-test scores. The pre-test and post-test were both created by the combined efforts of all the seventh grade mathematics teachers in the district.

Null Hypothesis 2

Students in the seventh grade mathematics class who were taught using SMARTBoard strategies will not evidence a measureable increase in their post-test scores compared to their pre-test scores.

The researcher ran a *t* test for difference in means for dependent samples. This test used the difference in pre-test to post-test scores for a random selection of 45 students in the researcher's classes. A Microsoft Excel spreadsheet was used to determine the standard deviation. The researcher then calculated the *t* test value.

Table 14

Diagnostic Test t-Test Results for Hypothesis 2

	t-test value
Percent	2.603997839
Raw score (out of 30)	2.595873481

Note: Alpha = 0.05 Critical Value 1.96

Both *t* scores were greater than the critical value, so the researcher was able to reject the null hypothesis. The alternate hypothesis was supported, which claimed that the SMARTBoard strategies helped to gain a significant increase in pre-test to post-test scores. The researcher recognized that the increase may not be completely due to the SMARTBoard strategies implemented in the classroom and other factors could apply.

Research Questions

How will the use of innovative SMARTBoard technology affect student mathematics achievement? This part of the research study focused on the impact SMARTBoard technology had on the test scores of a diagnostic test given at the start and end of the school year. SMARTBoard technology did influence the students' mathematics achievement as measured by pre- and post- test scores. The students demonstrated increases in the number of correct answers, which could be the result of the calculator strategies that the students developed in congruence with the SMARTBoard strategies. Students also encountered three questions in which their results demonstrated a decrease in correctness, which the researcher concluded to be the result of calculator dependency.

Implications

The teachers need to specifically address students' calculator skills. The questions that evidenced a decrease were long division problems. Since these questions were scored purely objectively, no partial credit given for work shown, students depended solely on the calculator and did not take into account the accuracy of their answer. Students need to learn that the calculator in decimal form is an approximate answer, not an answer in exact form. The questions that produced the largest increase in correct answers were related to multiplication, or long division problem with no remainder. The conclusion to this is that students are weak with their multiplication skills without the use of technology.

Recommendations for Other Studies

If the researcher were to replicate this portion of the study, she would include the results from the pre-test taken by the other classes in August, 2008 and also would have

had them take the same test again in May, 2009. This would allow a comparison of her students' results taught with a SMARTBoard with those who were not. A further qualitative analysis of the work students provided to find the answer on each question might lead to additional insight. This study was completed in one district, in one classroom. A larger, more diverse sample would provide more substantial evidence for the hypotheses.

Discussion

The researcher discovered that there were not many studies on interactive whiteboards, and most of the available studies were based in the United Kingdom and were qualitative rather than quantitative. The few studies found with a quantitative component were only measuring the teachers' characteristics, not using data from the students those teachers taught. The researcher wanted to use data from students' test scores, especially for those experiencing the use of the SMARTBoard in the mathematics classroom, to support the thought that technology useage can make a difference in what students can learn. A professor told the researcher that her students might have scored better, no matter what, due to the excitement she brought to teaching. This may be true, but the researcher honestly felt that the SMARTBoard made learning more engaging for the students.

The results of this study can impact education because of the support it provides for heavier use of technology in the classroom. School districts continually examine data; this study represents a form of data that can be used to realize the need for specific technological tools. Technology should play a major role in the education process at all

levels. Teachers and administrators must continue to evaluate all teaching tools, including technology, to ensure that they are truly supporting student learning.

The results of this study can impact students due to its emphasis on a more engaging classroom environment. The use of technology is such an important component for Digital Natives; some might even argue that for them to learn, it is a necessary component. A persuasive argument made today is that current students are not as motivated as students were ten years ago. The researcher disagrees and believes that the knowledge gained from this study supports the need for technology to engage the Digital Native learner.

The impact on leadership that this study can make could be an understanding of the importance of technology in the education process for all involved. All participants must develop an understanding of the need for technology to assist students, teachers, and administrators.

Conclusion

This part of the study used a diagnostic test created by the researcher and approved by the seventh grade mathematics teachers in the same building. The concept behind this aspect of the study was to show that students learned better through use of the SMARTBoard as a teaching tool in the classroom. Item analysis conducted on a diagnostic test assisted the researcher to observe that technology can help as well as hinder students in mathematics. The use of the SMARTBoard as a teaching tool is beneficial to students in their engagement in the lessons. The use of the calculator as a technological mathematical tool for students can be beneficial; however, it can also hinder them if used improperly.

Chapter Seven will address the controversial data. Some educators believe MAP data is not a statistically sound measure of student achievement, and therefore, should not be used as a measure of best-teaching classroom environments. Hypotheses one, four, five, six, seven, and eight all include the analysis of MAP raw scores and comparison with other tests.

Chapter Seven: MAP Data

Research Overview

There were two overarching questions of this study for this chapter. What are the unique and innovative SMARTBoard technology mathematic instruction strategies developed by the researcher of this study? How will the use of innovative SMARTBoard technology impact student mathematics achievement? This study sought to determine the specific effects on student mathematics achievement when an interactive whiteboard, a SMARTBoard, is used daily in a seventh grade mathematics classroom during instruction.

Procedures

The state department of education controlled the official administration of the MAP test. All test administrators read the same script, and all seventh grade students at Sun Valley Middle School took the MAP test at the same time. School officials controlled the administration of the MAP test in the building. Each seventh grade team organized its own classrooms for testing and, in the researcher's team classrooms, no students were tracked or leveled for testing. Each classroom consisted of 25 students. The time was 2 hours for each of the first 2 sections and 1 hour for the third, and last, section. The test was given only in paper and pencil format, which at the time of this research, was the only format available for the seventh grade mathematics test. A portion of the seventh grade mathematics MAP test is constructed response, where the students have to show all their work and respond in sentence form; and the majority of the test is multiple choice.

Limitations

The researcher worked in the building where the study was conducted. Her location in the building where the study occurred, her involvement on different district committees, such as the mathematics curriculum team and the district curriculum action team, allowed her to influence the seventh grade mathematics curriculum. However, since the MAP test was standardized, she had no impact on its development or scoring.

The participating students attended Sun Valley Middle School. This portion of the study was conducted for all three seventh grade teams. Each team had five core teachers that worked with the team's students. Students taught by the researcher, Mrs. Technology, also worked with young teachers each with at least five years of experience, who were open to new technologies and willing to integrate these into their classrooms. They formed one team. The other two teams had two of five teachers using a SMARTBoard in their classroom. This part of the study focused on the growth of the researcher's students taught with classroom technology, primarily with the use of a SMARTBoard. Each team in the school had a different mathematics teacher.

This component of the study compared the researcher's students to the other two mathematics teachers' students at the same school. Each teacher's classroom and strategies were different, although all utilized the same curriculum. However, the researcher could not ethically use the SMARTBoard for some sections of seventh grade mathematics and not others since she felt it would benefit students.

Another limitation is that not all students who took the MAP test in May had attended Sun Valley Middle School the entire school year. They may have received math instruction at a different school, which may have affected their test score. While there

were three seventh grade teams for the 2008-2009 school year, in an effort to reduce the number of students per mathematics classroom, some students from each team were taught by a fourth seventh grade mathematics teacher. This teacher had a combination in each class of the three teams, so data generated by students in these classes were not categorized by team.

Population

There were 421 students who participated in this part of the study. They were twelve to fourteen years of age and in the seventh grade during the school year 2008-2009. Students who participated were both male and female, 99 percent Caucasian, and classified in the middle-to-low socioeconomic range. They resided in rural and suburban communities.

Students whose Individualized Education Plan (IEP) stated that they were to take their test in a small group environment, have it read to them, or have extra time were not involved in the random sample chosen from each team. Those students all took their test in a separate room with special education teachers specifically assigned to them. Forty-five students were randomly selected from each team.

Development and Alignment of the Instrument

The MAP test was developed by a large, out-of-state testing company, and was purchased by the Missouri Department of Elementary and Secondary Education. It included a Terra Nova test and a multiple-choice test which is nationally administered. Results for this portion of the test is compared with students all over the United States (Pratical Parenting Partnerships, 2009).

The MAP test was aligned with state designed Grade Level Expectations (GLEs) for specific content areas and grade levels. The test in this study was specifically designed for seventh grade mathematics. The test was not scored at the study district site. As arranged by the state of Missouri, it was scored off-site in a large computer room by people who have earned at least a college undergraduate degree. These people do not have to have a degree in education, so many were not educators. Each scorer had a scoring guide and was randomly checked in their scores to a computer generated pre-scored question. The questions that were multiple-choice style were scored by the computer (Pratical Parenting Partnerships, 2009).

There were four different levels that students could score on this test. Students who score advanced receive the highest level and were deemed to have a complete understanding of the information. The next level was proficient; these students were believed to understand the information and have the skills needed according to the Show-Me Standards. The basic level meant students had a limited understanding of the information, they could solve basic problems, but errors might still be made. Below basic was the lowest level; these students were below grade level in their understanding of the information (Pratical Parenting Partnerships, 2009).

Data Collection

The state of Missouri collected the MAP data through Sun Valley School District. The data provided to the researcher came with completed item analysis on each question of the MAP test, separated by team (Robins, Blue Jays, Cardinals). Mrs. Technology was the mathematics teacher for the Robins team. Mr. Dry Erase was the mathematics teacher

for the Blue Jays team. Mrs. Overhead was the mathematics teacher for the Cardinals team. Data for this study was provided by Sun Valley School District.

Data Analysis

Table 15

MAP Results Separated by Level and by Teacher

Teacher	Advanced	Proficient	Advanced/ Proficient	Basic	Below Basic	Basic/ Below B
Mr. Dry Erase (143 students)	9 (6.3%)	51(35.7%)	60(42%)	62(43.3%)	21(14.7%)	83(58%)
Mrs. Technology (147 students)	10 (6.8%)	62(42.2%)	72(49%)	58(39.5%)	17(11.6%)	75(51%)
Mrs. Overhead (131 students)	11(8.4%)	39(29.8%)	50(38.2%)	71(54.2%)	10(7.6%)	81(61.8%)

Alternate Hypothesis 4: The proportion of students who scored proficient or advanced on the MAP test for Mrs. Technology will be different from the proportion of students who scored proficient or advanced for Mr. Dry Erase.

Null Hypothesis 4: The proportion of students who scored proficient or advanced on the MAP test for Mrs. Technology will not be different from the proportion of students who scored proficient or advanced for Mr. Dry Erase.

Alternate Hypothesis 5: The proportion of students who scored proficient or advanced on the MAP test for Mrs. Technology will be different from the proportion of students who scored proficient or advanced for Mrs. Overhead.

Null Hypothesis 5: The proportion of students who scored proficient or advanced on the MAP test for Mrs. Technology will not be different from the proportion of students who scored proficient or advanced for Mrs. Overhead.

Alternate Hypothesis 6: The proportion of students who scored basic or below basic on the MAP test for Mrs. Technology will be different from the proportion of students who scored basic or below basic for Mr. Dry Erase.

Null Hypothesis 6: The proportion of students who scored basic or below basic on the MAP test for Mrs. Technology will not be different from the proportion of students who scored basic or below basic for Mr. Dry Erase.

Alternate Hypothesis 7: The proportion of students who scored basic or below basic on the MAP test for Mrs. Technology will be different from the proportion of students who scored basic or below basic for Mrs. Overhead.

Null Hypothesis 7: The proportion of students who scored basic or below basic on the MAP test for Mrs. Technology will not be different from the proportion of students who scored basic or below basic for Mrs. Overhead.

The researcher used a *z* test for difference in proportions for comparing two proportions to calculate if there were differences that were statistically significant. Table 17 displays the results of the *z* tests.

Table 16

MAP Results of z *-Tests Comparing Each Teacher*

	Category	Z Score
Mr. Dry Erase vs. Mrs. Technology	Advanced/Proficient	-1.20044749
Mrs. Overhead vs. Mrs. Technology	Advanced/Proficient	-0.181328719
Mr. Dry Erase vs. Mrs. Technology	Basic / Below Basic	1.233607575
Mrs. Overhead vs. Mrs. Technology	Basic / Below Basic	1.813287193

Note: Alpha = 0.05 Critical Value 1.96

Null hypotheses four and five were not rejected. There was not a statistically significant difference in the proportions of students who scored advanced or proficient within the comparison of teams. Null hypotheses six and seven were not rejected. There was not a statistically significant difference in the proportions of students who scored basic or below basic within the comparison of teams.

Alternate Hypothesis 8: There is a relationship between the increase in student achievement indicated by scores on the pre-test and post-test and achievement on the MAP test indicated by students' raw scores.

Null Hypothesis 8: There is no relationship between the increase in student achievement indicated by scores on the pre-test and post-test and achievement on the MAP test indicated by the students' raw score.

The researcher used a Microsoft Excel spreadsheet to run the Pearson Product Moment Correlation Coefficient (PPMC). She used this test to demonstrate if there was any correlation among the data. She had the available data to select a random sample from each of the three teams. She calculated three different comparisons: difference in diagnostic test score to MAP raw score, difference in diagnostic score to Terra Nova score, and MAP raw score to Terra Nova score. She wanted to see if the diagnostic test had any correlation to the MAP to justify its' purpose, as well as determine the validity of the Terra Nova portion which is nationally compared to the MAP, which is only state run.

Table 17

MAP Results for Pearson Product Correlation Coefficient Hypothesis 8

Comparison	MAP Raw score	%	Classification
Test to MAP	-0.5034	-0.49815	Moderately negative
Test to Terra Nova	-0.525	-0.52245	Moderately Negative
MAP to Terra Nova	0.9146492		Strongly Positive

*Note:*To decide upon the significance of the relationship the Critical Value for PPMC is .349

The Pearson product correlation test was used to determine if there was a relationship between the MAP test and the diagnostic test the researcher used in her classroom. The researcher desired to have statistical support to represent the graphed relationships.

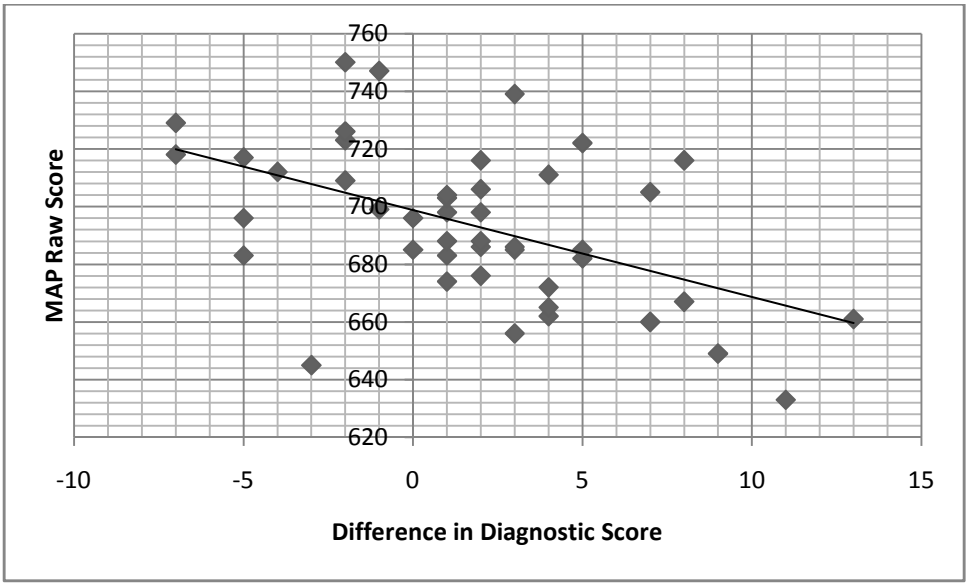

Figure 9. Scatter Plot Graph Comparing MAP Raw Score to Difference in Diagnostic Test Score

For the Null Hypothesis: There is no relationship between the increase in student achievement indicated by scores on the pre-test and post-test and achievement on the MAP test indicated by the students' raw score, the researcher discovered a moderate, negative relationship. Comparison of .503 to the critical value of .349 indicates that the

relationship is statistically significant. So, 25% of the variance in MAP raw scores can be explained by the variance in increase between pre- and post-test scores on the diagnostic tool.

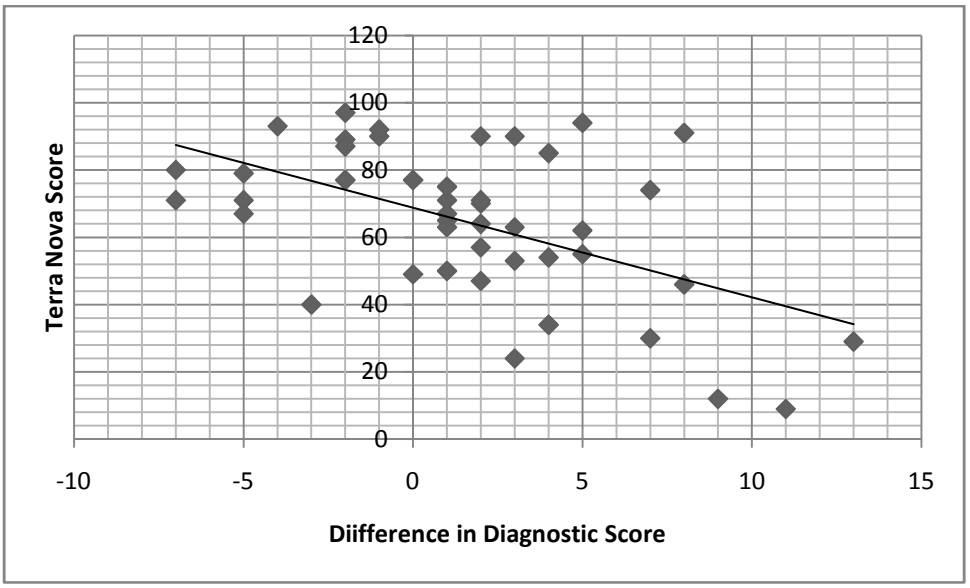

Figure 10. Scatter Plot Graph Comparing the Terra Nova Score to the Difference in Diagnostic Score

For the Null Hypothesis: There is no relationship between the increase in student achievement indicated by scores on the pre-test and post-test and achievement on the Terra Nova indicated by the students' percent score, the researcher discovered a moderate, negative relationship. Comparison of .525 to the critical value of .349 indicates that the relationship is statistically significant. So, 27.5% of the variance in Terra Nova percent scores can be explained by the variance in increase between pre- and post-test scores on the diagnostic tool.

The mathematical concern with these comparisons is that they both form a negative line of best fit. Null hypothesis 8 was not rejected; however, not in the manner the researcher originally desired. The Pearson coefficient indicated that students'

improvement on the diagnostic test did not form a positive relationship with their MAP or Terra Nova scores. The researcher observed the same relationship occurred when she compared the MAP test to the difference, as when she compared the Terra Nova portion percent to the difference. She then chose to run the Pearson Product to test if the MAP and the Terra Nova had a strong relationship.

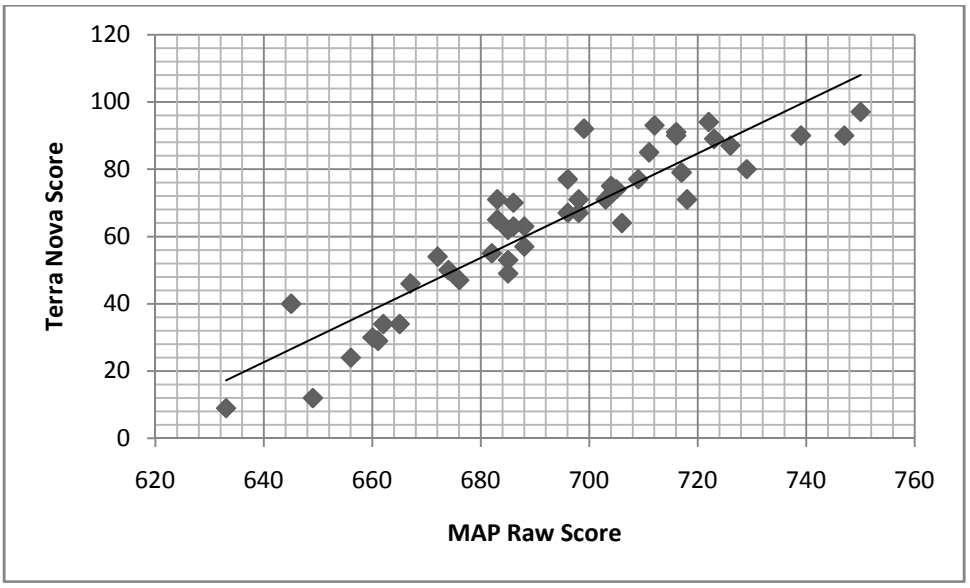

Figure 11. Scatter Plot Graph Comparing the Terra Nova Scores to the MAP Raw Scores

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For the Null Hypothesis: There is no relationship between the student achievement indicated by Terra Nova percent scores and achievement on the MAP test indicated by the students' raw scores, the researcher discovered a strong, positive relationship. Comparison of .913 to the critical value of .349 indicates that the relationship is statistically significant. So, 81% of the variance in MAP raw scores can be explained by the variance in Terra Nova percent scores. The scores on the Terra Nova portion of the MAP test are compared nationally with scores of students in the same grade level. It is a multiple choice section and, therefore, objectively scored. These

findings support that the MAP test, which was written for Missouri state grade level expectations, does indeed align with the national standards.

While there were three seventh grade teams for the 2008-2009 school year, in an effort to reduce the number of students per mathematics classroom, some students from each team were taught by a fourth seventh grade mathematics teacher. MAP testing data was separated by team, not by mathematics teacher. The chart below lists the breakdown of MAP data. The numbers represent the highest percentage of correct responses from the students on each team.

Table 18

MAP Results Separated by Teacher, Topic, and Question Type

	Mr. Dry Erase	Mrs. Overhead	Mrs. Technology
MC-Multiple Choice (51 questions total)	13 (25%)	16 (31%)	23 (45%)
CR - Constructed Response (7 total)	1 (14%)	3 (43%)	3 (43%)
Numbers/Operations 16 MC / 0 CR	2 MC (14%)	5 MC (36%)	7 MC (50%)
Algebra 9 MC / 2 CR	4 MC (44%) 0 CR (0%)	2 MC (22%) 1 CR (50%)	3 MC (33%) 1 CR (50%)
Geometry 10 MC / 2 CR	0 MC (0%) 0 CR (0%)	3 MC (33%) 1 CR (50%)	6 MC (66%) 1 CR (50%)
Measurement 9 MC / 2 CR	4 MC (44%) 1 CR (50%)	1 MC (11%) 0 CR (0%)	4 MC (44%) 1 CR (50%)
Data 11 MC / 1 CR	3 MC (30%) 0 CR (0%)	5 MC (50%) 1 CR (100%)	2 MC (20%) 0 CR (0%)

Alternate Hypothesis 1: The implementation of SMARTBoard strategies in seventh grade mathematics will impact student achievement as evidenced by higher average MAP scores for those students as compared with the average MAP scores for students who were taught seventh grade mathematics in the same building, using the same curriculum, without the SMARTBoard strategies.

Null Hypothesis 1: The implementation of SMARTBoard strategies in seventh grade mathematics will not impact student achievement as evidenced by lower or same average MAP scores for those students taught with SMARTBoard strategies as compared with the average MAP scores for students who were taught seventh grade mathematics in the same building, using the same curriculum, without the SMARTBoard strategies.

The researcher ran a *z* test for difference between means using a random selection of 45 students' MAP scores from each of the three teams. This test calculated whether there was a statistical difference between the team that had the SMARTBoard versus the teams that did not. She used a Microsoft Excel spreadsheet to calculate the variance and average of the MAP scores. She then calculated the *z* test values.

Table 19

MAP Results for z *score Test over Hypothesis 1*

Comparison	Z test value
Mrs. Technology vs Mrs. Overhead MAP	2.495621497
Mrs. Technology vs Mrs. Overhead Terra Nova	2.08091519
Mrs. Technology vs Mr. Dry Erase MAP	3.140663928
Mrs. Technology vs Mr. Dry Erase Terra Nova	2.805755134

Note: Alpha = 0.05 Critical Value 1.96

Every comparison resulted in the rejection of the null hypothesis. Alternate hypothesis 1 was supported. It is not guaranteed that the SMARTBoard teaching strategies caused the resulting higher average MAP scores; however, with the statistically significant scores that resulted from this analysis there is a strong support for use of these strategies contributing to the higher average scores.

Background of the Researcher

The researcher spent two weeks during summer, 2007, analyzing and aligning MAP questions for the seventh grade MAP test with the current Grade Level

Expectations. The researcher developed the state scoring guide for the Constructive Response questions for the seventh grade MAP for that year. She also spent time scoring the seventh grade MAP test state constructive response questions.

Implications

The MAP test was used because it carries validity as a format for evaluating student progress according to grade level expectations. It was written based on grade level expectations that should be taught during that school year. If a teacher does not teach the grade level expectations, those students will not score as well on the test. In Sun Valley Middle School the seventh grade mathematics teachers met twice each month to discuss their current location in the curriculum and best practices to be used in the classroom. All seventh grade students were taught the seventh grade curriculum, which was aligned with the Missouri grade level expectations for seventh graders. Students taught by Mrs. Technology with a SMARTBoard were more successful with test question accuracy than students taught by two teachers who did not employ a SMARTBoard.

Recommendations for Other Studies

Future studies could include involvement of more teachers who teach with a SMARTBoard in their classroom in other districts. This would provide additional support for the influence of technology as consistently responsible for higher test scores. Additional studies could compare classes with the same teacher if the technology was available for only half of the day, for example. Students could be taught one specific unit using the SMARTBoard, then using traditional methods for another unit. However, limitations will always exist in educational research when data from two groups of

students are compared. This is why proving that educational technology contributes to increases in student achievement is so difficult.

Conclusion

Some might say the excitement of the researcher who taught with the SMARTBoard resulted in the higher test scores of the students on her team. However, other research studies have demonstrated that students gain excitement for learning when a teacher is excited about learning. The use of a SMARTBoard was a significant factor, among others, for higher test scores for one of the three teams.

Chapter Eight provides a final summary and conclusion for the dissertation as a whole. The goal for chapter eight is to summarize the entire dissertation.

Chapter Eight: Final Conclusions and Summary

This study originated from the researcher's belief in the strong need for students to gain a solid understanding of mathematics and her love for the combination of teaching and technology. She knew, from her experience, that students responded well when technology was utilized in the classroom; but she neededdata to support that belief. This research then became her journey to discover the truth behind the technology she knew her students enjoyed.

Two seventh grade science teachers from Sun Valley Middle School developed the student technology survey. The researcher immediately realized that this provided valuable data about the current generation because it contained necessary information about the technology students had available to them in their homes. Additional research uncovered relevant instructional data pertaining to a single grade level. Students have technological tools and use them on a daily basis, such as cell phones and iPods or MP3 players. These items are more affordable, so many students owned them. This data supported her ideas that more children had computers in their homes with Internet service than teachers expected. Computers were much more affordable than ten years ago, and Internet access was available to most students.

Throughout this entire study, the researcher discovered that not all teachers accepted new technologies in their schools. She also discovered that there were also teachers who did not have the technologies in their school but would gladly use them if they were available. She did not survey teachers about their personal technology tools but believed this could be valuable as a comparison between personal technology tools and

teaching technology tools in the classroom. An important question continued to revolve around whether or not teachers were using the same technology as students but not transferring this for use in their classrooms. The researcher cannot prove or support that question, but many adults did own a cell phones, so it would be an interesting survey to conduct.

The personal interview was suggested to the researcher by one of her university professors. In the beginning, she did not think it would add to her research data. However, she truly gained a deeper understanding of the strategies she, herself, used in connection with technology in her classroom. This interview allowed her to think about the strategies she used in the classroom with those students and how she used the SMARTBoard as an interactive teaching tool, rather than just a glorified overhead.

The researcher, along with the other seventh grade mathematics teachers, developed the diagnostic test that was given to all seventh grade students at the beginning of the school year. This became a common assessment of students' mathematical knowledge level to determine which topics would need more attention and re-teaching and which topics could be taught at a higher level of understanding. The researcher chose to give the assessment again at the end of the school year to her own students. She wanted to determine if her students' achievement increased due to the SMARTBoard technology strategies that were implemented into the classroom. She discovered an increase in correct scores from her students, except on the questions that required long division. One cannot determine whether this result was from the use of the SMARTBoard, because the students might have seen the same gains from the researcher's enthusiasm when teaching mathematics with or without the SMARTBoard.

The researcher has the opinion that the SMARTBoard added to the depth of understanding the students obtained due to the extra visual and kinesthetic strategies she utilized in teaching. Student involvement was definitely more noticeable than in past lessons.

The last component of the research was to analyze the MAP data from all of the seventh grade students in the Sun Valley School District. The MAP test was a valid data gathering instrument since it was administered to all students during the same time in the same environment and with the same questions. The researcher implemented several comparisons of her students' scores to the other two teams with the same conclusion; the researcher's students scored higher. She compared her students to each seventh grade mathematics teacher's students in their MAP scores, as well as their Terra Nova scores. The researcher, Mrs. Technology, had student scores that were higher in the combined advanced and proficient categories, and also lower in the combined basic and below basic categories. One cannot completely determine whether this increase in performance on assessment of grade level expectations for the seventh graders was due to the technology used by the researcher or if the same gains might have occurred for students in the classrooms without the technology. The researcher concluded that technology assisted students throughout the process from learning the content to reviewing the grade level expectations. Because of the presence of the SMARTBoard in the classroom, the students were able to play interactive games as a class to review the seventh grade material to prepare for the MAP test. The students were always engaged in the lessons and active in many components of the lesson in ways that would not be possible with a chalkboard, dry erase board, or an overhead projector.

This study provides evidence that using the SMARTBoard in one seventh grade classroom contributed to higher achievement on the state standardized test. Further research on a large sample is needed to verify these exploratory findings. Digital Natives live in a digital society on a daily basis, and schools can embrace a digital society instead of alienating it. Educators can develop educational strategies that include iPods or MP3 players and cell phones in the classroom as opposed to banning them. On March 3, 2010, Arne Duncan U.S. Secretary of Education stated,

> In the 21st century, students must be fully engaged. This requires the use of technology tools and resources, involvement with interesting and relevant projects, and learning environments – including online environments – that are supportive and safe.
>
> …In the 21st century, educators must be given and be prepared to use technology tools; they must be collaborators in learning – constantly seeking knowledge and acquiring new skills along with their students. (Duncan, 2010, p. 1)

Technology will remain dominant in American society. Educators cannot ignore technology for our students to be truly prepared for the world in which they will work. Technology alone will not prepare students for the future, but the proper integration of technology in the classroom to assist their learning will prepare them.

Appendix

Appendix A: Questions on the diagnostic test:

1. Write the place value of the underlined digit in 5<u>2</u>3, 411, 396.

   6th grade GLE

   Numbers and Operations

   1Understand numbers, ways of representing numbers, relationships among numbers and number systems

   A Read, Write, and Compare Numbers

   Apply and understand whole numbers to millions, fractions and decimals to the thousandths (including location on the number line)

2. Write the place value of the underlined digit in 40<u>2</u>,659.

   6th grade GLE

   Numbers and Operations

   1Understand numbers, ways of representing numbers, relationships among numbers and number systems

   A Read, Write, and Compare Numbers

   Apply and understand whole numbers to millions, fractions and decimals to the thousandths (including location on the number line)

3. Round 4,078 to the hundreds place.

   6th grade GLE

   Numbers and Operations

   1Understand numbers, ways of representing numbers, relationships among numbers and number systems

   A Read, Write, and Compare Numbers

   Apply and understand whole numbers to millions, fractions and decimals to the thousandths (including location on the number line)

4. Round 116,830 to the thousands place.

   6th grade GLE

   Numbers and Operations

   1Understand numbers, ways of representing numbers, relationships among numbers and number systems

   A Read, Write, and Compare Numbers

   Apply and understand whole numbers to millions, fractions and decimals to the thousandths (including location on the number line

5. Write 12,230,612 in words.

   6th grade GLE

   Numbers and Operations

   1Understand numbers, ways of representing numbers, relationships among numbers and number systems

   A Read, Write, and Compare Numbers

   Apply and understand whole numbers to millions, fractions and decimals to the thousandths (including location on the number line)

6. Write ten billion in standard form.

   6th grade GLE

   Numbers and Operations

   1Understand numbers, ways of representing numbers, relationships among numbers and number systems

   A Read, Write, and Compare Numbers

   Apply and understand whole numbers to millions, fractions and decimals to the thousandths (including location on the number line)

7. Write one million, sixty-two thousand, nine hundred thirteen in standard form.

   6th grade GLE

   Numbers and Operations

   1Understand numbers, ways of representing numbers, relationships among numbers and number systems

   A Read, Write, and Compare Numbers

   Apply and understand whole numbers to millions, fractions and decimals to the thousandths (including location on the number line)

8. Use > or < to compare the numbers.

   106,218 _____ 106,812

   7th grade GLE

   Numbers and Operations

   1Understand numbers, ways of representing numbers, relationships among numbers and number systems

   A Read, Write, and Compare Numbers

   Compare and Order Integers, positive rationals and percents, including finding their approximate location on a number line

9. Order from least to greatest.

   2706; 2805; 2766; 2689

   7th grade GLE

   Numbers and Operations

   1Understand numbers, ways of representing numbers, relationships among numbers and number systems

   A Read, Write, and Compare Numbers

   Compare and Order Integers, positive rationals and percents, including finding their approximate location on a number line

10. Use > or < to make the relation true.

    43,561 _____ 44,679 _____ 44,697

    7th grade GLE

    Numbers and Operations

    1Understand numbers, ways of representing numbers, relationships among numbers and number systems

    A Read, Write, and Compare Numbers

    Compare and Order Integers, positive rationals and percents, including finding their approximate location on a number line

11. 4,208

+ 6,967

3rd grade GLE (to a much more difficult degree)

Numbers and Operations

2Understand meanings of operations and how they relate to one another

B Describe effects of operations

Describe the effects of adding and subtracting whole numbers as well as the relationship between the two operations

12. 591 + 79

3rd grade GLE (to a much more difficult degree)

Numbers and Operations

2Understand meanings of operations and how they relate to one another

B Describe effects of operations

Describe the effects of adding and subtracting whole numbers as well as the relationship between the two operations

13. four thousand sixty-two plus nine-hundred eighteen

3rd grade GLE (to a much more difficult degree)

Numbers and Operations

2Understand meanings of operations and how they relate to one another

B Describe effects of operations

Describe the effects of adding and subtracting whole numbers as well as the relationship between the two operations

5th grade GLE

Numbers and Operations

1Understand numbers, ways of representing numbers, relationships among numbers and number systems

A Read, Write, and Compare Numbers

Read, write and compare whole numbers less than 1,000,000 unit fractions and decimals to hundredths (including location on the number line)

14. 2,051 – 988

3rd grade GLE (to a much more difficult degree)

Numbers and Operations

2Understand meanings of operations and how they relate to one another

B Describe effects of operations

Describe the effects of adding and subtracting whole numbers as well as the relationship between the two operations

15. 116,493

- 90,287

3rd grade GLE (to a much more difficult degree)

Numbers and Operations

2Understand meanings of operations and how they relate to one another

B Describe effects of operations

Describe the effects of adding and subtracting whole numbers as well as the relationship between the two operations

16. nine thousand minus five hundred thirty-eight

3rd grade GLE (to a much more difficult degree)

Numbers and Operations

2Understand meanings of operations and how they relate to one another

B Describe effects of operations

Describe the effects of adding and subtracting whole numbers as well as the relationship between the two operations

5th grade GLE

Numbers and Operations

1Understand numbers, ways of representing numbers, relationships among numbers and number systems

A Read, Write, and Compare Numbers

Read, write and compare whole numbers less than 1,000,000 unit fractions and decimals to hundredths (including location on the number line)

17. 594 x 8

7th grade GLE

Numbers and Operations

3. Compute fluency and make reasonable estimates

C Compute problems

Multiply and Divide Rational Numbers

18. 1,174

X 6

7th grade GLE

Numbers and Operations

3. Compute fluency and make reasonable estimates

C Compute problems

Multiply and Divide Rational Numbers

19. six thousand eighty-one times seven

    7th grade GLE

    Numbers and Operations

    3. Compute fluency and make reasonable estimates

    C Compute problems

    Multiply and Divide Rational Numbers

    5th grade GLE

    Numbers and Operations

    1Understand numbers, ways of representing numbers, relationships among numbers and number systems

    A Read, Write, and Compare Numbers

    Read, write and compare whole numbers less than 1,000,000 unit fractions and decimals to hundredths (including location on the number line)

20. 54 x 917

    7th grade GLE

    Numbers and Operations

    3. Compute fluency and make reasonable estimates

    C Compute problems

    Multiply and Divide Rational Numbers

21. 806

X 255

7th grade GLE

Numbers and Operations

3. Compute fluency and make reasonable estimates

C Compute problems

Multiply and Divide Rational Numbers

22. one thousand sixty-nine times forty eight

7th grade GLE

Numbers and Operations

3. Compute fluency and make reasonable estimates

C Compute problems

Multiply and Divide Rational Numbers

5th grade GLE

Numbers and Operations

1Understand numbers, ways of representing numbers, relationships among numbers and number systems

A Read, Write, and Compare Numbers

Read, write and compare whole numbers less than 1,000,000 unit fractions and decimals to hundredths (including location on the number line)

23. one hundred thirty-three times four thousand, two hundred eighty-six

7th grade GLE

Numbers and Operations

3. Compute fluency and make reasonable estimates

C Compute problems

Multiply and Divide Rational Numbers

5th grade GLE

Numbers and Operations

1Understand numbers, ways of representing numbers, relationships among numbers and number systems

A Read, Write, and Compare Numbers

Read, write and compare whole numbers less than 1,000,000 unit fractions and decimals to hundredths (including location on the number line)

24. 822 divided by 6

7th grade GLE

Numbers and Operations

3. Compute fluency and make reasonable estimates

C Compute problems

Multiply and Divide Rational Numbers

25. 964 / 5

7th grade GLE

Numbers and Operations

3. Compute fluency and make reasonable estimates

C Compute problems

Multiply and Divide Rational Numbers

26. one thousand, two hundred eighty-seven divided by nine

7th grade GLE

Numbers and Operations

3. Compute fluency and make reasonable estimates

C Compute problems

Multiply and Divide Rational Numbers

5th grade GLE

Numbers and Operations

1Understand numbers, ways of representing numbers, relationships among numbers and number systems

A Read, Write, and Compare Numbers

Read, write and compare whole numbers less than 1,000,000 unit fractions and decimals to hundredths (including location on the number line)

27. 6,432 / 24

    7th grade GLE

    Numbers and Operations

    3. Compute fluency and make reasonable estimates

    C Compute problems

    Multiply and Divide Rational Numbers

28. 504 / 24

    7th grade GLE

    Numbers and Operations

    3. Compute fluency and make reasonable estimates

    C Compute problems

    Multiply and Divide Rational Numbers

29. 1,756 / 29

    7th grade GLE

    Numbers and Operations

    3. Compute fluency and make reasonable estimates

    C Compute problems

    Multiply and Divide Rational Numbers

30. 1,016 divided by 5

7th grade GLE

Numbers and Operations

3. Compute fluency and make reasonable estimates

C Compute problems

Multiply and Divide Rational Numbers

Appendix B

Table 20

Diagnostic Test Results

Questions	Totals (out of 88) August 15, 2008 (w/o calc)	Totals (out of 88) May 23, 2009 (w/calc)	Increase or Decrease
Q1	33	49	*Increase (16)*
Q2	54	51	**Decrease (3)**
Q3	62	69	*Increase (7)*
Q4	56	65	*Increase (9)*
Q5	62	76	*Increase (14)*
Q6	74	69	**Decrease (5)**
Q7	76	71	**Decrease (5)**
Q8	84	81	**Decrease (3)**
Q9	87	78	**Decrease (9)**
Q10	73	70	**Decrease (3)**
Q11	82	79	**Decrease (3)**
Q12	80	79	**Decrease (1)**
Q13	69	70	*Increase (1)*
Q14	56	76	*Increase (20)*
Q15	67	77	*Increase (10)*
Q16	54	69	*Increase (15)*
Q17	71	75	*Increase (4)*
Q18	71	83	*Increase (12)*
Q19	54	77	*Increase (23)*
Q20	44	72	*Increase (28)*
Q21	55	66	*Increase (11)*
Q22	26	62	*Increase (36)*
Q23	25	57	*Increase (32)*
Q24	66	76	*Increase (10)*
Q25	51	**7**	**Decrease (44)**
Q26	64	68	*Increase (4)*
Q27	32	74	*Increase (42)*
Q28	66	79	*Increase (13)*
Q29	23	**2**	**Decrease (21)**
Q30	54	**5**	**Decrease (49)**
Min	**23**	**2**	
Max	**87**	**86**	
Average (Mean)	**61.89**	**66.32**	
Median	**63**	**70.5**	
Mode	**54**	**69**	
Standard Deviation	**17.64**	**20.22**	

Appendix C

Table 21

Diagnostic Test Results for Z test separated by Question

Question #	1 Tail Z Test	Z Value	Reject Null, Do Not Reject Null, Support Hypothesis, Do Not Support Hypothesis
1	Actual CI (98.8%) Yes	2.266	Reject Null, Support Hypotheis
2	62.1 % No	0.307	Do Not Support Hypothesis, Do Not Reject Null
3	85% No	1.038	Do Not Support Hypothesis, Do Not Reject Null
4	90.3% No	1.3	Do Not Support Hypothesis, Do Not Reject Null
5	99.1% Yes	2.382	Reject Null, Support Hypothesis
6	78% No	0.772	Do Not Support Hypothesis, Do Not Reject Null
7	79.2% No	0.812	Do Not Support Hypothesis, Do Not Reject Null
8	73.2% No	0.62	Do Not Support Hypothesis, Do Not Reject Null
9	99.4% Yes	2.489	Reject Null, Support Hypothesis
10	65% No	0.54	Do Not Support Hypothesis, Do Not Reject Null
11	70.5% No	0.54	Do Not Support Hypothesis, Do Not Reject Null
12	50% No	0.001	Do Not Support Hypothesis, Do Not Reject Null
13	50% No	0.001	Do Not Support Hypothesis, Do Not Reject Null
14	100% Yes	3.306	Reject Null, Support Hypothesis

15	96.1% Yes	1.758	Do Not Support Hypothesis, Do Not Reject Null
16	98.9% Yes	2.301	Reject Null, Support Hypothesis
17	72.6% No	0.602	Do Not Support Hypothesis, Do Not Reject Null
18	99.4% Yes	2.508	Reject Null, Support Hypothesis
19	100% Yes	3.802	Reject Null, Support Hypothesis
20	100% Yes	4.294	Reject Null, Support Hypothesis
21	94.8% No	1.626	Do Not Support Hypothesis, Do Not Reject Null
22	100% Yes	5.275	Reject Null, Support Hypothesis
23	100% Yes	4.684	Reject Null, Support Hypothesis
24	95.7% Yes	1.718	Do Not Support Hypothesis, Do Not Reject Null
25	100% Yes	6.896	Reject Null, Support Hypothesis
26	69.9% No	0.521	Do Not Support Hypothesis, Do Not Reject Null
27	100% Yes	6.315	Reject Null, Support Hypothesis
28	99.1% Yes	2.374	Reject Null, Support Hypothesis
29	100% Yes	4.32	Reject Null, Support Hypothesis
30	100% Yes	7.664	Reject Null, Support Hypothesis

Note. 0.05 Alpha Critical Value 1.96

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Vitae

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