THE IMPACT OF A TECHNOLOGY-RICH CLASSROOM ON THE MEASURE OF ACADEMIC PERFORMANCE IN MATHEMATICS AT GRADES 3, 4, 5, and 6

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ABSTRACT

The purpose of this study was to determine if equipping classrooms with technology components had a positive impact on student achievement in mathematics in grades 3, 4, 5, and 6 as measured by the Measure of Academic Performance (MAP) in the Turner School District. The study was guided by four research questions. The first was “What impact does the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics in 3^{rd} grade classrooms?” The other three were identical except for grade level. The study was designed to use an experimental group and a control group. The sample included 855 students in grades 3-6 attending five different low socio-economic elementary schools in the Turner USD 202 School District in Kansas City, Kansas. After the data were collected, a *t* test for independent means was computed for each of the grade levels in the study (3^{rd}, 4^{th}, 5^{th} and 6^{th} grades). The independent *t* test was computed to determine the influence of a technology-rich classroom on student achievement in mathematics as measured by the MAP. Results from this quantitative, quasi-experimental study showed a significant difference for students in a technology-rich classroom in 3^{rd} grade. The results from students in the 4^{th} and 5^{th} grade revealed a difference for students in the technology-rich classroom compared to those in the traditional classroom; however, not a significant difference. Finally, results from the 6^{th} grade students revealed students in the traditional classroom significantly outperformed students receiving instruction in a technology-rich classroom. The literature reviewed in this study provided a similar outcome, with varying results in whether technology integration positively impacted student achievement.

However, previous research did support technology integration positively affected students' motivation and engagement in the classroom.

DEDICATION

This work is dedicated to the following people:

To my dad, who has always encouraged me to be a lifelong learner and to fulfill my dreams. I am grateful for the encouragement he has provided to always work hard and accomplish great things. Thank you for having high expectations and pushing me to be a better person; I love you.

To my husband, who has supported me through this entire program: The encouragement and sacrifice I am so grateful for; I love you.

To my children, who encouraged me to finish this doctoral program and dissertation, because it was personally meaningful to me; I love you all.

To my friends and co-workers, who provided the emotional support that kept me focused even when I was completely frustrated, and who provided those venting opportunities. I feel truly blessed.

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It is also important to recognize Dr. Ray Daniels for his dedication and commitment to serve on my committee. Dr. Daniels has provided inspiration for me as a superintendent as a result of his success as the Superintendent of Kansas City, Kansas, Public Schools for many years.

In addition, it is important to recognize the Turner USD 202 Board of Education, district and building administration, and the teaching staff, for without them, this research project could not have been successful. There are so many people in the district who have supported me throughout the doctoral program, and for that I am extremely thankful!

I must not forget the cohort members who met with me most Thursday nights for the past three years. I have made friendships and professional relationships that will last a lifetime. Many of them encouraged and inspired me throughout the program. I'll never forget the memories created in Cohort Three!

Finally, the most important acknowledgment is for my husband, Paul, and five children, Regan, Jared, Samantha, Kennedy, and Blair, who have patiently supported me through the entire process. The program was a great sacrifice for our family as I have missed many events in my children's lives. They have been so understanding and

supportive. In addition, Paul often times had to be Mr. Mom for the past three years so my time could be dedicated to the program and the writing of this dissertation. I am eternally grateful for Paul and the kids for their dedication to my success. This was possible as we all worked together as a team!

Table of Contents

List of Tables

List of Figures

CHAPTER ONE

INTRODUCTION AND RATIONALE

Over the past two decades, the concept of instructional technology in public schools has evolved dramatically. Twenty years ago, classrooms may have had one single computer for student use; however, today the technology components available for instruction seem to be endless. In addition, today's students are connected to technology in every aspect of their lives, from television, I-pods, hand-held video games, Internet, and computer, to text messaging. Thanks to technology, students are exposed to parts of society and different cultures in the world previously out of reach. With the large number of improved technology products on the market, education in the classroom can no longer be a place to share learning in a traditional approach. Prensky (2008) believed educators should work to remove the common approach to teaching to the test and should instead engage students in an interactive learning environment. More importantly, the interactive learning environment must have a direct impact on student achievement and growth.

Studies suggested that students actively involved in instruction using technology had positive gains in academic achievement (Schacter, 2009). Schacter believed that although technology is just a tool to enhance teaching and learning, technology can provide hands-on opportunities for student learning. Technology, as a tool for instruction, enhanced curriculum and engaged students in learning. When students were engaged in learning through technology, learning becomes more interactive, enjoyable, and customizable, which improved students' attitudes towards the subject and their interest in learning (Valdez, McNabb, Foertsch, Hawkes, & Raack, 2000). The 21st century classroom must be an environment where students are actively engaged in their own learning.

Problem Statement

With the ever-changing digital society of the 21st century, today's educators must continue to research the impact of technology integration on student achievement.

Background and Conceptual Framework

Turner Unified School District 202 is located in Kansas City, Kansas, on the southern edge of Wyandotte County. The small urban district has approximately 4000 students served in an early learning center (pre-school and all-day kindergarten), five K-6 elementary schools, one 7-8 middle school, one 9-12 alternative high school, and one comprehensive 9-12 high school. Over the past 5 years, the school district has undergone an ethnic shift in population growth (see Figure 1). The Caucasian population is the only population with a consistent decrease at 9.6 %, while the Hispanic population has grown approximately 8.6 %.

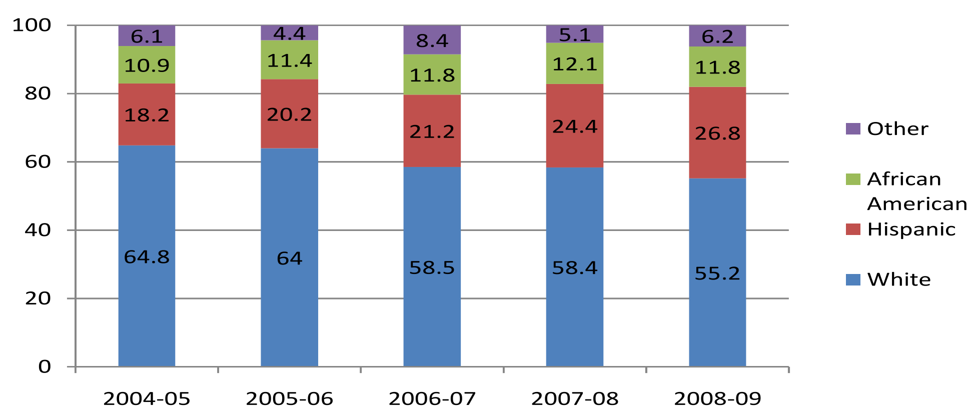

Figure 1. Turner USD 202 ethnicity percentages

Note. From *S066 Report*, Turner USD 202, September 2008. Unpublished document.

Although there has been some fluctuation in the small minority groups of African American and students identified as Other, the percentage change is small. In addition to a shift in the ethnic population, Turner has realized an increase in the number of students receiving free or reduced meal benefits (see Figure 2). The percentage of students receiving assistance in the lunch program has increased 12.7% in the past 5 years.

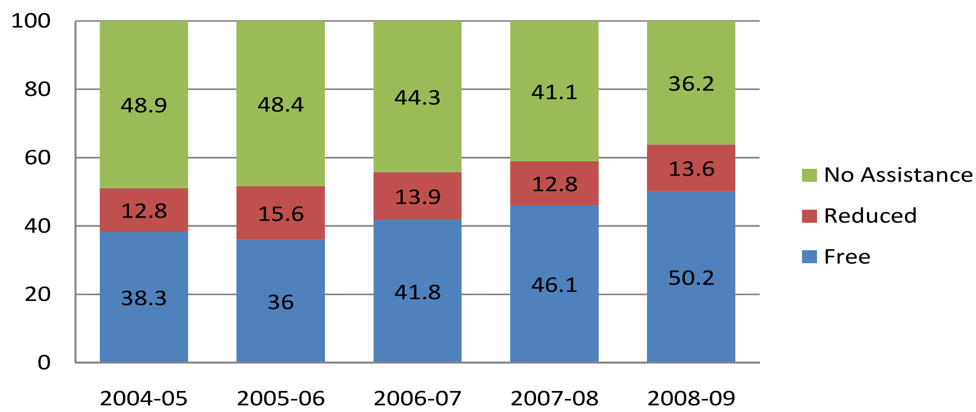

Figure 2. Turner USD 202 free/reduced lunch status percentages

Note. From *SO66 Report*, Turner USD 202, September 22, 2008. Unpublished document.

Over the past 5 years, the Turner School District has made great efforts to increase the number of students performing at the proficient level or above in both reading and math (see Figure 3 and Figure 4). Several Turner schools have recently achieved the Standard of Excellence as defined by the Kansas State Department of Education (2008d). Despite these gains, the Turner School District has not met adequate yearly progress (AYP) as defined by No Child Left Behind (NCLB). As a result, the school district was placed "on improvement" for the fifth consecutive year. No Child Left

Behind classifies Title I schools and districts not making AYP for two consecutive years as on improvement. When a district is on improvement, it must write an extensive improvement plan and accept technical assistance from professionals at the Kansas State Department of Education (KSDE). The KSDE team monitors district progress and provides support as needed to make the expected gains. There are numerous steps in the improvement process, with the ultimate reprimand resulting in KSDE restructuring and taking control of the district. The state department takeover has never happened in Kansas (Kansas State Department of Education, 2008a).

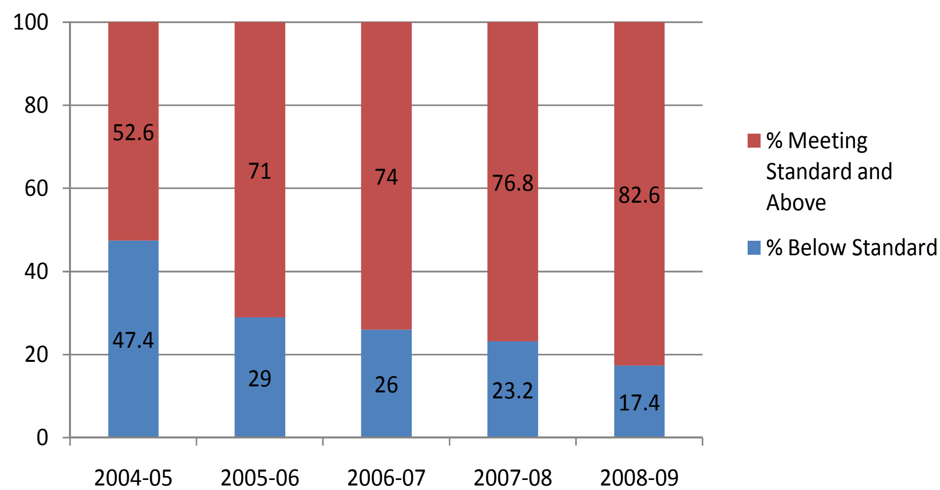

Figure 3. Turner USD 202 Kansas state reading assessment percentages

Note. Kansas State Assessment Data, Turner USD 202, May 2009. Available at http://online.ksde.org/rcard/search_database.aspx

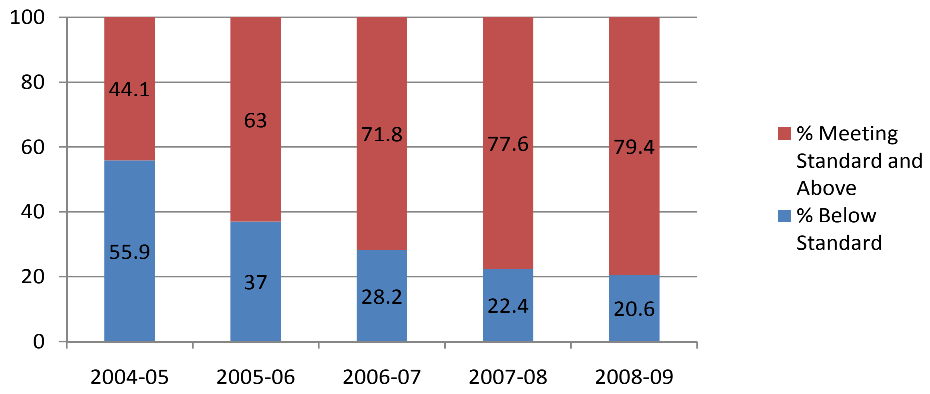

Figure 4. Turner USD 202 Kansas state math assessment percentages

Note. Kansas State Assessment Data, Turner USD 202, May 2009. Available at http://online.ksde.org/rcard/search_database.aspx

In spring 2008, students in the Turner School District began taking the Measure of Academic Performance Assessment (MAP) in addition to the Kansas State Assessments. The MAP assessment is administered in grades 3 through 10. All schools in the district are required to administer the MAP in early fall and late spring, which provides pre-test and post-test data for each classroom in the district for each academic school year. With the pre- and post-test data, the district is able to measure growth for individual students as well as for subgroups identified by the district.

One of the most important features of the MAP is the growth score obtained for individual students from the fall to spring test. In addition to each individual score, MAP provides a typical growth score for age, grade level, and performance level for comparison. The data provided in Figure 5 compare the district's fall 2008 MAP data with national norms. While grades 3, 5, 8, 9 and 10 are slightly below the national norm, grades 4, 6, and 7 are slightly above the national norm. The largest discrepancy from the norm is in grade 9, with a difference in RIT (short for Rasch unit) score mean of -3.3, while grade 6 students were performing with a 1.1 gain over the national norm.

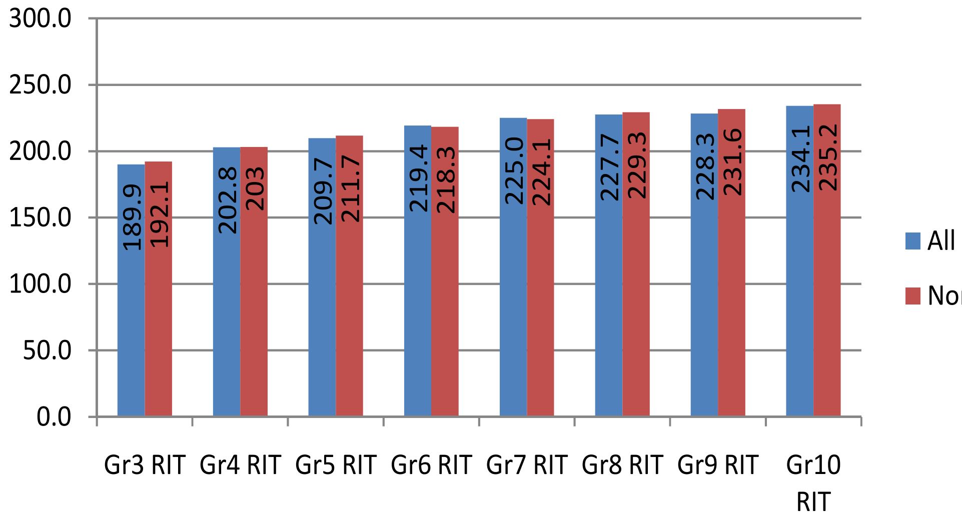

Figure 5. Turner USD 202 fall 2008 math MAP percentages

Note. From *MAP Assessment Data*, Turner USD 202, November 2008. Unpublished document.

Figure 6 shows comparison of the spring 2009 MAP data to the national norm. With the exception of grades 4 and 6, all other grade levels were performing below the national norm, with a difference in mean RIT scores ranging from -1.0 in grade 7 to -3.4 in grade 9.

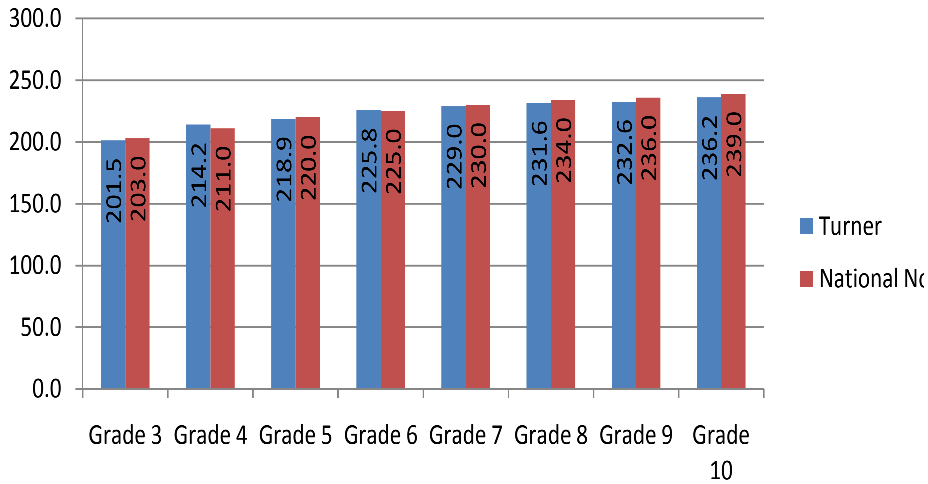

Figure 6. Turner USD 202 spring 2009 math MAP percentages

Note. From *MAP Assessment Data*, Turner USD 202, May 2009. Unpublished document.

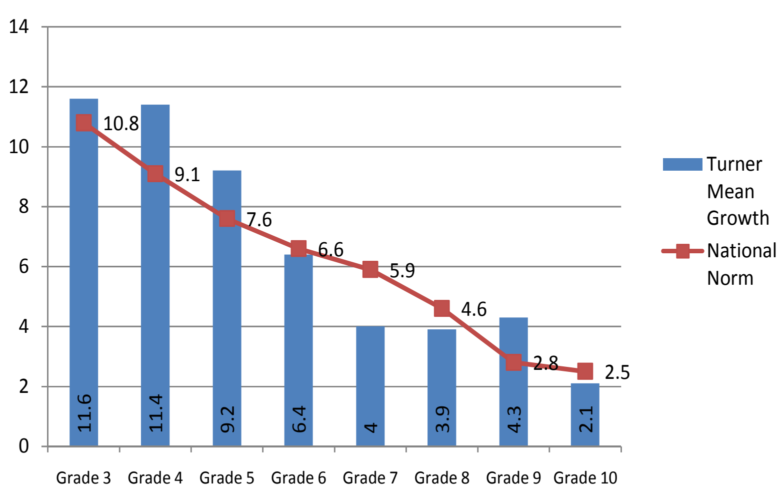

Figure 7. Turner USD 202 MAP 2008-09 student growth mathematics summary

Note. From *MAP Assessment Data*, Turner USD 202, June 2009. Unpublished document.

Figure 7 compares the typical growth mean from fall 2008 to spring 2009 for Turner to the national norm for all students in grades 3 through 10. During the 2008-09 academic school year in the Turner School District, students in grades 3, 4, 5, and 9 had more growth than the national norm, while grades 6, 7, 8 and 10 growth were lower than the national norm. The growth index ranged from -1.9 in grade 7 to 2.3 in grade 4.

In October 2007, the Turner School District put forth a bond issue geared specifically toward developing technology-rich classrooms. The bond issue would have provided each classroom with a SMART board, an LCD projector, a document camera, and access to classroom response systems. Unfortunately, the bond issue did not pass. The Board of Education remained committed to providing Turner students and staff with technology-rich classroom opportunities and voted unanimously to support the technology integration through a capital bonds project. The school district decided to move forward with the project starting in the 2008-09 school year, and it became a goal to see whether the technology-rich classroom would yield improvement in student achievement. Because the Board of Education made a decision to proceed despite the voters, it was imperative for the Board of Education to provide accountability for the project to the voting community. As part of the 3-year phase-in project, the school district placed technology in 75 classrooms each year until all 225 classrooms are fully equipped (Keberlein, 2008). The data collected could provide a vehicle to provide district leaders with valuable information on future decisions made in the second and third years of the project. The initial classroom teachers were chosen through an application process.

Integration of technology into public school classrooms seems to be a common topic of discussion for educators in the 21st century.The effectiveness of instructional technology on student achievement continues to be debated by educators. While chapter two of this document discusses research studies both supporting and contradicting the positive impact of technology on student achievement, educators and students perceive a direct relationship between the integration of technology and the motivation to learn; hence, enhancing student achievement (Pompeo, 2004).

Significance

The significance of the study was to validate the impact of a $2 million expenditure on technology-rich classrooms on student achievement in mathematics. This study can assist schools, specifically low-income schools in urban areas, with efforts to determine the value of instructional technology and the impact on student achievement in mathematics. It will also assist the Turner School District in future initiatives regarding the purchase of technology and the impact on student achievement.

Purpose Statement

The purpose of this study was to determine if equipping classrooms with technology components (interactive whiteboard, LCD projector, document camera, and e-clickers) had a positive impact on student achievement in mathematics as measured by the MAP in the Turner School District. Conducted during year one of the implementation, this study was designed to examine and compare the impact on student achievement in mathematics for students in a technology-rich classroom environment with student achievement in mathematics for students instructed in a traditional classroom.

Delimitations

Delimitations are variables controlled by the researcher. According to Roberts, "Delimitations clarify the boundaries of a study and provide the reader with how the researcher has narrowed the study's scope" (2004, p. 129). The following delimitations were defined:

1. Mathematics data were collected and analyzed during one school year (2008-09) in Turner USD 202.
2. Mathematics data were collected and analyzed only in grades 3, 4, 5 and 6 in Turner USD 202.

Assumptions

Assumptions, according to Roberts (2004), are the items that are taken for granted in a study. The following assumptions were made while conducting this research study:

1. Teachers in technology-rich classrooms used the technology provided in the instructional process.
2. Students gave 100% effort on the indicated assessment.
3. A common curriculum was taught throughout the district in both technology rich and traditional classrooms.
4. Teaching methods were consistent and aligned to the district improvement plan in all classrooms.

Research Questions

Numerous studies have been completed on the effects of technology in the classroom, although few studies have measured the impact of the interactive whiteboard, document cameras, LCD projectors, or classroom response systems. While most studies focused on attitude and perception of technology, the current study focused on the impact of technology on student achievement in mathematics. The following questions guided this research study:

1. What impact does the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics in 3rd grade classrooms?
2. What impact does the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics in 4th grade classrooms?
3. What impact does the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics in 5th grade classrooms?
4. What impact does the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics in 6th grade classrooms?

Definition of Key Terms

Adequate yearly progress (AYP). The No Child Left Behind Act (1996) requires adequate yearly progress. The term refers to the growth rate in the percentage of students who achieve the state's definition of academic proficiency. In addition to all students making AYP, individual subgroups with students of 30 or more students must also meet the state’s definition of academic proficiency, as well. AYP data is contained within the building, district, and state report card (Kansas State Department of Education, 2008a).

Bond issue. A bond is a written promise that the borrower will pay back a specified amount with interest at a fixed-rate to the lender at a certain time in the future. The interest is usually paid in equal time frames, which are described on the bond. For school districts, interest payments are generally paid twice a year with some of the principle, or the base amount borrowed, paid annually.

Classroom response system. "Clickers" are small, handheld devices allowing students to respond to verbal questions on paper or on screen and enabling students instantly to assess their comprehension of the presented lessons (Classroom Performance System, 2009).

Document camera. Document cameras, like an ELMO or Aver Media, allow users to display live, color images to the class when used with an LCD projector. In addition, most document cameras have a zoom-in feature allowing users to feature even the smallest manipulation or text. Users can also record video of a presentation and capture digital stills (photos) at the press of a button. Adjustable brightness features allow for variations in classroom lighting, thus ensuring all students can view the presentation (Bedley, 2007).

Kansas Math Assessment, Kansas Reading Assessment. Kansas Math and Reading Assessments are given annually at grades 3 through 8, and once in high school. The results of both tests are used to calculate AYP scores in accordance with NCLB. The standards were revised in the fall of 2005 and new tests implemented in the spring of 2006 (Kansas State Department of Education, 2008b).

LCD projector. Liquid crystal display (LCD) projectors are used to display vivid, color images to the class from a computer, document camera (ELMO or Aver Media), DVD player, or VCR (Bedley, 2007).

Measure of academic performance (MAP). A state-aligned computerized adaptive assessment program that provides educators with the information they need to improve teaching and learning. Educators use the growth and achievement data from MAP to develop targeted instructional strategies and to plan school improvement (NWEA: Northwest Evaluation Association, 2009).

No Child Left Behind. The No Child Left Behind Act of 2001 (Public Law 107-110), often abbreviated in print as NCLB, is a controversial United States federal law (Act of Congress) that reauthorized a number of federal programs aiming to improve the performance of U.S. primary and secondary schools by increasing the standards of accountability for states, school districts, and schools, as well as providing parents more flexibility in choosing which schools their children will attend (United States Department of Education, 2008).

On improvement. NCLB requires Title I schools and districts that do not make adequate yearly progress (AYP) for two consecutive years to be identified for improvement (Kansas State Department of Education, 2008c).

Standard of excellence. This award of excellence is given to schools when a large percentage of students perform at the *exemplary* level and a limited number of students perform in the *academic warning* performance level (Kansas State Department of Education, 2008d).

Smartboard. SMART Board technology provides for an interactive and engaging platform that enhances instruction and student learning. When used with an LCD Projector, the touch-sensitive display allows users to control computer applications, such as Microsoft programs, the Internet, and more, directly from the whiteboard display. In addition, users can write notes in "digital ink" and save this work to share with students later. Larger, securely-mounted projector screens will provide more width and height to any classroom presentation when used with an LCD projector or overhead projector with transparencies (SMART Technologies, 2008).

Technology-rich classroom. A classroom equipped with the technology components of an LCD projector, a document camera, an interactive whiteboard, and a classroom response system.

Overview of the Methodology

This study was designed to compare student achievement in mathematics (specifically, growth on the MAP Assessment) of the students receiving a portion of their instruction in a technology-rich classroom as compared to those students receiving instruction in classrooms not having technology-rich components. The 3rd grade sample included 35 students receiving a portion of their instruction in a technology-rich classroom and 50 students receiving instruction in the traditional classroom setting. The 4th grade sample included 154 students receiving a portion of their instruction in a technology-rich classroom and 96 students receiving instruction in the traditional classroom setting. The 5th grade sample included 99 students receiving a portion of their instruction in a technology-rich classroom and 147 students receiving instruction in the traditional classroom setting. The 6th grade sample included 135 students receiving a portion of their instruction in a technology-rich classroom and 139 students receiving instruction in the traditional classroom setting. All students participated in a pre-test of the MAP within the first 3 weeks of the school year and all students took a post-test of the MAP the last 3 weeks of the school year. All students in this study started the 2008-09 school year in the assigned classroom and remained there for the entire school year, with the same classroom teacher.

After the data were collected, a *t* test for independent means was conducted for each of the grades levels in the study (3^{rd}, 4^{th}, 5^{th} and 6^{th} grades). The independent samples *t* test was conducted to determine the influence of a technology-rich classroom on student achievement in mathematics.

Summary

This chapter has provided background information about Turner Unified School District 202 located in Kansas City, Kansas, including district demographics, technology expectations and opportunities, and student performance. This research was designed to measure the impact of technology-rich classrooms in the 3^{rd} through 6^{th} grades in mathematics on the MAP. Chapters two, three, four, and five provide a review of literature, the methodology used in the study, the study results, interpretation, and recommendations for future research.

CHAPTER TWO

REVIEW OF LITERATURE

Introduction

This chapter provides a discussion around the literature relating to the use of technology in the classroom and the impact on student achievement. In addition, this chapter reviews a variety of research studies addressing the impact of instructional technology on student achievement, as well as engagement and motivation. The material reviewed consists of quantitative and qualitative research studies, journal articles, Web sites, and other current literature. While research studies specifically on the effect of interactive whiteboards, LCD projectors, document cameras, or classroom response systems in elementary schools were scarce, existing studies and journal articles described professional development, teacher perception of technology in the classroom, secondary instructional technology, student motivation and student engagement, and the impact on student achievement. This chapter is organized into a historical perspective of the past three decades; a description of the instructional technology components specific to this study, including the interactive whiteboard (IWB), Liquid Crystal Display (LCD) projector, document camera, and classroom response system; and the advantages and disadvantages of computer technology integration and its impact on student achievement.

As mentioned in chapter one, today's students are connected to technology in every aspect of their lives, from television, I-pods, hand-held video games, Internet, and computers, to text messaging. Because technology is so prevalent in the lives of youth today, it is only logical to provide opportunities in the classroom to ensure the educational field is meeting the needs of all students. According to Prensky, technology is a tool for both teachers and students to use to manage their learning (2008). Technology is the vehicle transforming teachers' pedagogy in the classroom. Research has shown that technology can provide equal learning opportunities for all students, regardless of their demographic background (Peck & Dorricott, 1994; Pompeo, 2004). Teachers must work with the technology to provide rigorous and relevant opportunities in the classroom.

While instructional technology can be traced back to the early 1900s, the majority of literature addressing instructional technology appears in the past three decades. According to Reiser (2001), in the 1970s, technology in the classroom primarily consisted of media use by teachers. Media were used to help teachers with instructional design and as a supplement to the general curriculum. In addition to media, the 1980s brought the use of microcomputers to the classroom for instructional purposes. While computer-based instruction was evolving in the classroom, the primary use of computers in the 1980s was to automate some elements of instructional design, making lesson design easier for teachers, and to manage data for teachers (Reiser, 2001). During the 1980s, the number of educators utilizing technology increased and teachers began to experience the advantages technology brought to the classroom such as the quality and quantity of students' thinking and writing, creativity and grammatical risks, as well as editing and creating finished products (Peck & Dorricott, 1994). The 1990s brought a significant change to the classroom with regards to instructional technology. The Internet was introduced, along with distance learning and interactive whiteboards (Howe, 2009; SMART Technologies, 2008).

At the turn of the 21st century, the United States Department of Education created legislation, referred to as Goals 2000, which incorporated a plan to support systemic technological reform for public schools. This legislation required states to develop technology plans describing their use of technology and to explain how they would support student learning in the reform efforts. The intent of the Goals 2000 commission was to move the use of technology away from the traditional uses and to transition to technology being used as a more efficient vehicle or tool for learning, preparing students for the "real world" (U.S. Department of Education , n.d.).While the traditional uses of technology defined through the U.S. Department of Education should not be construed as ineffective practices, they were noted as unlikely to transform a classroom or school. The traditional uses were defined as:

1. Technology as the teacher's presentation tool;
2. Technology for remedial instruction;
3. Teaching students about technology (U.S. Department of Education , n.d., n.p.).

The effectiveness of instructional technology techniques on student achievement continues to be debated by educators. Paino (2009) conducted research supporting that the integration of technology had a positive impact on student achievement in mathematics. The research was conducted in a first grade classroom in an inner-city urban district in the Northeastern part of the United States. The classroom had 24 first grade students ranging from six to eight years old. None of the students had been exposed to instruction using technology. The study had a control group which would receive instruction through the use of personal whiteboards and markers and an experimental group which would receive instruction through the IWB.

The study was designed around the Houghton Mifflin 1st Grade Math series textbook, Volume 1, Unit 4, Chapters 10-12. All students were given a pre-test and a post-test from the math series materials. In addition to the quantitative data, Paino also measured the motivation of the students with three different instruments: 1) a reflection journal; 2) an observation checklist; and 3) student interviews. The instruments were developed by the researcher (Paino, 2009).

Paino (2009) conducted an ANOVA to determine there was no significant difference between the pre and post test of the two groups. While the post test results revealed both groups improved, there was a significant difference in the mathematical performance of the experimental group as compared to the control group. Additionally, qualitative results indicated students were more engaged with the integration of technology in the classroom.

In a causual comparitive study conducted by Wendt (2007), results showed signficant improvement in student achievement, as measured by the Tennessee Comprehensive Assessment Program, also known as the TCAP, for students taught in classrooms with instructional technology, as compared to those taught in classes without technology. Wendt’s study was conducted in nine elementary schools over a three year period. Student achievement scores, reviewed before and after the implementation of an Enhancing Education Through Technology grant, showed significant gains in student achievement for math and reading/language arts.

In addition to Wendt, Pompeo (2004) conducted a qualitative comparison study with four secondary schools to determine the impact of computer integration into the classroom through a survey. Schools were identified as advanced computer technology schools through a survey ranking five different areas: (a) hardware, (b) connectivity, (c) content, (d) staff development, and (e) integration and use of technology. Based on a survey created by Pompeo, the advanced computer technology schools were compared to the schools in a convenience sample not identified as advanced computer technology schools. The survey was completed by administrators, teachers, technology supervisors, and students. Since Pompeo specifically examined perceptions, data did not support increased student achievement. The study yielded the following results:

1. For schools to be successful in computer technology integration, there needed to be some sort of special funding source.
2. Computer technology integration was usually a result of the pressure of societal change or an educational reform initiative.
3. The change for computer technology integration usually began at the organizational level and moved to the classroom level.
4. For computer technology integration to be successful, sufficient support and adequate teacher training had to be in place.
5. Computer technology integration may lead to increased student interest and motivation, greater peer collaboration, and improved quality of work from students (Pompeo, 2004).

In contrast, Ziegler (2002) conducted a study with seven teachers and 109 students in two elementary schools in a suburban public school district to determine the impact of potential changes in teachers' instructional practice and students' behaviors in the general education setting when instructional technology was present. While results revealed significance in the instructional practices of teachers and improved student behaviors in the technology rich classrooms, there was not statistically significant improvement found regarding student achievement.

Historically, from video media in the 1970s to IWB in the 21st century, instructional technology has evoloved in the public school classroom. Although Ziegler produced results indicating instructional technology had no significant impact on academic achievement, other researchers have provided data supporting a positive impact on student achievement as a result of implementing instructional technology.

Instructional Technology Utilized in the Study

While instructional technology has many facets, this researcher narrowed the focus of the literature review to the components specific to the current study. The following section provides a discussion, including advantages and disadvantages, of the instructional technology components utilized in the study. The instructional technology components include: (a) the interactive whiteboard (IWB); (b) liquid crystal display (LCD) projector; (c) document camera; and (d) classroom response system.

Interactive Whiteboard

The interactive whiteboard (IWB) can be described as a large white surface that works in conjunction with a computer and LCD projector, similar to a traditional classroom whiteboard, which enables a large group of students to interact with one another and to share information with people in the same room or in other locations in real time (Clemens, Moore, & Nelson, 2008; SMART Technologies, Inc., 2004). The first interactive whiteboard to provide touch control computer applications was produced in 1991 by SMART Technologies (SMART Technologies ULC, 2008). Because public schools do not always have access to LCD projectors, students sometimes must crowd around a small classroom monitor for whole-group instruction. The IWB has created a medium for whole-class instruction and students no longer crowd around individual classroom monitors because of the size of the large board (Clemens et al., 2008). In addition, the use of the IWB provides an opportunity for the students to actively engage in their own learning. In 2003, IWBs were relatively new; however, now IWBs are appearing in more classrooms throughout the United States (Becta ICT Research, 2003; SMART Technologies, 2009).

Although there are many advantages to the IWB, cost creates a disadvantage for public schools. Today, the average cost for an IWB ranges from $2500 to $3200 (Keberlein, 2009, August 23, personal communication). Some of the other disadvantages of the IWB mentioned include:

1. The hard surface of the board can become damaged and the replacement cost is expensive (Brown, 2002).
2. The board is used as a glorified whiteboard and not used interactively (Knight, Pennant, & Piggott, 2007).
3. Free-standing boards are not secure and often must be re-calibrated (Brown, 2002).
4. The user can cast a shadow on the IWB, obscuring the image to audience (Brown, 2002).

5. The height of the board can be a barrier to small children, as they often have trouble reaching the surface (Brown, 2002).

LCD Projector

The LCD projector was originally invented in 1984 by Dolgoff in New York. LCD projectors have become popular commodities in classrooms throughout the United States. LCD projectors can be used for almost any projection purpose and are easily transported to locations of need. LCD projectors may be portable on carts or may be permanently installed in classrooms. In addition, the school district supervisor of technology for the studied district, Keberlein, reported the cost of an LCD projector continues to become more reasonable for public schools (Keberlein, 2009, August 23, personal communication).

While LCD projectors are popular in U.S. classrooms, they also have downfalls (Becta ICT Research, 2003). Depending on the resolution quality of the projector, images can portray small lines that form grids on the projected surface. In addition, other problems that occur with projectors include motion blurring, poor color saturation, and expensive bulb replacement. However, in recent years the technology of LCD projectors has continued to improve (Silva, 2009).

Document Camera

A document camera is a small camera, usually mounted or assembled on a stand, that is hooked up to an LCD projector so an image can be displayed on a screen to a large group of students (Bedley, 2007). Document cameras may be known as digital overheads, digital visualizers, visual presenters, and docucams. The camera also functions as an overhead projector, although a document camera has greater advantages. Some of those advantages include real time video input/output, recording and editing options, displaying two- and three- dimensional objects, additional flexibility through the arm extension, and higher resolution power, to name a few. More commonly in today's educational field, document cameras are connected to an IWB rather than projecting to a standard screen (Bedley, 2007).

While the document camera has many advantages, like other technology components, the price is sometimes a deterrent for schools. The cost of a document camera averages $700, along with the cost of an LCD projector of approximately $700, bringing the cost to around $1400 per setup or classroom (Bedley, 2007; Keberlein, 2009, August 23, personal communication).

Classroom Response System

Electronic classroom response systems (CRS), also known as clickers or student response pads, are wireless handheld devices allowing students to interact with the teacher instantaneously (Classroom Performance System, 2009). This system compares to the traditional method of a classroom teacher asking a question and students responding by the show of hands (Deal, 2007). These response systems allow for multiple avenues assisting in teaching and learning. Some examples of the CRS assistance to teachers include assessing students' knowledge immediately, ability to communicate with an electronic grading system, taking attendance, allowing students to answer questions when they might be reluctant to answer a question in a large group, providing an avenue for students to be actively involved in classroom discussions, and ultimately providing accountability on behalf of the student without being singled out in a classroom full of peers (Classroom Performance System, 2009). Electronic classroom response systems have been used in the higher education arena since the early 1960s, although the use in public schools did not evolve until later (Deal, 2007). The majority of research surrounding classroom response systems has been focused on higher education; however, some studies reviewed public schools are discussed throughout this chapter.

Musselman (2008) conducted a study to determine how middle school teachers were utilizing student response systems (SRS). The study was conducted using an electronic survey with 658 middle school teachers using student response systems. The purposes of the study were to determine (a) the reasons middle school teachers were utilizing SRS, (b) the subject areas where the student response systems were utilized, (c) the characteristics of teachers and their use of SRS, (d) if teacher utilization was correlated to their perception of effectiveness on instruction, and (e) if teacher utilization was correlated to their perception of the impact on student achievement. Of the population (N = 658), 121 teachers responded, resulting in 18.38% of the population comprising the sample (Musselman, 2008).

The results of the Musselman (2008) study indicated teachers were using the SRS across the curriculum and mainly for the purposes of formative assessments. The researcher used multiple ANOVAs and a chi-square to analyze the data. The ANOVA used to analyze the relationship between teacher demographics and the amount of time used did not produce significance in the amount of time teachers used the SRS, as compared to their demographics (teaching experience, age, etc.). However, the chi-square revealed a significant relationship between the utilization by the teacher and the amount of both technical and instructional professional development the teacher had received. An

ANOVA was used to analyze the utilization and the teachers' perception of instruction, showing the correlation was significant. Additionally, an ANOVA showed a significant correlation between the teachers' demographics and their perception of student achievement (Musselman, 2008).

Advantages of Computer Technology Integration

As presented in the next few sections of this review, the advantages of computer technology integration appear to outweigh the disadvantages in both elementary and secondary schools. The advantages of the technology components utilized in this study included: (a) the ability to address the three modalities of learning; (b) the impact of computer technology integration on motivation and student engagement; and (c) the advantages of universal design.

Three Modalities of Learning

Today's classrooms are filled with a wide range of learners with varying needs and learning styles. Some learners prefer instruction with audio while other learners need to touch, see, or be actively involved in the learning process. The interactive whiteboard (IWB) provides a variety of learning methods including visual, auditory, and tactile learning to meet the needs of diverse learners (SMART Technologies, 2009).

The first modality, visual learning, is greatly enhanced through the IWB, which provides an avenue for students' instruction to be enhanced through the use of graphics, pictures, text, video, and animation. The second modality, auditory, is also enhanced through the sound associated with the IWB. Numerous activities and software are available for students to hear sounds, listen to music, and pronounce vocabulary as well as listen to full versions of text. The third modality of learning, tactile, is also supported through the IWB. Students can physically manipulate the whiteboard by touching the screen, assisting the needs of the tactile learner. The extent to which these three modalities of learning can be integrated into instruction is broad. The extent of students' ability to interact with an IWB may determine the extent to which they are motivated and engaged in the learning process (Atkinson, 2000, Asmawi, 2004, Beeland, 2002).

Motivation and Student Engagement

Students engaged in the learning process are empowered through four goals identified by Strong, Silver, and Robinson (1995) as components that satisfy human needs. Those four goals are (a) success, (b) curiosity, (c) originality, and (d) relationships. Students will work diligently regardless of challenges to ensure their own learning if they are engaged in the learning process (Strong et al., 1995).

One of the most important factors affecting student achievement is student motivation; apathy creates a barrier to learning (Beeland, 2002). Classroom teachers must find ways to motivate students, as motivation is critical for student achievement. If students are motivated, they will be engaged in the learning process. While numerous factors affect student motivation, some of the more valuable factors, relevant to this study and identified throughout the literature include effective use of technology, dynamics of the classroom teacher (Beeland, 2002), parental involvement, and participation in extra-curricular activities (Musselman, 2008, Sartori, 2008).

Beeland conducted a study to determine if IWBs increased the level of student engagement (2002). The research was conducted in a middle school with 10 teachers and 197 student participants. Student engagement was measured through two different instruments. The first instrument was a survey modified from the Computer Attitude

Questionnaire. The survey was administered to all students immediately following the use of an IWB in the classroom. The purpose of the survey was to determine the students' attitude towards the IWB. Two students in each classroom completed the second student attitude questionnaire, one student who appeared to like the IWB and one student who most likely did not enjoy the IWB experience. Teachers were given two questionnaires to measure their attitude towards the technology. The first questionnaire teachers were given was modified from a version of the Teachers' Attitudes Toward Information Technology instrument to measure teacher attitude. Additionally, teachers were given a questionnaire to determine why they chose to use the IWB as a method of delivering instruction.

The research questions for the study were (a) "Did the use of the IWB impact student engagement?", and (b) "Did the method in which the IWB was used as a tool impact student engagement?" Based on the two research questions in the study, the research results showed IWBs increased student engagement during classroom instruction. In addition, Beeland's study revealed a correlation between how the students rated the whiteboard and the type of media used; however, no correlation was found between student engagement and the amount of time the students were allowed to interact with the board. While educators often assume a correlation between engagement and achievement, no data were collected to determine if there was any impact on achievement in this study (Beeland, 2002).

Like Beeland, Morgan (2008) conducted a study to determine the impact of an IWB on student engagement and on-task behaviors of junior high students in two public schools in northeast Florida. The study was completed with 226 students in the second quarter of junior high. The two instruments used were an on-task behavior checklist and an attitude survey administered to the students to determine their perception of enjoyment and engagement when their instruction included an IWB. The results, analyzed through descriptive statistics, *t* tests, and ANOVAs, showed significant impact on engagement and positive behaviors when the IWB was used during instruction (Morgan, 2008). While assumptions are often made of a direct correlation between engagement and achievement, Morgan's study did not address this correlation.

Sartori (2008) conducted an empirical case study in a K-12 public school setting regarding the impact of a classroom response system as an instructional aid on student engagement, student motivation, and student achievement, based on the opinions of students and teachers in the district. The study was conducted in five middle school classrooms in the southeast United States. Both qualitative and quantitative data were analyzed and provided a significantly positive result for the classroom response system.

The quantitative results were gathered from the pre-test/post-test taken directly from the state adopted textbook; all five classes' scores were significantly higher on the post-test. The qualitative results were based on a post-implementation survey wherein teachers responded favorably, supporting the response systems. The students also reported they enjoyed the response systems and that learning was more fun (Sartori, 2008). Contrary to Morgan (2008), Sartori's study did provide data to support improved engagement and student achievement as a direct result of technology integration in the classroom.

Universal Design

According to the Center for Universal Design at North Carolina State University, universal design is defined in many different ways (2009). However, the underlying definition of universal design is simply designing all products in the most user-friendly way possible to provide access for all persons. Universal design is also referred to in a variety of literature sources as design for all, inclusive design, or barrier-free design (Connell et al., 2008). The Center for Universal Design has published seven principles:

1. Equitable use: establishes whether a product is useful and marketable for individuals.
2. Flexibility in use: provides for a wide range of ability and preference for individuals.
3. Simple and intuitive use: the design should be easily understood, regardless of one's language, abilities, experience, or concentration.
4. Perceptible information: communicates effectively regardless of one's language or sensory abilities.
5. Tolerance for error: allows for user error or unintended actions without hazard or adverse effects.
6. Low physical effort: easily accessible without fatigue or great physical effort.
7. Size and space for approach and use: allows for a large range of mobility regardless of one's size, posture, or mobility (Center for Universal Design, 2009).

Interactive whiteboards conform to the guiding principles established for universal design by the Center and to the guiding principles outlined by CAST. Interactive whiteboards are adaptable to unique learning environments and to learners of all abilities. Some of the features IWBs have include interactivity, size, accessibility, and record-ability. Interactivity provides opportunities for students to interact or engage in the IWB, allowing hands-on activities for students to learn. The size of the IWB allows the entire class to view the board rather than individual students at a small monitor, facilitating collaborative grouping. Additionally, the size of the board allows for more efficient accessibility for all students. The ability of the IWB to record, providing lessons for students multiple times, is especially beneficial in high schools and middle schools, and is a feature that lends itself to the Universal Design for Learning (SMART Technologies, 2009).

Influenced by the Center for Universal Design, the Center for Applied Special Technology (CAST), a nonprofit research and development organization, focused specific universal design principles to the field of education. CAST's intent in their research was to discover means of providing education without barriers for all students, including students with special needs. CAST identified three primary guiding principles they refer to as Universal Design for Learning:

1. Representation: the "what" of learning, the ability to discover and gain knowledge;
2. Action and Expression: the "how" of learning, the ability to demonstrate understanding; and

3. Engagement: the “why” of learning, the ability to motivate and engage students in the learning process (National Center on Universal Design for Learning, 2009).

Kirstein (2006) conducted a longitudinal study with a group of approximately 2300 senior students over a four-year period in urban schools in Massachusetts. The purpose of the study was to determine if text to speech (TTS) could support English language learners (ELL) through the writing process on computers. TTS is a software system built on the Universal Design for Learning philosophy and it was specifically designed to assist students with translating audible voice into computer text. The data for this study were collected through questionnaires, documents, interviews, and observations of students utilizing TTS and students not utilizing TTS. Two questionnaires were administered. One gathered background information and the other was a pre/post writing questionnaire. Kirstein did not elaborate on where the questionnaires originated. The results of the study showed when students used the TTS software based on the Universal Design for Learning philosophy, the following happened:

1. The students produced more writing.
2. The students spent additional time on the writing assignments.
3. The students detected more errors on their own.
4. The students had increased revisions of meaningful features.

However, at the same time, the results showed ELL students struggled to express themselves in expository essays and looked for TTS to improve their fluency. Kirstein’s study results suggested that to make the most of the universal design software, ELL students should be allowed to utilize the software to meet their individual goals (2006).

Additionally, Kirstein suggested when applying technology to learning, TTS and the universal design principles should be applied to enhance the learning process.

Again, there are many advantages to the integration of technology into classroom instruction. Throughout the review, studies have been presented to support these advantages. As with most all concepts, disadvantages were also identified and will be discussed.

Disadvantages of Computer Technology Integration

While there appear to be many more advantages to instructional technology integration than disadvantages, some setbacks have been noted throughout the researcher's review of literature; however, most were practical or logistical in nature. The largest disadvantage for public schools was the cost of integrating technology into the classroom. In addition to the cost of the IWB discussed previously, Keberlein (2009, August 23, personal communication) noted the document camera, LCD projectors, CRS, and the connectivity for all of the components as a cost barrier for public schools.

The Telecommunications Act of 1996 was signed into law by President Clinton. This law provides assistance to schools and libraries to obtain state–of-the-art equipment and services for technology purposes at a discounted rate. Prior to this law, there were no provisions providing schools with financial assistance in obtaining technology and technological services for the classroom (Telecommunications Act of 1996, 1996).

In addition to cost, Chen (1999) reported teachers do not have sufficient time to plan instruction utilizing technology. Additionally, teachers reported there was inadequate technical and administrative support offered. In conjunction with the disadvantage of time and support, teachers do not always know where to turn to ensure their digital media is appropriately aligned with their curricula (Fatemi, 1999).

Summary

In chapter two, a variety of literature was reviewed to determine the impact of instructional technology on student achievement. A variety of quantitative and qualitative research studies, journal articles, Web sites, and other current literature were reviewed. While the research is contradictory, the majority of research shows a positive correlation, or impact of instructional technology, on students in the classroom in the areas of motivation, engagement, and student achievement.

The review of literature contained a historical overview of instructional technology in the classroom. Although the review revealed minimal disadvantages, the research studies presented advantages for student achievement associated with the implementation of instructional technology. More specifically, the research provided support that instructional technology has a positive impact on student achievement as well as engagement and motivation of students. The next chapter provides a detailed overview of the methodology used in this research study.

CHAPTER THREE

METHODS

Introduction

The ever-changing digital society of the 21st century has forced educators to find opportunities for students to be actively engaged in their own learning. The purpose of this study was to determine if equipping classrooms with technology components had a positive impact on student achievement in mathematics as measured by the Measure of Academic Performance (MAP) in the Turner USD 202 school district. The following questions guided this research study:

1. What impact does the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics in 3rd grade classrooms?
2. What impact does the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics in 4th grade classrooms?
3. What impact does the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics in 5th grade classrooms?
4. What impact does the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics in 6th grade classrooms?

This chapter describes the methodology used to determine the impact on student achievement growth in mathematics as measured by the MAP. Specifically, the chapter contains the population and sample, sampling procedures, instrumentation, measurement, validity and reliability, data collection procedures, data analysis and hypothesis testing, and limitations.

Research Design

This research was designed as a quantitative, quasi-experiment. Two groups of students in grades 3, 4, 5, and 6 participated in this study. The first was a control group of students instructed in a traditional classroom without access to an IWB, LCD projector, document camera, or a classroom response system, and the second was an experimental group of students receiving a portion of their instruction in technology-rich classrooms with access to an IWB, LCD projector, document camera, and a classroom response system. The dependent variable was the mathematics growth score on the MAP.

Population and Sample

The population for the study included 1820 students in the five elementary schools in the Turner Unified School District 202 in Kansas City, Kansas. The five schools and their demographics are presented in Table 1 and 2. The researcher included ethnicity and socio-economic status of the population as it is a common thread for urban settings and often has an impact on student achievement.

All elementary schools were identified as school-wide Title I schools and received Title I federal funding for additional support in reading and mathematics. Additionally, the sample for this study included students in grades 3 through 6. The students were administered the MAP test in the fall of 2008 and in the spring of 2009. While the total population size for grades 1 through 6 was 1820, the sample size was 855, representing only students in grades 3, 4, 5, and 6 with complete data. The selection of students was based solely on their random assignment to a teacher with a technology-rich classroom. Neither students nor parents had a choice about placement into a technology-rich classroom.

Table 1

Turner USD 202 Elementary School Demographics, Grades 1-6

Elementary School	Number of Students	% Low SES	Gender	
			Male	Female
Junction	356	68.75	184	172
Midland Trail	482	69.45	246	236
Morris	96	63.16	54	42
Oak Grove	422	72.13	219	203
Turner	464	72.01	229	235

Note. From *LCP Report*, Turner USD 202, September 2008. Unpublished document.

Table 2

Turner USD 202 Elementary School Ethnicity, Grade 1-6

Elementary School	Ethnicity						
	White	Black	Hispanic	Indian	Asian	Multi-Racial	Total
Junction	151	38	117	3	5	42	356
Midland Trail	239	25	143	3	20	52	482
Morris	81	3	9	1	0	2	96
Oak Grove	219	30	116	1	19	37	422
Turner	253	73	87	1	8	42	464

Note. *Principal Building Report*, Turner USD 202, September 2008. Unpublished document.

The 3rd grade sample included 35 students receiving a portion of their instruction in a technology-rich classroom and 245 students receiving instruction in the traditional classroom setting, totaling 280 students. However, the researcher random sampled 50 traditional classroom students from the 245, for a total 3rd grade sample of 85. The 4th grade sample included 154 students receiving a portion of their instruction in a technology-rich classroom and 96 students receiving instruction in the traditional classroom setting, totaling 250 students. The 5th grade sample included 99 students receiving a portion of their instruction in a technology-rich classroom and 147 students receiving instruction in the traditional classroom setting, totaling 246 students. The 6th grade sample included 135 students receiving a portion of their instruction in a technology-rich classroom and 139 students receiving instruction in the traditional classroom setting, totaling 274 students.

Sampling Procedures

The target sample for this study was students in grades 3 through 6 randomly assigned to technology-rich classrooms. All other students in grades 3 through 6 were served in the traditional classroom setting. The criteria for teachers having a technology-rich classroom included:

1. A completed teacher application for a technology-rich classroom for the 2008-09 school year.
2. Acceptance of the Technology-rich Classroom Grant, which included:
    a. Teachers' willingness to participate in intensive 3-day training on the technology components.
    b. Teachers' willingness to follow up on professional development activities throughout the 2008-09 school year.

Instrumentation

The Measure of Academic Performance (MAP) assessment, developed by the Northwest Evaluation Association (NWEA), is an adaptive computerized test aligned to the Kansas State Standards that measures growth over a period of time and reflects the instructional level of individual and groups of students (NWEA: Northwest Evaluation Association, 2009). Results from the MAP can assist educators in the following: (a) identifying skills and concepts students have mastered; (b) diagnosing instructional needs; (c) monitoring academic growth over an extended period; (d) making data-driven decisions at the classroom, school, and district level; and (e) placing new students in the appropriate instructional program. The results of this study focused on student mathematics performance on the MAP (NWEA: Northwest Evaluation Association, 2009).

Like the Scholastic Aptitude Test, Graduate Record Exam, and Law School Admissions Test, the MAP is a nationally normed test. The scale is based on modern test theory. The scale is divided into equal parts similar to a centimeter on a ruler and it aligns student achievement levels with item difficulty on the same scale, providing an equal interval scale. The NWEA has chosen to call the equal parts a RIT score, short for Rasch unit, name after a Danish statistician, George Rasch. The MAP RIT scale values fall between 140 and 300. A RIT is the score that measures individual student growth over time. In addition to an individual growth score, the MAP provides a predictor of performance of each individual student on the Kansas Assessments (NWEA: Northwest Evaluation Association, 2009).

The MAP is a computer-based, multiple-choice test taken by students. In the initial assessment, all students receive questions at their grade level. The assessment adjusts the student’s difficulty of items based on the student’s ability to answer correctly. When students answer incorrectly, the next item is easier. The system continues to adapt until the RIT score for the student is established. Therefore, the number of questions administered depends on the academic ability of the student. (NWEA: Northwest Evaluation Association, 2009).

Measurement

The MAP assessment is a scientifically based measurement. It provides educators with longitudinal data allowing them to make educational decisions affecting student achievement. The MAP assessment allows educators to measure a student's growth as well as compare the student to the national norm at the particular school level. Turner USD 202 administers the MAP assessment two times each year and the data are available for this study (NWEA: Northwest Evaluation Association, 2009).

Validity and Reliability

In addition to alignment with modern test theory, the MAP quality is enhanced by the 15,000 items developers created for assessing mathematics, reading, language usage, and science. The NWEA constantly updates its test bank with new teacher-developed items, which have passed a rigorous bias and content review. NWEA regularly publishes research conducted to validate and improve the quality of the assessment instruments (NWEA: Northwest Evaluation Association, 2004).

The NWEA uses the test-retest approach to reliability. This type of reliability answers the question, "To what extent does the test administered to the same students twice yield the same results from one administration to the next?" (NWEA: Northwest Evaluation Association, 2009). One of the two prominent differences of NWEA from the typical test-retest approach is they use a different test during the second administration. Because two versions of the test were used, parallel forms reliability was established. The second difference is the tests are spread across 7 to 12 months, while the typical time frame is 2 to 3 weeks. Most of the MAP test-retest reliability coefficients range from .80 to low .90s. To determine internal consistency, NWEA calculates the marginal reliability coefficient. In 1999, the math coefficient range was .92 to .95 (NWEA: Northwest Evaluation Association, 2009).

Data Collection Procedures

Data collection began after IRB approval was granted to the study (see Appendix). The MAP was administered to students identified for the sample in this study in grades 3, 4, 5, and 6 in the fall to determine baselines, and in the spring to determine a level of growth for the experimental and control groups. The baseline test was administered by the classroom teacher and a proctor in a computer lab at each individual school location during September 2008. The post-test was administered by the classroom teacher and a proctor in a computer lab at each individual school location during May 2009.

The data for MAP is stored in a database housed by NWEA. The data can be accessed through the organization’s Web site at http://www.nwea.org. The data collected for this study were downloaded to the Turner USD 202 student management system, Infinite Campus, by the Turner USD 202 Assessment Coordinator. From Infinite Campus, the data were exported to Microsoft Excel format by the researcher. The researcher then imported data from Microsoft Excel into SPSS and the statistical analyses were conducted for the following groups:

1. Mean growth scores from classrooms with technology-rich components.
2. Mean growth scores from traditional classrooms.
3. Mean growth scores based on student gender.
4. Mean growth scores based on ethnicity.
5. Mean growth scores based on lunch status.

Data Analysis and Hypothesis Testing

The research questions focused on the growth differences in mathematics performance on the MAP between students in a technology-rich classroom and students in a traditional classroom. The descriptive statistics used in the analysis included measures of central tendency and the measures of variability, in particular, the standard deviation. The data were analyzed using a *t* test for independent means computations to determine if a significant difference existed between the students in the technology-rich classrooms and the traditional classroom settings. The following hypotheses were proposed:

H1: Technology-rich classrooms had greater student achievement gains in mathematics as assessed by the Measure of Academic Performance (MAP) for 3rd grade students at the 0.05 level of significance.

H2: Technology-rich classrooms had greater student achievement gains in mathematics as assessed by the Measure of Academic Performance (MAP) for 4th grade students at the 0.05 level of significance.

H3: Technology-rich classrooms had greater student achievement gains in mathematics as assessed by the Measure of Academic Performance (MAP) for 5th grade students at the 0.05 level of significance.

H4: Technology-rich classrooms had greater student achievement gains in mathematics as assessed by the Measure of Academic Performance (MAP) for 6th grade students at the 0.05 level of significance.

For each of the above hypotheses, an independent samples *t* test was used to compare the MAP mean growth score of students in a technology-rich classroom with the MAP mean growth score of students in a traditional classroom.

Limitations

Limitations, according to Roberts (2004), are areas where the researcher has no control over the study. Limitations may have an impact on the interpretations of findings or lead to misinterpretation of the study. The limitations identified in this study were:

1. All teachers had the ability to apply for a technology-rich classroom. The researcher had no control of which applicants received the grant.
2. The research was limited to grades 3 through 6. Conclusions of the impact on lower elementary grades, middle school, or high school students cannot be made.
3. The results are limited to the short-term impact on student achievement.
4. The teachers' professional experience and ability varied in each classroom.
5. The traditional classrooms had some access to technology, but not all components of a technology-rich classroom as described in this study. Accessibility for traditional classrooms included:
    a. Check out an LCD projector from the school media center.
    b. Exposure during a special course (PE, music, special programs, etc.).
    c. Check out a classroom response system from the school media center.

Summary

This chapter provided an overview of the methodology used in researching the impact of technology-rich classrooms on student mathematics achievement, particularly as measured by the MAP. Technology-rich classrooms were compared to traditional classrooms by analyzing the MAP mean growth score for each group. A *t* test for independent samples was used to compare and analyze the data for results. Chapter four provides a discussion of the results found in the research study, while chapter five contains interpretation of the results and recommendations.

CHAPTER FOUR

RESULTS

Introduction

This quantitative, quasi-experimental study was designed to determine whether students receiving a portion of their instruction in a technology-rich classroom would have a greater mean score growth in mathematics on the MAP assessment, as compared to those students in a traditional classroom setting. This chapter presents the data gathered regarding student growth scores in grades 3, 4, 5, and 6 in mathematics on the MAP assessment. An independent *t* test was conducted to test each of the research hypotheses. This chapter contains a summary of the data collected, the statistical analyses regarding the research questions, and the results of hypotheses testing.

Descriptive Statistics

The target population for this research was a K-12 setting in the Turner USD 202 school district in Kansas City, Kansas. The sample had a control group and an experimental group of students in grades 3, 4, 5, and 6. The statistical program, SPSS, was utilized to analyze the data of the study. The descriptive statistics used in this analysis, along with the demographics of the sample, are presented in Tables 3 through 22.

3rd Grade

The 3rd grade sample students attended school in five different elementary schools. Of the 85 students, the largest representation of 31 students attended Oak Grove Elementary. The smallest number of students in the five elementary schools was 10, at

Turner Elementary. Table 3 represents the schools and the percentage of students in attendance.

Table 3

Turner USD 202 School Locations of 3rd Grade Research Sample

Elementary Schools	*f*	%
Junction	15	17.6
Midland Trail	13	15.3
Morris	16	18.8
Oak Grove	31	36.5
Turner	10	11.8
Total	85	100.0

There were 39 females, which represented 45.9 percent of the 3rd grade sample, and 46 males, comprising 54.1 percent of the sample. Five ethnic groups were represented in the 3rd grade sample. The White population had the largest representation with 54.1 percent, followed by Hispanic population at 22 percent. One of the participants did not report ethnicity. Table 4 presents the demographic breakdown of the 3rd grade sample.

Table 4

Turner USD 202 Ethnicity of 3rd Grade Research Sample

Ethnicity	*f*	%
Failed to Designate	1	1.2
American Indian	1	1.2
Asian	3	3.5
Black	12	14.1
White	46	54.1
Hispanic	22	25.9
Total	85	100.0

The majority, 67.1 percent, of the 3rd grade sample received free or reduced lunch services, while 32.9 percent of the sample received no assistance for lunch services. The lunch status is represented in Table 5.

Table 5

Turner USD 202 Lunch Status of 3rd Grade Research Sample

Lunch Status	*f*	%
Reduced	13	15.3
Free	44	51.8
No Assistance	28	32.9
Total	85	100.0

4th Grade

The 4th grade sample, students attended school in five different elementary schools. Of the 250 students, the largest representation of 79 students attended Turner Elementary. The smallest number of students in the five elementary schools was 13 at Morris Elementary. The schools and the percentage of students are shown in Table 6.

Table 6

Turner USD 202 School Locations of 4th Grade Research Sample

Elementary Schools	*f*	%
Junction	38	15.2
Midland	63	25.2
Morris	13	5.2
Oak Grove	57	22.8
Turner Elementary	79	31.6
Total	250	100.0

There were 121 females, which represented 48.4 percent of the 4th grade sample, and 129 males, comprising 51.6 percent of the sample. Five ethnic groups were represented in the 4th grade sample. The ethnic group most represented was the White population with 55.2%, followed by the Hispanic population with 28.8%. Four of the 4th grade participants did not report their ethnicity. The demographic ethnicity breakdown of the sample is shown in Table 7.

Table 7

Turner USD 202 Ethnicity of 4th Grade Research Sample

Ethnicity	*f*	%
Failed to Designate	4	1.6
American Indian	3	1.2
Asian	9	3.6
Black	24	9.6
White	138	55.2
Hispanic	72	28.8
Total	250	100.0

The majority, 68 percent, of the 4th grade sample received free or reduced lunch services, while 32 percent of the sample received no assistance for lunch services. Table 8 shows the lunch status for the 4th grade sample.

Table 8

Turner USD 202 Lunch Status of 4th Grade Research Sample

Lunch Status	*f*	%
Reduced	40	16.0
Free	130	52.0
No Assistance	80	32.0
Total	250	100.0

5th Grade

The 5th grade students in the sample attended school in five different elementary schools. Of the 246 students, the largest representation of 68 students attended Turner Elementary. The smallest number of students in the five elementary schools was 14 at Morris Elementary. The schools and the percentage of students are shown in Table 9.

Table 9

Turner USD 202 School Locations of 5th Grade Research Sample

Elementary Schools	*f*	%
Junction	42	17.1
Midland	66	26.8
Morris	14	5.7
Oak Grove	56	22.8
Turner	68	27.6
Total	246	100.0

There were 123 females, which represented 50 percent of the 5th grade sample, and 123 males, comprising 50 percent of the sample. Five ethnic groups were represented in the 5th grade sample. The White population had the largest representation of 56.9 percent, followed by Hispanic population at 26 percent. Three of the participants did not report their ethnicity. The demographic ethnicity breakdown of the sample is shown in Table 10.

Table 10

Turner USD 202 Ethnicity of 5th Grade Research Sample

Ethnicity	*f*	%
Failed to Designate	3	1.2
American Indian	1	.4
Asian	6	2.4
Black	32	13.0
White	140	56.9
Hispanic	64	26.0
Total	246	100.0

The majority, 71.1 percent, of the 5th grade sample received free or reduced lunch services, while 28.9 percent of the sample received no assistance for lunch services. Table 11 represents the lunch status for the 5th grade sample.

Table 11

Turner USD 202 Lunch Status of 5th Grade Research Sample

Lunch Status	*f*	%
Reduced	35	14.2
Free	140	56.9
No Assistance	71	28.9
Total	246	100.0

6th Grade

The 6th grade students in the sample attended school in five different elementary schools. Of the 274 students, the largest representation of 79 students attended Midland Trail Elementary. The smallest number of students in the five elementary schools was 11 at Morris Elementary. The schools and the percentage of students are shown in Table 12.

Table 12

Turner USD 202 School Locations of 6th Grade Research Sample

Elementary	*f*	%
Junction	50	18.2
Midland	79	28.8
Morris	11	4.0
Oak Grove	62	22.6
Turner Elementary	72	26.3
Total	274	100.0

There were 135 females, which represented 49.3 percent of the 6th grade sample, and 139 males, comprising 50.7 percent of the sample. Six ethnic groups were represented in the 6th grade sample. The White population had the largest representation with 56.9 percent, followed by Hispanic population at 28.8 percent. One of the participants did not report ethnicity. The demographic ethnicity breakdown of the sample is shown in Table 13.

Table 13

Turner USD 202 Ethnicity of 6th Grade Research Sample

Ethnicity	*f*	%
Failed to Designate	1	.4
American Indian	4	1.5
Asian	10	3.6
Black	23	8.4
Other Pacific Islander	1	.4
White	156	56.9
Hispanic	79	28.8
Total	274	100.0

The majority, 66.8 percent, of the 6th grade sample received free or reduced lunch services, while 33.2 percent of the sample received no assistance for lunch services. Table 14 represents the lunch status for the 6th grade sample.

Table 14

Turner USD 202 Lunch Status of 6th Grade Research Sample

Lunch Status	*f*	%
Reduced	34	12.4
Free	149	54.4
No Assistance	91	33.2
Total	274	100.0

Hypothesis Testing

This study utilized independent samples *t* tests to examine the individual mean growth scores of students in technology-rich classrooms as compared to those students in the traditional classroom setting.

Research Question 1: What impact does the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics in 3rd grade classrooms?

This research question examined the mean growth scores for 3rd grade students receiving a portion of their instruction in a technology-rich classroom (TRC) compared to those instructed in a traditional classroom (TRA). The sample for 3rd grade included 85 students: 35 in a technology-rich classroom and 50 in the traditional classroom. The mean growth score for the students in a technology-rich classroom was 14.17, while the students in the traditional classroom produced a mean growth score of 9.04. The standard deviation was 5.27 for the technology-rich classroom and 7.49 for the traditional classroom. The results are presented in Table 15.

Table 15

Turner USD 202 3rd Grade Mean and Standard Deviation

Classroom Type 3rd Grade	Number of Students	Mean Growth Score	*SD*
TRC	35	14.17	5.27
TRA	50	9.04	7.49

An analysis was performed to test Hypothesis 1: Technology-rich classrooms had greater student achievement gains in mathematics as assessed by the Measure of

Academic Performance (MAP) for 3rd grade students at the 0.05 level of significance. Results, as shown in Table 16, revealed a significant difference between the mean growth score of students in a technology-rich classroom as compared to those in the traditional classroom, *t* (83) = 3.49, *p* = .001. Growth scores were larger in the technology-rich classroom.

Table 16

Independent Samples t Test for 3rd Grade Study

	F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	.89	.34	3.49	83	.001	5.13	1.47
Equal variances not assumed			3.70	82.99	.000	5.13	1.38

Research Question 2: What impact the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics in 4th grade classrooms?

This research question examined the mean growth scores for 4th grade students receiving a portion of their instruction in a technology-rich classroom (TRC), compared to those instructed in a traditional classroom (TRA). The sample for 4th grade included 250 students: 154 in a technology-rich classroom and 96 in the traditional classroom. The mean growth score for the students in a technology-rich classroom was 11.40, while the students in the traditional classroom produced a mean growth score of 11.34. The standard deviation was 7.23 for the technology-rich classroom and 7.13 for the traditional classroom. The results are shown in Table 17.

Table 17

Turner USD 202 4th Grade Mean and Standard Deviation

Classroom Type	Number of Students	Mean Growth Score	*SD*
TRC	154	11.40	7.23
TRA	96	11.34	7.13

An analysis was performed to test Hypothesis 2: Technology-rich classrooms had a greater student achievement gains in mathematics as assessed by the Measure of Academic Performance (MAP) for 4th grade students at the 0.05 level of significance. Results, as shown in Table 18, revealed no significant difference between the growth score of students in a technology-rich classroom as compared to those in the traditional classroom, t (248) = .063, p = .950.

Table 18

Independent Samples t Test for 4th Grade Study

	F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	.00	.99	.06	248	.95	.058	.93
Equal variances not assumed			.06	203.76	.95	.058	.93

Research Question 3: What impact does the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics in 5th grade classrooms?

This research question examined the mean growth scores for 5th grade students receiving a portion of their instruction in a technology-rich classroom (TRC) compared to those instructed in a traditional classroom (TRA). The sample for 5th grade included 246 students: 99 in a technology-rich classroom and 147 in the traditional classroom. The mean growth score for the students in a technology-rich classroom was 9.82, while the students in the traditional classroom produced a mean growth score of 8.42. The standard deviation was 6.30 for the technology-rich classroom and 7.90 for the traditional classroom. The results are shown in Table 19.

Table 19

Turner USD 202 5th Grade Mean and Standard Deviation

Classroom Type	Number of Students	Mean Growth Score	*SD*
TRC	99	9.82	6.30
TRA	147	8.42	7.90

An analysis was performed to test Hypothesis 3: Technology-rich classrooms had greater student achievement gains in mathematics as assessed by the Measure of Academic Performance (MAP) for 5th grade students at the 0.05 level of significance. Results, as shown in Table 20, revealed no significant difference between the mean growth score of students in a technology-rich classroom as compared to those in the traditional classroom, t (244) = 1.47, p = .142.

Table 20

Independent Samples t Test for 5th Grade Study

	F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	2.94	.088	1.47	244	.142	1.39	.94
Equal variances not assumed			1.54	236.95	.125	1.39	.90

Research Question 4: What impact does the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics in 6th grade classrooms?

This research question examined the mean growth scores for 6th grade students receiving a portion of their instruction in a technology-rich classroom, compared to those instructed in a traditional classroom. The sample for 6th grade included 274 students, 135 in a technology-rich classroom and 139 in the traditional classroom. The mean growth score for the students in a technology-rich classroom was 5.43, while the students in the traditional classroom produced a mean growth score of 7.48. The standard deviation was 7.12 for the technology-rich classroom and 6.59for the traditional classroom. The results are shown in Table 21.

Table 21

Turner USD 202 6th Grade Mean and Standard Deviation

Classroom Type	Number of Students	Mean Growth Score	*SD*
TRC	135	5.43	7.12
TRA	139	7.48	6.59

An analysis was performed to test Hypothesis 4: Technology-rich classrooms had a greater student achievement gains in mathematics as assessed by the Measure of Academic Performance (MAP) for 6th grade students at the 0.05 level of significance. Results, as shown in Table 22, revealed a significant difference between the mean growth score of students in a technology-rich classroom as compared to those in the traditional classroom, *t* (272) = -2.46, *p* = .014. Growth scores were higher in the traditional classroom setting.

Table 22

Independent Samples t Test for 6th Grade Study

	F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	.32	.56	-2.46	272	.014	-2.04	.82
Equal variances not assumed			-2.46	268.94	.014	-2.04	.82

Summary

This chapter contained an introduction to the results of the study. The introduction was followed by a presentation of the descriptive statistics of the sample, including location of the elementary school attended, gender, ethnicity, and lunch status. The primary research questions and hypotheses were then reviewed and analyzed.

Results from this quantitative, quasi-experimental study tested through an independent *t* test discovered a significant difference for students in a technology-rich classroom in 3rd grade. The results from students in the 4th and 5th grade revealed differences for students in a technology-rich classroom compared to those in the traditional classroom; however, the differences were not significant. Finally, results from the 6th grade students revealed students in the traditional classroom outperformed students receiving instruction in a technology-rich classroom. While there was not a large amount of research examined through the review of literature pertaining to the direct impact of the technology-rich components on student achievement, as in the current study, the literature review had mixed results. Chapter five presents an analysis of the quantitative results from the study. Additionally, recommendations are made for future research in the area.

CHAPTER FIVE

INTERPRETATION AND RECOMMENDATIONS

Introduction

This study was designed to determine if students receiving instruction in a technology-rich classroom (TRC) would have greater gains in mathematics than would students receiving their instruction in a traditional classroom setting (TRA). The MAP mathematics assessment was used in grades 3, 4, 5, and 6. This chapter provides a summary of items discussed in chapters one through four, including a study summary, an overview of the problem, research questions, review of methodology, major findings, findings related to the literature, implications for action, recommendations for future research, and a chapter summary.

Study Summary

This study was conducted in the Turner USD 202 School District in Kansas City, Kansas. The sample population consisted of 855 students in grades 3, 4, 5, and 6. The study compared the student growth of students in the experimental group (TRC) to the students in the control group (TRA) on the MAP mathematics assessment. An independent *t* test analysis was performed to analyze the hypotheses.

Overview of the Problem

With the ever-changing digital society of the 21st century, today's educators must continue to research the impact of technology integration on student achievement.

Purpose Statement and Research Questions

The purpose of this study was to determine if equipping classrooms with technology components (IWB, LCD projector, document camera, and a classroom response system) had a positive impact on student achievement in mathematics as measured by the Measure of Academic Performance (MAP) in the Turner School District. This study was designed to examine and compare the impact on student achievement in mathematics for students in the TRC environment with students instructed in a TRA. The research question for grades three, four, five and six was: What impact does the use of an interactive whiteboard, an LCD projector, a document camera, and classroom response systems have on student achievement in mathematics?

Review of the Methodology

This study compared student growth on the MAP mathematics assessment of students receiving their instruction in a technology-rich classroom to students receiving instruction in traditional classrooms. The sample included 855 students in grades three, four, five and six. All students participated in a mathematics pre-test of the MAP within the first 3 weeks of the school year and all students took a mathematics post-test of the MAP the last 3 weeks of the school year. All students in this study started the 2008-09 school year and had a valid pre- and post-test score.

After the data were collected, a *t* test for independent means was computed for all grades levels in the study (3^{rd}, 4^{th}, 5^{th}, and 6^{th} grades). An independent samples *t* test was computed to determine the influence of a technology-rich classroom on student achievement in mathematics as measured by the MAP.

Major Findings

Results from this quantitative, quasi-experimental study were tested through using an independent samples *t* test. Data collected discovered a significant difference, for 3^{rd} grade students in a technology-rich classroom. The results from students in the 4^{th} and 5^{th}

grade revealed a positive difference for students in the technology-rich classroom, as compared to those in the traditional classroom; however, the difference was not significant. Finally, results from the 6th grade students revealed students in the traditional classroom significantly outperformed students receiving instruction in a technology-rich classroom.

Additionally, descriptive statistics were used to portray an overview of the demographic population of the sample.

Findings Related to the Literature

All of the research studies reviewed in chapter two were conducted in K-12 public school settings including elementary, middle level, and high school. This study was conducted at the elementary level. Paino and Kirstein's studies discussed in Chapter two were conducted in an urban setting, similar to the current research study. Another similarity, of the research reviewed to the current research study, included comparisons made between control and experimental groups (Paino, 2009, Wendt, 2007, Pompeo, 2004).

Results from this study had very similar findings to the literature reviewed. The results varied in both the review and this study. In a study completed by Sartori (2008), data-supported technology integration had a positive impact on student achievement, similar to the results of the 3rd grade sample in this research study. Additionally, Wendt (2007) and Kirstein (2006) each provided research supporting a positive impact on student achievement because of technology-rich classrooms. Similar to Ziegler's (2004) research, 4th, 5th, and 6th grade results did not support technology integration as having a statistically significant improvement on student achievement. However, Ziegler did reveal significance in positive changes to teachers and students' behaviors.

The researcher in the present study did not measure motivation or engagement and the impact on student achievement. However, the review of literature would indicate that students in technology-rich classrooms are more engaged and motivated than are students in a traditional classroom setting (Paino, 2009; Pompeo, 2004; Ziegler, 2002). Although it is often assumed by educators there is a correlation between engagement and achievement, Sartori's study did provide data to support this theory.

Implications for Action

As indicated earlier in this study, this research was conducted in a low socio-economic, urban setting. This research can provide other urban school districts with data to support their decision making process in the area of technology integration. Although the research study had varied results depending on grade level, there was some support that the integration of technology in the classroom had a positive impact on student achievement. It is important for school districts to consider the assumptions and limitations identified in this study. In addition, schools should consider reviewing future research recommendation results as they become available.

Recommendations for Future Research

As the researcher analyzed the results and reflected on the findings, recommendations were developed for future research. The recommendations for future research are summarized and should be considered by other researchers who wish to determine whether technology integration has a significant impact on student achievement.

To ensure valid measurement results, it is recommended future research evaluating the impact of technology on student achievement not be administered during the first year of implementation. In addition to new technology components, the teachers also experienced new curriculum and resources in language arts.

If the study were reproduced in subsequent years, a longitudinal study could determine the long-term impact on student achievement. The researcher should consider cohort tracking to determine the long-term effects of technology integration and student achievement. By examining data longitudinally, one could also measure the success of the Kansas State Assessment in addition to the Measure of Academic Performance (MAP).

In addition to the recommendations above, a researcher should consider a quantitative research study measuring the impact of a technology-rich classroom on reading, language usage and science. This study could be duplicated as MAP measures those contents as well.

Finally, a study should be considered to analyze teacher and student perceptions of technology integration into the classroom and the impact on student achievement. Another researcher could conduct a study to measure the possible correlation between engagement and motivation of students in a technology-rich classroom and the impacts on student achievement. These components would provide a comprehensive study of technology integration.

Concluding Remarks

Based on the findings of this study, the integration of technology into the classroom will continue to be an ongoing challenge for educators. While teacher and student perceptions of technology in the classroom support engagement and motivation, the research on the impact of technology on student achievement is not as readily found in literature. With the cost of technology of public school budgets, future study in this area is imperative for educators to continue to make research-based decisions to ensure all students are provided the best educational experience possible.

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APPENDIX A

IRB APPROVAL FORM

Date:____________________

SCHOOL OF EDUCATION
GRADUATE DEPARTMENT

IRB PROTOCOL NUMBER__________
(IRB USE ONLY)

IRB Request

Proposal for Research

Submitted to the Baker University Institutional Review Board

I. Research Investigator(s) (Students must list faculty sponsor first)

Department(s) **School of Education Graduate Department**

Name	Signature	
1. Dr. Bill Neuenswander	______________________,	Faculty Sponsor
2. Peg Waterman	______________________,	Research Analyst
3. Dr. Amy Wintermantel		
4. Dr. Ray Daniels		

Principal Investigator: Michelle Sedler __________________

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Expected Category of Review: __X__Exempt ____Expedited ____Full

II: Protocol Title

"The Impact of a Technology Rich Classroom on Student Achievement in Mathematics on the Measure of Academic Performance in Grades Three Through Six."

Summary

The following summary must accompany the proposal. Be specific about exactly what participants will experience, and about the protections that have been included to safeguard participants from harm. Careful attention to the following may help facilitate the review process:

In a sentence or two, please describe the background and purpose of the research.

The purpose of this study is to determine if students receiving instruction in a technology rich classroom will have more growth in mathematics on the Measure of Academic Performance (MAP) than those students instructed in the traditional classroom setting. The study focuses on students grades three through six in the Turner Unified School District 202 in Kansas City, Kansas. These elementary students are served in five different grade schools, all receiving Title I services, ranging from approximately 95 students to 482.

Briefly describe each condition or manipulation to be included within the study.

The independent variables will take the form of categories which will include:

- Gender (male and female),
- Ethnicity (White, Black, Hispanic, Asian, Indian and Multi-racial),
- Lunch status (free, reduced, and paid), and
- Student assignment (technology rich classroom or traditional).

What measures or observations will be taken in the study? If any questionnaire or other instruments are used, provide a brief description and attach a copy.

The research study includes a dependent variable, MAP target growth score, in the form of a numerical average for elementary school students grade three through six for the 2008-09 school year.

Will the subjects encounter the risk of psychological, social, physical or legal risk? If so, please describe the nature of the risk and any measures designed to mitigate that risk.

The subjects will not encounter any psychological, social, physical or legal risk in this study.

Will any stress to subjects be involved? If so, please describe.

No stress will be experienced by any of the subjects in this study.

Will the subjects be deceived or misled in any way? If so, include an outline or script of the debriefing.

The subjects will not be deceived or misled in any way in this study.

Will there be a request for information that subjects might consider to be personal or sensitive? If so, please include a description.

Information from the student management system will be used for this research study and students will not be asked any questions. Information requested for this study includes demographic information for each student grades three through six in the Turner Unified School District 202 in Kansas City, Kansas. Information will include name, grade level, school in attendance, teacher, gender, ethnicity, lunch status, and whether they student was assigned to a technology rich classroom. Student names and student IDs will be used when setting up data tables and cross-referencing information. Once complete, the researcher will delete student names and only view student IDs. Students will never be mentioned by name in this research study.

Will the subjects be presented with materials that might be considered to be offensive, threatening, or degrading? If so, please describe.

The subjects will not be presented with any materials for this study.

Approximately how much time will be demanded of each subject?

No additional time will be demanded by the student subjects by the researcher. The researcher is utilizing school data which can be gathered quickly from the district's student information system. The testing, administered by the district during the 2008-09 school year, took approximately one hour in the fall and one hour in the spring.

Who will be the subjects in this study? How will they be solicited or contacted? Provide an outline or script of the information which will be provided to subjects prior to their volunteering to participate. Include a copy of any written solicitation as well as an outline of any oral solicitation.

The subjects in this study are all elementary school students, grades three through six in the Turner Unified School District 202 during the 2008-2009 school year. Students will not be contacted or solicited for this study.

What steps will be taken to ensure that each subject's participation is voluntary? What if any inducements will be offered to the subjects for their participation?

Student subjects will not be contacted for this study.

How will you ensure that the subjects give their consent prior to participating? Will a written consent form be used? If so, include the form. If not, explain why not.

Student subjects will not be contacted for this study and therefore a written consent is not necessary.

Will any aspect of the data be made a part of any permanent record that can be identified with the subject? If so, please explain the necessity.

No data will be made a part of any permanent record from this study.

Will the fact that a subject did or did not participate in a specific experiment or study be made part of any permanent record available to a supervisor, teacher or employer? If so, explain.

No data will be made a part of any permanent record from this study.

What steps will be taken to ensure the confidentiality of the data?

All data given to the researcher will remain confidential and will only be reviewed by the researcher and Baker's Research Analyst. Student names will not be used.

If there are any risks involved in the study, are there any offsetting benefits that might accrue to either the subjects or society?

There are no risks to this research study. Benefits to this study are to increase the body of research in this area. The findings could assist decision making with regards to funding technology for instructional purposes.

Will any data from files or archival data be used? If so, please describe.

Yes, data used from student files will include name, grade level, school in attendance, teacher, gender, ethnicity, lunch status, and whether they student was assigned to a technology rich classroom.

APPENDIX B

IRB APPROVAL

Dear Ms. Sedler:

The IRB approves your research proposal (M-0073-0909-0926-G) under the Exempt protocol. Until the hard-copy letter of approval arrives (which will go out Monday), you may consider this email as evidence of that approval.

Good luck with your research,

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Marc Carter, PhD
Associate Professor and Chair
Department of Psychology
College of Arts & Sciences
Baker University