Technology Integration in Rural and Small Schools: Does It Make a Difference?

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ABSTRACT

The purpose of this study was to determine the effects of integrating educational technology into large rural, small rural and small non-rural public high schools in Georgia. The researcher also sought to determine if a correlation existed between principals' perception of technology and student achievement. Math pass rates on the Georgia High School Graduation Test (GHSGT) in 2008 and 2010 were used to measure achievement. School groups were given a technology score based on a Technology Inventory. Principal perceptions were measured using a Technology Integration Survey.

A causal-comparative research design was used in this study. Repeated-measures ANOVA were used to compare the math pass rates of large rural, small rural and small non-rural public schools. An independent-samples *t* test was used to compare mean math pass rates of small schools and small non-rural schools. Three hypotheses were proposed to examine the effects of technology integration on math pass rates on the GHSGT. None of the hypotheses were supported; all three groups' mean pass rates decreased. There was a statistically significant decline in math pass rates for large rural schools, $M = -5.19$, $SD = 8.75$, Wilks' Lambda = .74, $F(1,123) = 45.53$, $p < .001$. There was not a significant decline in math pass rates for small rural schools, $M = -1.67$, $SD = 11.34$, Wilks' Lambda = .98, $F(1,35) = .78$, $p = .38$. There was not a significant difference in math pass rates between small public schools ($M = -1.71$, $SD = 5.56$) and small public rural schools ($M = -1.67$, $SD = 11.34$); t (46) = .01, $p = .99$. There was no correlation found between principal's perception of technology and 2010 GHSGT math pass rates, $r = -.12$, $n = 22$, $p = .58$.

TABLE OF CONTENTS

LIST OF TABLES

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Chapter I

INTRODUCTION

Today's world is driven by technology. There is scarcely a part of a day when one is not inundated by its influence. Fifteen years ago, most employees were tethered to a desk behind a computer. Now, with laptops, smartphones, and tablets connected through wireless networks, workers can be anywhere and accomplish even more because of the incredible capabilities of modern technology.

Adults are not the only ones consumed with technology. Children as young as preschool can be seen transfixed by an iPad, smartphone, or tablet of their own. They can literally create their own universe with games like Minecraft, Sims, and Tinkatolli. Teenagers' communication systems have mostly been replaced by text messages. Social media sites, like Facebook, allow users to share news and their opinions at the speed of a button click. Friedman (2005) argued that as Internet access grows, the world becomes more flat. Technology continues to be less complex, faster, and cheaper each year. The question becomes, has the United States reached the point of *too much of a good thing* when it comes to technology?

The purpose of technology is to help mankind achieve an end more efficiently (Belcher, 2013). Examples are the invention of the wheel around 4000 BC and Gutenberg's printing press around 1450 AD (Atkinson, 1990). As various machines were invented and mass produced, Americans left farms to seek work in urban areas in these new factories. During the first years of the Industrial Revolution, children were running the machines of mass production. However, the passage of child labor laws (National Child Labor Committee, 2013) as well as mandatory school attendance laws (Katz, 1976) moved masses of children from factories into classroom between the late 1800s and 1920s.

In order to better prepare children for a future employment in the factories, educators began to borrow techniques from industry (Bobbit, 1918). In 1913, Franklin Bobbitt founded the Social Efficiency ideology for developing curriculum, which called for educators to employ the scientific techniques of production developed by industry to prepare students to meet the needs of the industrial workplace (Schiro, 2013). This behavioristic approach to education sought the most efficient use of educational time, money, and human resources (Tyler, 1949). Educators used quantitative measures from professors and efficiency engineers in order to "embrace current innovations targeted at cutting costs while boosting productivity" (Cuban, 1986, p. 11).

This approach to education was first seen on a large scale in Gary, IN (Volk, 2005) where the plan of work-study-play was implemented. The Gary Plan divided students into groups; one group receiving the three Rs and the other group taught by specialized teachers to include art, gym and shop (Rich, 1992). The Gary Plan included industrial education in the regular curriculum, even for elementary students, with shops distributed throughout the building (Volk, 2005).

Cuban (1986), a leading authority in technology use in education, traced the introduction of various technologies into the classroom from the 1920s through the 1980s. He found that the reasons teachers gave for not using computers in the 1980s were the same in the 1920s for not using film. He also found that when teachers do use educational technology, they typically use it in ways that maintain rather than transform their existing instructional practices (Cuban, 2001).

Despite teachers' limited use of technology, the perceived impact of technology on classroom instruction became so great that states eventually began developing technology plans. In 2001, the Georgia Department of Education (GADOE) began work on a statewide technology initiative that culminated in the Georgia K-12 Technology Plan 2007-2012 (GADOE, 2008). The purposes of this plan included: establishing how technology can improve student achievement, publishing public goals for improving student achievement through technology, and addressing funding for the technology plan (GADOE, 2003).

In order to prepare students for the work world, Georgia's Office of Planning and Budget (2012) reported an investment of tens of millions of dollars per year in technology in an attempt to create 21st Century Schools. A 21st Century School consists of classrooms that engage students in forms of learning they regularly experience outside the classroom and that seem natural to them, primarily through student-centered use of technology. Students build learning skills using Web 2.0, applications, technology tools and research-based instructional strategies (Song & Lee, 2014). Instruction is individualized by formatively assessed data (Centers for Quality Teaching and Learning, 2011). The technology tools of the 21st Century classrooms include high speed internet access, interactive white boards, computers for student use, teacher laptops, multimedia projectors, and student response systems (Caldwell, 2009). To help school systems track their progress toward this goal, Georgia's public schools must submit an Annual School

Technology Inventory Survey to the GADOE set out in the K-12 Technology Plan (GADOE, 2012).

This technology does not come without expenditures. Public schools have historically been underfunded (Leachman & Mai, 2014) which impacts their attempt to make the latest technology available for all students. This problem was exacerbated when the U.S. economy plummeted in 2008. Major budget shortfalls occurred as federal dollars disappeared coupled with the loss of state and local tax revenues. As a result, state legislators had to make tough decisions regarding expenditures. One of the largest expenditures in the state's budget is education. The Georgia Department of Education receives almost 40% of the appropriations granted by the state legislature, just over $7 billion (Alford, 2012). In 2012, the Georgia School Board Association (GSBA) reported beginning in Fiscal Year 2008, the decreased state funding led local schools to cut programs, positions, and operations to include furloughing teachers and reducing the total number of school days. The GSBA (2008) blamed the loss of revenue from federal, state, and local taxes on the economy.

Small rural schools are typically underfunded and especially sensitive to cuts in state revenue. This is of importance because of the number of rural students in Georgia. The *Why Rural Matters Report 2011-12* states that Georgia has the third largest absolute rural student enrollment (as opposed to per capita rural student enrollment) in the nation. The report cites rural areas have a limited tax base which leads states like Georgia to heavily depend on the federal government for funding. Title VI, Part B-Rural Education Achievement Program (REAP) "is designed to assist rural school districts in using Federal resources more effectively to improve the quality of instruction and student academic achievement" (GADOE, 2013, *Title VI, Part B-Rural Education Achievement Program*, para. 1). REAP consists of two programs: the Small, Rural School Achievement (SRSA) program and the Rural and Low-Income Schools (RLIS) program. In FY09, 83 of the 180 school districts in Georgia (46.1%) received REAP Funds (GADOE, 2009).

Although fewer funds were available to Georgia schools after 2008, they still had to adhere to the accountability mandates of No Child Left Behind. Adequate Yearly Progress (AYP) required schools to improve annually on standardized tests such as the Georgia High School Graduation Test. Technology was seen as a way to achieve that end as cost-effectively as possible. The GADOE (2008) stated that the primary purpose of the Georgia K-12 Technology Plan (2007-2012) was, "To establish how technology can contribute to statewide goals for improving student achievement in Georgia's K-12 public schools" (p. i). Georgia schools have been implementing a state-wide technology plan and it is now possible to begin determining whether or not the incorporation of educational technology correlates with increased student achievement.

Statement of the Problem

States, including Georgia, have seen technology as an opportunity to save money in the area of education while more efficiently and effectively teaching students (GADOE, 2008). Van Beek (2011) in a comprehensive review of online learning in Michigan, found that virtual schools (like Georgia's Virtual Academy) can cost taxpayers less per pupil than traditional brick-and-mortar schools. He reported that these virtual schools can provide more flexibility for individual learning and provide access to outstanding teachers for poor and remote schools.

One strategy used by the educational community to prepare students for the work world was a large financial investment in technology in an attempt to become 21st Century Schools. The Annual School Technology Inventory Surveys (GADOE, 2012), revealed that educators in Georgia have been equipping schools with advanced interactive technologies, such as LCD projectors, student response systems, SmartBoards, iPads, wireless campuses, and have even created virtual academies. However, a recent search using ERIC for scholarly articles relating to the impact of technology on student achievement in Georgia did not turn up a single article that addressed small schools or rural schools. Given the limited financial resource and lower academic performance of students in small and rural schools, this information gap needs to be addressed.

The Council of Economic Advisors (2013) stated that on average, rural residents have lower incomes than urban residents. Socio-economic status (SES) has been shown to correlate with student achievement. The research of Morgan, Farkas, Hillemeier, and Maczuga (2009) indicated that children from low-SES households and communities develop academic skills more slowly than children from higher SES groups. Aikens and Barbarin (2008) found the school systems in low-SES communities were often underfunded and under resourced, negatively affecting students' academic achievement. The *Why Rural Matters Report 2011-12* states that nearly 575,000 students attend rural schools in Georgia, the third largest absolute rural student enrollment in the nation. As noted in *Status of Education in Rural America* (2007), rural public schools tended to receive a smaller percentage of their revenues from federal sources: 9% for rural public schools compared to 11% for city public schools. Salzer (2013) indicated small rural schools have missed out on equalization funding in Georgia and have no hope of raising serious money from property taxes. These data make it imperative to examine the effect of technology on student achievement as educational resources continue to dwindle, particularly for small and rural school districts.

Conceptual Framework for the Study

Recent studies of the power of technology to affect student learning, studies of the special challenges faced by small and rural schools, and the studies of the role that administrators play in successfully integrating technology into schools informed this study.

In an attempt to save money, increase teacher output, and raise student achievement, Georgia invested heavily in the K-12 Technology Plan in 2003 (GADOE, 2008). Cobb County, for example, the second largest school system in Georgia, began implementing its technology initiative in 2005. This included a one-to-one laptop computer for teachers and students. The rationale for this project was presented in *One to One Computing: A Summary of the Quantitative Results from the Berkshire Wireless Learning Initiative* (Bebell & Rachel, 2010). The results from the 3 year study indicated teachers overwhelmingly reported increased student engagement and motivation. Further, student research skills as well as collaboration were enhanced because of the use of technology in the classroom. Finally, there was evidence that student achievement was positively impacted by the one-to-one program (Bebell & Rachel, 2010). During the 2007-08 school year Cobb County equipped schools with advanced interactive technologies, such as LCD projectors, student response systems, and SmartBoards. The final phase (2009-12) included the incorporation of iPads and related software for various 21st Century projects. To date, Cobb County Schools have created Cobb Virtual

Academy, an online learning school which offers online classes to high school students. This allows students to communicate with teachers remotely, participate in a rigorous curriculum (including AP level courses), and have access to information outside of the classroom. Students can work at their own pace and complete a combination of assignments, tests, quizzes, projects, and assessments that permit a teacher to follow their educational progress (Hanover Research Council, 2010). Cobb County schools are far from small or rural. However, this school system's experience suggests that interactive technology can positively impact student learning, at least in some school settings (Bebell & Rachel, 2010).

Cobb County's success may not automatically translate in all educational environments. Shapely (2011) conducted a study of technology to investigate the effects on students' academic achievement. The relationships among technology immersion and intervening factors at the school, teacher, and student levels were also examined. The research involved 42 middle schools assigned to either treatment or control conditions. Twenty-one middle schools comprised the treatment group. They received laptops for each teacher and student, instructional and learning resources, professional development, and technical and pedagogical support. There were 21 schools in the control group who received none of these. The finding revealed disciplinary actions declined, but treatment students attended school somewhat less regularly than control students. However, there was no statistically significant immersion effect on students' reading or mathematics achievement (based on the Texas state criterion-referenced tests).

Studies of small and rural schools reveal the special opportunities and challenges faced in these educational environments. When examining the difference in academic achievement between large and small schools in Texas, Stewart (2009) used the University Interscholastic League for school size classification. The University Interscholastic League is an organization that establishes rules and conferences in Texas for participation in competitions among Texas public schools. The purpose of the study was to determine whether there exists a relationship between student achievement in Texas, as measured by the Texas Assessment of Knowledge and Skills (TAKS) test, and the size of the high school at different socioeconomic levels. Stewart compared five size categories of Texas high schools to determine which size high school had the highest percentage of eleventh grade students passing all four sections (reading, writing, math, and science) of the TAKS test. Traditional (non-alternative) schools with similar SES populations. The findings indicated that smaller rural schools experienced higher percentages of students passing all four parts of the eleventh grade TAKS test in Texas than the larger urban and suburban schools where 25% or more of the students lived in low socioeconomic situations. Stewart listed possible explanations of the results of his study as lower student-to-adult ratio and the familial feeling of a smaller school. He made no mention of technology as a major factor in the differences in achievement.

Barley and Beesley (2007) conducted an exploratory study using the factors perceived by school personnel to contribute to success in high-performing, high-needs (HPHN) rural schools. The four key components of success were leadership, instruction, professional community, and school environment. Five schools received site visits that included interviews and focus groups of educators, school board members, parents, and community representatives. From the site visits, case studies were created to further elaborate the schools' stories. The most important perceived factors Barley and Beesley identified from telephone interviews with principals of HPHN schools were high expectations, focus on student learning, use of data, and individualization of instruction, teacher retention and professional development, and alignment of curriculum with assessment. The case studies revealed that although schools differed in context, they all reported a supportive relationship with their community, high teacher retention, and high expectations for students. The supportive relationship with the community was thought to help schools enact high expectations and facilitate principal leadership. Although there was no mention of technology as one of the factors for success in rural schools, school leadership was among the most important.

Effective leadership during the implementation process of any reform is vital to its success (Anderson & Dexter, 2005; Bailey, 2002; Ertmer & Ottenbreit-Leftwich, 2010). Anderson and Dexter (2005) and Hayes (2006) found leadership and an administrator's ability to lead is a significant factor in determining the success of implementing a new technology. Byrom and Bingham (2001) make a stronger statement regarding a principal's role for successful technological reform: "…leadership is probably the single most important factor affecting the successful integration of technology into schools" (p. 4). As modern technology integration has become the focal point of educational reform, leaders must not fall into previous technology implementation issues (Cuban, 2001). In the past, these issues included several problems: difficulty installing and maintaining hardware, problems caused by technology glitches, the amount of time required to use technology, problems aligning technology and the curriculum, and difficulty scheduling access to technology (Strong-Wilson, 2008). As Cuban (1986) mentioned, these issues lead to technology simply gathering dust.

Basran (2000) noted that principals must stay abreast of the most current technological developments and align their school management accordingly. Basran suggested this will enhance school personnel's technical knowledge and skills. How a principal perceives his or her leadership role and ability to listen to the teachers' needs frequently impacts the implementation process (Berrett, 2012). Principals' technology leadership qualifications should include a technology vision, promotion of staff development, encouraging instructional integration, infrastructure for technology, and using technology (Parks, Sun & Collins, 2002). The idea of supportive leadership and strong vision having a great influence on successive technology leadership understanding can be formulated as "Leadership + that First Success = Vision Accomplished" (Sun, 2000, p. 7). Because the reform of technology integration is top down, principals should include teachers in the technology planning process for school-wide implementation (Clark & Denton, 1998). A principal's perception of technology integration is important in understanding the school- wide implementation of a technology plan (Berret, Murphy, & Sullivan, 2012).

Purpose of the Study

Technology integration has become a focal point of educational reform over the last decade. Federal, state, and local funds have been provided to implement educational policies and integrate new technology integrations in school districts (Bailey, 2002; Christensen, & Knezek, 2007; Forte, 2010; Lowther, Inan, Strahl, & Ross, 2008). The purpose of this study was to determine if there was a difference in student achievement from 2008-2010 by comparing math pass rates on the Georgia High School Graduation Test (GHSGT) in large rural, small rural and small non-rural schools. Because of the importance of school leaders on educational reform, a principal's perception of technology use survey was administered to gauge its impact on student achievement as measured by percentage of students passing the GHSGT.

Research Questions

Research Question 1. Is there statistically significant growth for large public rural Georgia schools in mean percentage of passing rates on the math portion of the Georgia High School Graduation Test over a 3-year period after incorporating technology such as computers, high speed internet access, and electronic white boards?

Research Question 2. Is there statistically significant growth for small public rural Georgia schools in mean percentage of passing rates on the math portion of the Georgia High School Graduation Test over a 3-year period after incorporation of technology such as computers, high speed internet access, and electronic white boards?

Research Question 3. Is there a statistically significant difference between small public Georgia schools and small public rural Georgia schools in mean percentage of passing rates on the math portion of the Georgia High School Graduation Test over a 3-year period after incorporation of technology such as computers, high speed internet access, and electronic white boards?

Research Question 4. Is there a correlation between principals' perceptions of technology use and percentage of passing scores on the math portion of the Georgia High School Graduation Test scores in small public schools in Georgia?

Definition of Terms

Educational Technology. Educational technology is defined as "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (Association for Educational Communications and Technology, 2004, p. 1)

21st Century Schools. 21st Century Schools include networked digital electronics such as computers, the internet, interactive whiteboards, cell phones, portable media players, digital cameras, digital camcorders, etc. and the software developed to use with them (Anderson, 2009).

Small School. Small school is defined by the smallest 21-22% of member high schools of the Georgia High School Association not to exceed 525 students.

Rural School. Schools with a locale code of 6, 7, and 8 are considered rural schools for this study. According to the U.S. Census Bureau, a locale code of *6* indicates an area outside of a metropolitan statistical area (MSA) and has a population of at least 2,500 persons, but fewer than 25,000 persons. A locale code of *7* indicates a place outside a MSA and has a population of fewer than 2,500 persons. A locale code of *8* indicates a place that is inside a MSA and has a population of fewer than 2,500 persons (National Center for Education Statistics, 2011).

Small Rural School. The Small, Rural School Achievement Program defines a small rural school as: (a) The total number of students in average daily attendance (ADA) at all of the schools served by the local education agency (LEA) is fewer than 600, or each county in which a school served by the LEA is located has a total population density of fewer than 10 persons per square mile; (b) if all of the schools served by the

LEA are designated with a school locale code of 7 or 8 by the Department's National Center for Education Statistics (National Center for Education Statistics, 2011) .

Small Non-Rural School. A school inside the territory of an urbanized area and inside a principal city with population less than 100,000 and is one of the smallest 21-22% of member high schools of the Georgia High School Association not to exceed 525 students (National Center for Education Statistics, 2011) .

High School. A high school is a publicly supported secondary school usually consisting of grades 9 through 12 that prepares students for graduation and exit from the public school system.

Georgia High School Graduation Test (GHSGT). A state-mandated series of tests in which students must pass a Writing Assessment, English Language Arts, Mathematics, Science, and Social Studies in order to qualify for graduation. Students take the graduation tests for the first time in the eleventh grade. Students who do not pass on the first attempt of the tests have multiple opportunities to receive additional instruction, retest, and qualify for graduation before the spring of the twelfth grade (GADOE, 2012).

Methodology

The research design utilized in this study is referred to as causal-comparative (Fraenkel & Wallen, 2010). In this design, random sampling of rural schools and small schools is not used because the effects and alleged cause(s) have already occurred. Schools will be categorized *rural* based on FY09 REAP eligibility criteria and *small* based on 2008-2010 GHSA Class A classification. There were 188 public high schools that met the rural criteria for FY 2009 and there are 55 public schools in GHSA Class A for the 2008-2010 classification. Because of the relatively small number of *small* and *rural* schools, all were included in the sample. GHSGT scores from 2008-2011, available from the GADOE website, were used to see if schools made a statistically significant improvement in scores after incorporating technology. The small and rural schools' Annual School Technology Inventory Surveys (GADOE, 2012) were used to determine *incorporation of technology* in the schools used in the study. These inventories include data such as: student population, total classrooms, type/speed of internet connection, types of computers, student-per-internet connected computer ratio, percentage of classrooms with high-speed internet access, percentage of instructional areas that currently have wireless connection, and various types of hardware (projectors, interactive whiteboards, student response devices, etc.). Finally, a principal's technology use perception survey was administered to all of the small and rural schools in Georgia to compare student achievement in their respective school. Each principal received three invitations via email with a link to the survey indicating that the survey would be available for three weeks. The survey included questions to establish demographic information and a Likert survey indicating attitudes towards the incorporation of technology in their respective school. To increase the participation rate, surveys were mailed to those that did not respond to the email survey option. The participants' responses were analyzed using Statistical Package for the Social Sciences (SPSS) computer program and the findings reported.

Significance of Study

The *Why Rural Matters 2011-12* (2012) lists Georgia as having the third largest rural student enrollment in the nation as well as having 37% of its public schools considered rural. State legislators have poured millions of dollars into educational technology (GADOE, 2013). As recent as 2011, Georgia lawmakers created the Education Financing Study Commission with HB 192 (Georgia.gov). This commission was comprised of legislators, educators and civic leaders whose purpose was to examine Georgia's K-12 budget priorities. Their proposals included a $20 million state grant program to expand technology infrastructure, plus more than $52 million in new spending on technology for classroom instruction (Barrow, 2012). As schools in Georgia have increased their use of technology over the last three years the objective has been to save money and increase student achievement. According to the Nation’s Report Card (2011), Georgia’s reading and math test scores have not changed significantly for those in elementary or middle school in recent years.

This study will address whether there has been a difference in students’ standardized math test scores (GHSGT) in the state of Georgia after the incorporation of technology such as computers, high speed internet access, and electronic white boards in small and rural schools. As the U.S. and Georgia economies post anemic growth coupled with the state’s multi-million dollar commitment to educational technology, it is imperative to explore if there is a correlation between technology inclusion and student achievement.

Limitations of the Study

The use of a causal-comparison design does not allow for the manipulation of variables making a correlational relationship impossible (Fraenkel & Wallen, 2010). Simon and Goes (2013) stated that because there is no random assignment to the treatment, there could be inherent confounds in the variables studied. They added that because of the lack of a random sample, generalization is limited. Other variables may impact test scores besides a school's designation of rural, small, the availability of technology, and principal perceptions of technology use. These variables include socio-economic status of students, difference in quality of teachers, and testing conditions.

The principal is seen as the instructional leader of the school (Fullan, 2010). Research shows that the direct effect of principals on student achievement is near zero (Hallinger & Heck, 1996; Leithwood, Jantzi, & Steinbach, 1999; Witziers, Bosker, & Kruger, 2003). Principals can have an indirect influence on conditions in which improved teaching and learning occurs (Hallinger, Bickman, & Davis, 1996). Another limitation of the study is the possibility that the leadership of a school has changed from 2008-2010 when the GHSGT scores being examined. Grusky (1960) was one of the first to recognize that leadership turnover promotes instability in an organization and even called it a succession crisis.

A potential limitation of the principal's perception survey must be considered. Cuban (2001) noted the self-reported data gathered from surveys may not be accurate due to exaggeration of perceived activity. Another potential limitation could be a lower than expected participation rate of principals in the principal's perception survey.

Organization of the Study

The first chapter identifies the problem and the parameters of the study. Chapter 2 provides a review of previous research on major issues of the study to include the history of technology inclusion in education, educational technology's impact on student achievement, small school size and rural status impact on student achievement, and the importance of school leadership perceptions. Chapter 3 discusses the methodology, research design, survey respondents, data collection and data analysis. Chapter 4 presents the findings and Chapter 5 includes a discussion of conclusions, implications, limitations, and recommendations for future research in the areas of technology in small and rural schools.

Chapter II

LITERATURE REVIEW

Introduction

Since the Industrial Revolution in the late 1800s, America has been obsessed with mass production and efficiency. New technologies revolutionized the production of goods in factories, thus allowing workers to produce more with the same, or even less, effort (U.S. History Scene, 2013). Mass production techniques were carried over into education as well. A leading researcher on the use of technology in education, Cuban (1986) declared, "Since the mid-nineteenth century the classroom has become home to a succession of technologies (e.g., textbook, chalkboard, radio, film, and television) that have been tailored to the dimensions of classroom practice" (p. 2).

Society has evolved as technology has allowed things to be done more efficiently. Steam power replaced water power and sped up the Industrial Revolution (Morris, 2012). Families moved from rural areas to urban areas in order to work in factories (U.S. History Scene, 2013). Much of the labor force was made up of children because they were a cheaper source of labor and easier to control than adults. The passage of child labor laws (National Child Labor Committee, 2013) as well as mandatory school attendance laws (Katz, 1976) led to a huge growth in public education. Franklin Bobbit (1913) wrote that the purpose of public education was to prepare workers for the factories of the Industrial Age. His approach to teaching children was based on the mass production model: educate as many children as possible for the fewest amounts of dollars.

This was first seen on a large scale in Gary, IN (Volk, 2005) where the plan of work-study-play was implemented. The Gary Plan divided students into groups; one receiving the three Rs and the other group taught by specialized teachers to include art, gym and shop (Rich, 1992). The Gary Plan included industrial education in the regular curriculum, even for elementary students, with shops distributed throughout the building (Volk, 2005).

As new technology became available, first in the form of radio, film and television and later in the form of personal computers and the Internet, educators tried to incorporate them into schools. Currently, interactive white boards, computers in the classrooms, student response systems, high speed Internet access, and virtual academies are part of the 21st Century classrooms (Brent & Johnson, 2011). Incorporating these technologies came at great financial cost. The United States Department of Education (2013) alone has spent billions of dollars on educational technology since 2000 in order to make learning more efficient and better prepare students for the working world. Of particular importance, according to the National Education Association (NEA), was the need to close the funding gap between urban and rural schools (2013). The NEA reported that rural schools have continued to receive fewer funds than urban and suburban schools. Although technology has been seen as a way for rural schools to offer the same education as urban and suburban schools, funding issues have prevented this change (de la Varre, Keane, & Irvin, 2011).

History of Educational Technology

Beginning as early as the 1600s, audiovisual aids were used by Johann Comenius when he wrote the first illustrated textbook (Reiser, 1987). Comenius' rationale was that learning is best achieved through the senses. Many forms of technology have been integrated into schools since this time. The Definition and Terminology Committee of the Association for Educational Communications and Technology (1972) indicated the educational technology added to the classroom since the early 20th century has expanded the range of resources for learning.

A brief summary of the history of film, radio, television and computers in the classroom is important to understand the current emphasis on schools' investments in technology in the 21st century. Although *magic lanterns* (stereoscopes and stereopticons) were used in the late 1800s (Anderson, 1962), it was not until 1910 that the first instructional films were published. In 1913, Thomas Edison predicted that motion pictures would replace books as the preferred way to teach (Saettler, 1968). Practice did not follow this prediction. Cuban (1986) found in a 1933 NEA survey only half of elementary teachers used film in the classroom. By 1954, Cuban noted that 32% of Georgia elementary teachers never used film. As interest in film waned, radios became the next promising educational technology.

Benjamin Darrow (1932), founder and first director of the Ohio School of the Air, stated the purpose of radio in education was to bring the world into the classroom and provide teachers with the finest resources via *textbooks of the air*. Levenson (1945) predicted that radios would be as prevalent in the classrooms as blackboards. This prediction was also too optimistic. By the 1950s, radios were not as common as blackboards in classrooms. Ohio, a leader in educational radio, only had 18% of its teachers regularly used radio in the classroom (Cuban, 1986). Televisions would take the lead in educational technology in the 1950s (Reiser, 1987).

During the 1950s, there was tremendous growth in the use of instructional television (Cuban, 1986; Reiser, 1987). Hezel (1980) stated, "Especially prior to the 1960s, educational broadcasting was seen as a quick, efficient, inexpensive means of satisfying the nation's instructional needs" (p. 173). It was at this time that Hagerstown, Maryland, incorporated televisions to supplement delivery of instruction (Reiser, 1987). By 1961, however, only 13% of content was delivered through television (Cuban, 1986). Since private and public sources had invested over $100 million in educational television by 1971, Tyler (1975) found that school districts discontinued funding for instructional television once the external funding was halted. Roccobono (1985) concluded that television had failed to change the educational system the way that many had hoped. The personal computer replaced the television as the number one instructional technology in the 1980s (Center for Social Organization of Schools, 1983).

Bork (1987) and Papert (1980) predicted that computers would revolutionize teaching and learning, just as Edison predicted film would in 1913. Unlike earlier technologies, though, personal computers have been rapidly and widely adopted in schools. In 1980, 5% of elementary and 20% of secondary schools in the United States had computers being used for instructional purposes; by 1983, it was 40% and 75% respectively (Center for Social Organization of Schools, 1983). Cuban (2001) noted the increasing growth of computers in the classroom when he found that in 1981, there was a 125:1 student/computer ratio; it was 5:1 in the year 2000.

Historically, these educational technologies (film, radio, and instructional television) have failed to make headway in the classroom for four reasons:

- teacher's lack of skill in using equipment;

- cost of equipment/maintenance;
- inaccessibility of equipment;
- fitting the use of the equipment with the curriculum (Cuban, 1986; Taylor 1975; Office of Technology Assessment, 1988).

Cuban confirmed the continued existence of these problems in *Oversold and Underused: Computers in the Classroom* (2001). Since 2003, Georgia has invested millions of dollars and planned long for the long term use of modern technology in the classroom though its K-12 Technology Plan (GADOE, 2008). This plan addresses many of problems that undermined earlier efforts in technology integration by including professional development for training teachers in necessary equipment skills and curriculum development as well as providing the equipment in the classrooms. The cost of addressing these problems is high. Since almost 37% of public schools in Georgia are considered rural and 48 high schools in the 180 school districts are small (U.S. Census Bureau, 2012), it is important to see if there is a correlation between the inclusion of educational technology and student achievement.

21st Century Schools

Partnership for 21st Century Schools (2014), an initiative that began in 2002, noted that "U.S. citizens and workers must be able to exhibit a range of functional and critical thinking skills related to information, media and technology" (p. 5). NEA Executive Director John I. Wilson (2011) said, "Learning in the 21st century takes new thinking… The 21st century skills are imperative to implement in our classrooms in order to prepare our students for our globalized workforce" (para. 21) In order to help achieve this, Anderson (2009) defined 21st Century Schools as including networked digital electronics such as computers, the internet, interactive whiteboard, cell phones, portable media players, digital cameras, digital camcorders, etc. and the software developed with them. Clemmons (2013) acknowledged a need for new instructional models and that technology provides a means to this end.

It is not just the hardware and software that makes the 21st Century School. Stevens (2011) discussed the importance of access via the internet to a global source of information. U.S. public schools have increased their connectivity to the internet since the mid-1990s. A study conducted by the National Center for Education Statistics (NCES) (2006) showed that in 1994, 35% of U.S. public schools and only 3% of public school instructional rooms had access to the internet. By 2005, nearly 100% of public schools and 94% of public school instructional rooms had internet access. This study also showed that U.S. schools have increased the speed of their internet connection: 74% used dial-up in 1994 while only 5% used dial-up in 2001. The majority of public schools reported a broadband connection (T1/DS1 line), a much faster connection than dial-up (Kleiner & Farris, 2002). Finally, the NCES (2006) found the ratio of students to computer with internet access decreased from 12.1 to 1 ratio in 1998 to 3.8 to 1 in 2005.

The Effect of School Size and Location on Technology Availability and Utilization

The National Center for Education Statistics (NCES) revised its definitions of school locale types (including *small* and *rural*) in 2006 after working with the Census Bureau to create a new locale classification system (2011). Their website (2013) uses the following definitions:

- A small city is defined as territory inside an urbanized area and inside a principal city with population less than 100,000;

- A small suburb is defined as territory outside a principal city and inside an urbanized area with population less than 100,000;

- A remote town is defined as territory inside an urban cluster that is more than 35 miles from an urbanized area. ("New Urban-Centric Codes," para. 1)

The NCES website (2013) uses the following definitions to define rural:

- Fringe-rural territory that is less than or equal to 5 miles from an urbanized area, as well as rural territory that is less than or equal to 2.5 miles from an urban cluster;

- Distant-rural territory that is more than 5 miles but less than or equal to 25 miles from an urbanized area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an urban cluster;

- Remote-rural territory that is more than 25 miles from an urbanized area and is also more than 10 miles from an urban cluster. ("New Urban-Centric Codes," para. 1)

As the nation has made great strides toward connecting its educational infrastructure to high-speed internet, recent studies have shown that rural schools and communities have had less broadband coverage when compared with their non-rural counterparts. In 2010, for instance, 57% of rural households had broadband Internet access, compared to 72% in urban areas, according to a November 2011 report by the U.S. Department of Commerce (Butrymowicz, 2010).

Howley, Kim, and Kane (2012) highlighted the dangers of inadequate connections for rural schools. They pointed to the increased growth of rural school enrollment versus non-rural schools and stated, "Without adequate high-speed internet infrastructure, rural schools and the students they serve will be left behind" (Howley, Kim, & Kane, 2012, p. 1). The federal government has begun to address this inadequacy. They have made building a broadband infrastructure for rural America a national priority. In 2009, Kruger reported that the American Recovery and Reinvestment Act (ARRA) included 7.2 billion dollars for broadband network build-out. Copps (2012), who was the acting director of the Federal Communications Commission (FCC) stated, "…my goal is that all rural Americans, like their counterparts in more densely populated areas of the country, have the opportunity to reap the full benefits of broadband services" (p. 3). He also laid out the FCC and the Rural Utilities Service (RUS) rural broadband strategy to enhance educational opportunities in rural areas. Howley et al. (2012) argued that these broadband initiatives were critical given that broadband-enabled teaching and learning has begun to fundamentally reshape education, allow for improved student instructional access and provide more professional development. Schools also deployed broadband internet access to overcome some of the education challenges associated with rural locale. Broadband has supported access to instructional offerings not otherwise available locally due to cost constraints, small class sizes, or lack of subject area teachers (Hannum, 2009).

Unfortunately, rural areas are often the last to be connected because the cost of connecting sparsely populated and geographically vast rural areas can be prohibitive for broadband service providers. In addition, even when high-speed service is available, adoption costs can be particularly high for rural residents. One study conducted by the Small Business Administration (2010) found that rural small businesses are charged higher prices for similar services provided to non-rural small businesses.

Technology and Student Achievement

In *Rural Schools: What Can We Learn*, Barley and Beesley (2007) conducted an exploratory study using the factors perceived by school personnel to contribute to success in high-performing, high-needs (HPHN) rural schools. They found four key components of success which were leadership, instruction, professional community, and school environment. Five schools in the study received site visits that included interviews and focus groups of educators, school board members, parents, and community representatives. Interviews revealed that the factors perceived as most important were high expectations, focus on student learning, effective use of data, individualization of instruction, teacher retention and professional development, and alignment of curriculum with assessment. Although the schools involved in these case studies differed in context, they all reported a supportive relationship with their community, high teacher retention, and high expectations for students. The researchers concluded that the close relationship with the community helped schools enact high expectations and facilitate principal leadership. This study did not mention technology as an important factor for high-performing, high-needs (HPHN) rural schools.

Researchers found studies of various forms of educational technology differ in their conclusions. In a meta-analysis of distance education studies conducted in 2004, Bernard, Abrami, Borokhovski, Wade, Wozney, and Wallet looked at a total of 232 studies from 1985 to 2002. The overall effect size for distance education in their meta-analysis was 0.0128, indicating a very small positive effect from learning by distance education. Hannum (2007) reached a similar conclusion: meta-analyses typically show small to moderate effect sizes from computer use while showing larger effect sizes from other instructional variables. He suggested that using empirically-validated instructional variables could increase the impact from teaching with computers. Hannum reported that adding computers without attention to the design of the instruction produced little gain in learning outcomes.

A design-based study conducted by Li, Dyjur, Nicolson, and Moorman (2009) examined the effects of an inquiry-based learning environment, with the support of videoconferencing, on both rural and urban secondary students' mathematics and science learning. The results suggest positive effects of this learning environment on student learning of math and science. In particular, both urban and rural students showed significant gains in their achievement. Additionally, students showed an increased interest and heightened confidence in math and science.

Mundy (2011) conducted a study to determine the effect of interactive electronic white boards (IWBs) on the academic performance of kindergarten through fifth grade elementary students. The participants covered seven local school districts with approximately 700 teachers instructing 16,421 students. The data from the study revealed that teachers who use the IWBs for 120 minutes or more per day had students with better test scores than if the interactive electronic white boards were used for less than 120 minutes a day. The research indicated that trainers, teachers, and administrators had positive perceptions and views of the interactive electronic white boards as an instructional tool.

A study conducted by Swan, Kratcoski, Schenker, and van't Hooft (2010) using reading and math scores on standardized achievement tests showed similar results. All student scores in third through eighth grades in an urban district in northern Ohio were included in order to compare those who received instruction with interactive whiteboards and those who did not. When comparing scores, the interactive whiteboard group had a slightly better performance (m = 415.81, n = 1379) on the Ohio Achievement Mathematics Tests than the group that did not use interactive whiteboards (m = 414.63, n

= 1813) across all grades. The difference was statistically significant, $F(1, 3168) = 5.591$, $p = 0.018$.

In 2005, Pearson, Ferdig, Blomeyer, and Moran conducted a meta-analysis to determine whether digital technologies affected reading acquisition skills (comprehension, metacognition, strategy use, motivation and engagement). Another purpose was to identify characteristics of effective interventions in order to guide educators to improve reading acquisition. There was little emphasis on metacognitive performances and almost no attention to issues of motivation and engagement. They found that a wide range of digital technologies appeared to enhance reading performance of middle school students by the robust overall effect size obtained by the meta-analysis. They made no specific software recommendations and urged schools to thoroughly investigate these technologies prior to adoption.

Slavin and Lake (2008) conducted a review of the quantitative evidence on elementary mathematics programs. Their goal was to determine the scientific basis for the touted effects of these programs. The review used 87 studies and focused on three different approaches to improve mathematics in elementary schools. One approach looked at mathematics curricula with the main focus on the introduction of alternative textbooks. These programs required professional development for teachers, and many included innovative instructional methods. The second approach reviewed was computer-assisted instruction (CAI), which uses technology to enhance student achievement in mathematics. Kulik (2003), who studied CAI programs extensively, concluded that these programs were almost always used in conjunction with a textbook-based program. Murphy et al. (2002) found that after diagnosing a student's level of performance, CAI programs provide them with an individualized set of exercises. The third elementary math approach focused on instructional process programs. The curriculum was almost always held constant with the focus being on teachers' instructional practices and classroom management strategies such as cooperative learning or tutoring (Slavin & Lake, 2008). After the review, Slavin and Lake concluded that there were limited differential effects for mathematics textbooks and that the effects of CAI were moderate. Finally, the instructional process approaches provided the strongest positive effects with programs designed to change daily teaching practices as opposed to those focusing on curriculum or technology alone.

Studies of distance education and virtual classes provide further evidence of the potential effectiveness of the latest educational technology. Watson et al. (2012) concluded that virtual schools have been a growing trend in education with 31 states allowing full online schools. Aronson and Timms (2004) discussed the advantages of online learning as intended to provide supplementary online courses to high school students who would otherwise be unable to take them, due to scheduling conflicts or their own school's limited curriculum. Online distance education (ODE) has been an attractive option for rural schools, which educate 29% of all K-12 students in the United States, because they often struggled to provide advanced courses and attract highly qualified teachers (de la Varre et al., 2010). According to a survey of rural schools in 2009, the two most common formats for distance education courses in rural schools were two-way videoconferencing courses and online courses (Hannum, Irvin, Banks, & Farmer, 2009). Online courses have been becoming so important that states like Virginia, Florida, and Idaho now require high school students to complete at least one virtual class before graduation (Brown, 2012).

Picciano and Seaman (2009) found in an administrator's survey of K–12 online learning just how prevalent virtual education has become. First, they found that 66% of school districts with students enrolled in online or blended courses anticipated their online enrollments will grow. Second, the overall number of K-12 students engaged in online courses in 2007-2008, was estimated at 1,030,000. This represents a 47% increase since 2005-2006. Third, respondents reported that online learning is meeting the specific needs of a range of students, from those who need extra help and credit recovery to those who want to take Advanced Placement and college-level courses. Finally, those respondents representing small rural school districts indicated the availability of online learning was a lifeline and enabled them to provide students with course choices and in some cases, the basic courses that should be part of every curriculum.

A study of technology immersion was conducted to investigate the effects of its impact on students' academic achievement (Shapely, 2011). The relationships among technology immersion and intervening factors at the school, teacher, and student levels were also examined. The research involved 42 middle schools assigned to either treatment or control conditions (21 middle schools that received laptops for each teacher and student, instructional and learning resources, professional development, and technical and pedagogical support, and 21 control schools). Shapely found that disciplinary actions declined, but treatment students attended school somewhat less regularly than control students. However, there was no statistically significant effect on students' reading or mathematics achievement (based on the Texas state criterion-referenced tests).

When examining the difference in academic achievement between large and small schools in Texas, Stewart (2009) used the University Interscholastic League (UIL) for school size classification. The UIL was an organization that established rules and conferences in Texas for participation in competitions among Texas public schools. The purpose of the study was to determine whether there was a relationship between student achievement in Texas, as measured by the Texas Assessment of Knowledge and Skills (TAKS) test, and the size of the high school at different socioeconomic levels. Stewart compared five size categories of Texas high schools to determine which size high school had the highest percentage of eleventh grade students passing all four sections (reading, writing, math, and science) of the TAKS test. Traditional schools with similar socio-economic status (SES) populations were studied. The findings indicated that smaller rural schools experienced higher percentages of students passing all four parts of the eleventh grade TAKS test in Texas than the larger urban and suburban schools where 25% or more of the students were living in low socioeconomic situations. Stewart suggested possible explanations for this include the lower student-to-adult ratio and the familial feeling of a smaller school. Stewart made no mention of technology as a major factor in the differences in achievement.

Expenditures on Technology and Student Achievement

Hancock (2005) conducted a study to determine if there was a relationship between expenditures on technology and student achievement in the state of Texas. He used the national standardized test scores of the Scholastic Aptitude Test (SAT), and the American College Test (ACT) as well as Texas state standardized tests to measure student achievement. Hancock found strong patterns of relationship between technology expenditures and achievement on the Texas standardized tests. From 2001 to 2003, there was a positive relationship between technology expenditures and achievement.

Potter and Small (1998) studied a Title I junior high school for 2 years that had used Title I funds to purchase and implement a computer reading program. The criterion used in the study was the percentage of students meeting the minimum standard on the Stanford Achievement Test. Before the program started, only 65.5% met the minimum standard. After 2 years of implementation, 74.4% of students had met the threshold. Potter and Small concluded that the Title I expenditures on technology played a vital part in the increase in student achievement.

However, after conducting a 3-year longitudinal study in Texas public high schools, Dorhout (2012) reached a different conclusion. The purpose of this study was to determine if a relationship existed between expenditures for technology, instructional resources, and professional development and a positive impact on at-risk student achievement. Results showed no relationship between per student expenditure and at-risk student achievement on the state mandated eleventh grade test in ELA, math, science and social studies. This led Dorhout to conclude that there was no relationship between at-risk student achievement and per student expenditure in the area of technology access, implementation, and instructional integration.

Student Access to Technology and Achievement

In order to ensure students have access to technology, many schools across the nation are implementing One-to-One computer initiatives (Saltpeter, 2006). Rosen (2011) proposed that these initiatives impacted student engagement and achievement if they were coupled with professional development for teachers. Researchers in Illinois

(Griffin, 2013) found overall math scores for sixth, seventh, and eighth graders increased on the state standardized tests 1 year after the adoption of a One-to-One computer initiative.

Lee (2010) conducted a study that focused on a One-to-One laptop program over a 3-year period. He was trying to determine if there was a difference in standardized test scores between students who participated in classrooms engaged in a deep use of technology (learning with computers) versus those with a shallow use of technology (learning from computers). Lee hypothesized that test scores would be significantly higher for those learning with computers for constructivist lessons versus those using computers as a textbook, word processor, and an electronic tutor (learning from computers). However, the data collected from 810 eleventh graders over a 3-year period found no significant difference in test scores between the two groups.

In 2012, Talley studied the relationship between student achievement scores on Maryland state tests and their *access* to technology and *use* at school. The Talley study included 229 public Maryland middle schools and used the Maryland Technology Inventory to determine access by looking at the student-to-computer ratio and internet accessible classrooms. When comparing group means in mathematics, Talley concluded that low-achieving schools tended to have higher student-to-computer ratios, higher student-to-classroom computer ratios, fewer teachers with classroom computers, and fewer classrooms with Internet access compared to higher achieving schools. He reached the same conclusion for low-achieving schools when comparing group means in reading regarding computer ratios and internet access. One constant for both high-achieving mathematics and reading schools was the tendency for teachers to have a higher level of technology efficacy.

In 2003, Knight focused on the relationship between three sub-categories in technology (access to technology, usage of technology, and capacity for technology) and student achievement scores in reading and math. Using all U.S. fourth and eighth grade reading and math scores from the National Assessment of Educational Progress (NAEP) in 2003, 2005, and 2007, Knight found only a small positive correlation between access of technology and standardized achievement scores and a small negative correlation between usage of technology and standardized achievement scores. Analysis showed no correlation between capacity of technology and standardized achievement scores. Knight concluded that the combined results of access, usage, and capacity did not provide a clear correlation between technology and student standardized achievement scores.

Interactive White Boards and Student Achievement

Interactive white boards (IWBs) have been used to make the shift from teacher-centered instruction to student-centered instruction (Cuthell, 2005; Miller, Glover & Averis, 2003, 2004; Painter, Whiting & Wolters, 2005). An IWB consists of a multi-media projector, computer and a touch sensitive screen (Jones, Kervin & McIntosh, 2011). Their growing popularity in classrooms has led researchers to study the impact on student achievement. Zittle (2004) explored the effects of interactive whiteboard lessons on elementary students by comparing pre- to post-test gains between 53 students whose teachers used interactive whiteboards with 39 students whose teachers did not. He found statistically significant differences between the groups with the interactive white board group obtaining an average gain score of 20.76 and the control group averaging a gain of

11.48 when looking at the pre- to post-test scores. When comparing pre- to post-test gains between college classes, Dhindsa and Emran (2006) found statistically significant gains for students taught using interactive whiteboards, with the interactive whiteboard group averaging a mean effect size of 2.68 and the control group averaging a mean effect size of 2.16.

Although early evidence reported that IWBs can have a positive effect on teaching and learning (Glover, Miller, Averis, & Door, 2007), much of this research is based on case studies making it difficult to generalize (DiGregorio & Sobel-Lojeski, 2010). DiGregorio and Sobel-Lojeski (2010) recommended large sample quantitative studies because current studies result in contradictory findings (Glover, Miller et al., 2005b; Higgins, Beauchamp, & Miller, 2007; Martin, 2007; Schuck & Kearney, 2007; Thompson & Flecknoe, 2003).

Georgia Student Achievement and Technology

Schools in Georgia have increased their use of technology since the adoption of their state-wide technology plan in 2003. The purpose has been to save money and increase student achievement. However, has it made a difference? According to the Nation's Report Card (2011), Georgia's test scores have not changed significantly for those in elementary or middle school in recent years. In 2011, the average score of fourth-grade math students in Georgia was 238. This was lower than the average score of 240 for public school students in the nation. The average score for students in Georgia in 2011 (238) was higher than their average score in 2009 (236) and was higher than their average score in 1992 (216). In 2011, the Nation's Report card showed the score gap between students in Georgia at the 75th percentile and students at the 25th percentile was

40 points. This performance gap was not significantly different from that of 1992 (45 points). The percentage of students in Georgia who performed at or above the NAEP *Proficient* level was 37% in 2011. This percentage was not significantly different from that in 2009 (34%) and was greater than that in 1992 (15%). The percentage of students in Georgia who performed at or above the NAEP *Basic* level was 80% in 2011. This percentage was not significantly different from that in 2009 (78%) and was greater than that in 1992 (53%).

This trend continued for the eighth graders as well. In the same Nation's Report Card-A Snapshot (2011), the average score of eighth-grade math students in Georgia was 278. This was lower than the average score of 283 for public school students in the nation. The average score for students in Georgia in 2011 (278) was the same as their average score in 2009 and was higher than their average score in 1990 (259). In 2011, the score gap between students in Georgia at the 75th percentile and students at the 25th percentile was 47 points. This performance gap was not significantly different from that of 1990 (52 points). The percentage of students in Georgia who performed at or above the NAEP *Proficient* level was 28% in 2011. This percentage was not significantly different from that in 2009 (27%) and was greater than that in 1990 (14%). The percentage of students in Georgia who performed at or above the NAEP *Basic* level was 68% in 2011. This percentage was not significantly different from that in 2009 (67%) and was greater than that in 1990 (47%).

There were fewer gains in reading test scores. In 2011, The Nation's Report Card-A Snapshot showed the average score of fourth-grade reading students in Georgia was 221. This was not significantly different from the average score of 220 for public school students in the nation. The average score for students in Georgia in 2011 (221) was not significantly different from their average score in 2009 (218) and was higher than their average score in 1992 (212). In 2011, the score gap between students in Georgia at the 75th percentile and students at the 25th percentile was 46 points. This performance gap was not significantly different from that of 1992 (49 points). The percentage of students in Georgia who performed at or above the NAEP *Proficient* level was 32% in 2011. This percentage was not significantly different from that in 2009 (29%) and was greater than that in 1992 (25%). The percentage of students in Georgia who performed at or above the NAEP *Basic* level was 66% in 2011. This percentage was not significantly different from that in 2009 (63%) and was greater than that in 1992 (57%).

In 2011, The Nation's Report Card-A Snapshot showed the average score of eighth-grade reading students in Georgia was 262. This was not significantly different from the average score of 264 for public school students in the nation. The average score for students in Georgia in 2011 (262) was not significantly different from their average score in 2009 (260) and was higher than their average score in 1998 (257). In 2011, the score gap between students in Georgia at the 75th percentile and students at the 25th percentile was 41 points. This performance gap was not significantly different from that of 1998 (46 points). The percentage of students in Georgia who performed at or above the NAEP *Proficient* level was 28% in 2011. This percentage was not significantly different from that in 2009 (27%) and was not significantly different from that in 1998 (25%). The percentage of students in Georgia who performed at or above the NAEP *Basic* level was 74% in 2011. This percentage was not significantly different from that in 2009 (72%) and was greater than that in 1998 (68%).

Rural Education and the State of Georgia

Examining rural education has been of the upmost importance for states like Georgia. According to the *Why Rural Matters Report 2013-14*, over 580,000 students attended rural schools in Georgia, the third largest absolute rural student enrollment in the nation. This report added that Georgia poverty and mobility rates were among the highest in the U.S., as was the percentage of minority students. Only three states have larger rural schools and districts than Georgia. Georgia's Rural National Assessment of Educational Progress (NAEP) scores are near the bottom nationally, and just over 6 in 10 rural students graduate from high school (only Louisiana's rate is lower). The rate of growth for rural students was dramatic, and the rate of growth in the rural Hispanic student population was among the highest in the nation. This report groups 25 statistical indicators into five gauges to take the measure of rural education in each of the 50 states. The five gauges have been combined to produce a rural education priority gauge. The higher the priority ranking, the more important and challenging rural education was in a state's overall education system. Georgia has a priority ranking of 9 among the 13 highest-priority states. The *Why Rural Matters Report 2011-12* indicates the major challenges facing Georgia's rural schools:

- 52% of the students attending schools in a rural district in Georgia live in poverty—compared to 40% at the national level;
- more than 1 in 3 students in rural Georgia is a child of color and the rate of growth in rural Georgia's Hispanic student population is among the highest in the nation;
- nearly 1 in 6 has changed residences in the past 12 months;
- rural NAEP scores in Georgia are near the bottom nationally, and just over 6 in 10 rural students graduate from high school. Only Louisiana's rate is lower (p. 36).

Educational Leader's Impact on Technology Integration and Student Achievement

Koh, Steers, and Terborg (1995) found evidence that leadership has been a strong predictor of teacher beliefs and practices, such as technology integration. Edmond (1979) was considered a pioneer in educational leadership and school effectiveness. He concluded that an involved principal was one of the most important components of an effective school. Witziers, Bosker, and Kruger (2003) added that the principal was responsible for professional development, supervision of teachers and achievement, and most importantly instructional leadership. Suber (2011) described transformational leadership in schools as directly affecting such school outcomes as teacher perceptions of student goal achievement and student grades. Although research reviews found that the direct effect of principals on student achievement was near zero (Hallinger & Heck, 1996; Leithwood, Jantzi, & Steinbach, 1999), they could have had an indirect influence on achievement. Hallinger, Bickman, and Davis (1996) found that when principals created a positive instructional environment (i.e., high teacher expectations, student opportunity to learn, clear mission, and grouping for instruction), it contributed to reading achievement.

The International Society for Technology in Education (ISTE) stated in 2001 that "the success of technology integration depends on leaders who can implement systemic reform in our schools" (para. 4). The ISTE adopted the following National Educational Technology Standards (NETS) for administrators in 2009:

- Visionary leadership: Educational Administrators inspire and lead development and implementation of a shared vision for comprehensive integration of technology to promote excellence and support transformation throughout the organization.

- Digital age learning culture: Educational Administrators create, promote, and sustain dynamic, digital-age learning culture that provides a rigorous relevant and engaging education for all students.
- Excellence in professional practice: Educational Administrators promote an environment of professional learning and innovation that empowers educators to enhance student learning through the infusion of contemporary technologies and digital resources.
- Systematic improvement: Educational Administrators provide digital age leadership and management to continuously improve the organization through the effective use of information and technology resources.
- Digital citizenship: Educational Administrators model and facilitate understanding of social, ethical and legal issues and responsibilities related to an evolving digital culture (pp. 1-2).

Based on these studies and the NETS, it is important to gauge the principals' perceptions of technology use in their schools when looking at achievement results.

Summary

Those in the field of education have continued to seek less expensive and more efficient ways to prepare students for the working world (GADOE, 2012). The merit of heavy investment in 21st Century classrooms by Georgia must be considered as educational dollars continue to decrease. Small and rural schools have felt these constraints more than larger schools (Salzer, 2013). Previous studies have varied as to the impact on student achievement of modern technology in the classroom--especially in small and rural schools. However, the importance of the principal has been shown to, at a minimum, indirectly impact student achievement (Hallinger & Heck, 1996; Leithwood, Jantzi, & Steinbach, 1999).

Arnold, Newman, Gaddy, and Dean (2005) found issues with research in general when it came to rural education. The authors searched the ERIC and PsycINFO databases for K-12 rural education research studies conducted in the United States and published in journal articles between 1991 and summer 2003. Only 21% of studies in their database met the requirement of employing a *comparative* (broadly defined) research design to investigate a rural education problem. These articles were then reviewed using quality-of-research criteria developed by McREL. No truly experimental studies were found in their review. The strongest studies identified were quasi-experimental and causal-comparative research designs. Of the 106 articles that used some kind of comparative research design, only ten were rated as higher-quality research, and only 48 were considered to be of medium quality. Forty-eight studies were rated as lower quality.

The previous limitations of educational technology integration into the classroom have been dealt with in Georgia through the Georgia Technology Plan. The purpose of this study was to determine if there was a difference in achievement when looking at Georgia High School Graduation Test Math Scores in small Georgia schools (to include small rural schools) that incorporate technology. A survey of principals' perceptions of technology was used to gauge these perceptions of technology and their impact on student achievement. Chapter 3 discusses the methodology, research design, survey respondents, data collection and data analysis.

Chapter III

METHODOLOGY

Introduction

The state of Georgia has invested heavily in educational technology since 2003 when it adopted its first K-12 Technology Plan (GADOE, 2008). Educational technology has been seen as a way for schools to save money and expand the curriculum (Van Beek, 2011). As state revenues declined from 2008-2011, it was important that expenditures were used as efficiently as possible. Small rural schools that depend on federal grants for improving student achievement remain typically underfunded making them especially sensitive to cuts from the state (GADOE, 2012). This is of importance given the large number of rural students in Georgia. The *Why Rural Matters Report 2011-12* states that Georgia has the third largest absolute rural student enrollment (as opposed to per capita rural student enrollment).

The purpose of this study was to determine if there were changes in the math pass rates of the GHSGT of public rural, small and small non-rural schools that incorporated technology over a 3-year period. Additionally, the principals' perceptions of technology use were assessed as a factor to consider when looking at student achievement in these schools. Because socio-economics has been shown to impact student achievement (Sirin, 2005), Title I schools were identified. The aim of this study was to learn if small Georgia schools have benefited academically from investing in technology and if small, rural Georgia schools experienced similar gains in achievement from similar investments by comparing the mean percent of those who passed the GHSGT over a 3-year period. These GHSGT scores were one criterion used to determine if schools met Adequate Yearly Progress (AYP). Because principals are expected to be the instructional leaders of schools, surveys were administered to see if there was a correlation between their perception of technology use and achievement.

Data collection included GHSGT pass rates that are available on the GADOE website. High school principals' perceptions data were collected utilizing a self-report survey. This chapter presents a description of participants and the instruments used in the study. Data collection procedures and data analysis are also explained.

The following research questions guided this study:

1. Is there statistically significant growth for large public rural Georgia schools in mean percentage of passing rates on the math portion of the Georgia High School Graduation Test over a 3-year period after incorporating technology such as computers, high speed internet access, and electronic white boards?

2. Is there statistically significant growth for small public rural Georgia schools in mean percentage of passing rates on the math portion of the Georgia High School Graduation Test over a 3-year period after incorporation of technology such as computers, high speed internet access, and electronic white boards?

3. Is there a statistically significant difference between small public Georgia schools and small public rural Georgia schools in mean percentage of passing rates on the math portion of the Georgia High School Graduation Test over a 3-year period after incorporation of technology such as computers, high speed internet access, and electronic white boards?

4. Is there a correlation between principals' perceptions of technology use and of percentage of passing scores on the math portion of the Georgia High School Graduation Test scores in small public schools in Georgia?

Three hypotheses were proposed for these research questions:

Hypothesis 1: There is statistically significant growth in large public Georgia schools' GHSGT math percent pass rate over a 3-year period when technology has been incorporated into the school.

Statistical procedures were used to test the following null hypothesis:

H_0 1: There is no statistically significant growth in large public schools' GHSGT math percent pass rate over a 3-year period when technology has been incorporated into the school.

Hypothesis 2: There is a statistically significant difference in small public rural Georgia schools' GHSGT math percent pass rate over a 3-year period when technology has been incorporated into the school.

Statistical procedures were used to test the following null hypothesis:

H_0 2: There is no statistically significant growth in small public rural schools' GHSGT math percent pass rate over a 3-year period when technology has been incorporated into the school.

Hypothesis 3: There is a statistically significant difference in small public Georgia schools' and small public rural Georgia schools' GHSGT math percent pass rate over a 3-year period when technology has been incorporated into the school.

Statistical procedures were used to test the following null hypothesis:

H$_0$ 3: There is not a statistical difference in small public schools' and small public rural schools' GHSGT math percent pass rate over a 3-year period when technology has been incorporated into the school.

Hypothesis 4: There is a correlation between a principal's perception of technology use and student achievement in small public schools in Georgia.

Statistical procedures were used to test the following null hypothesis:

H$_0$ 4: There is no correlation between a principal's perception of technology use and student achievement in small schools in Georgia.

Research Design

The research design utilized in this study is referred to as causal-comparative (Fraenkel & Wallen, 2010). In this design, random sampling is not used. Many studies are conducted on differences between intact groups that are formed by such categories as gender or location (Shenker & Rumrill, 2004). Shenker and Rumrill (2004) added that the causal-comparative design is important when a comparison needs to be made after groups have been exposed to the dependent variable(s). Because there is a lack of manipulation of the independent variable or random assignment of participants to groups, the certainty of what effect the independent variable has on the dependent variable is limited (Shenker & Rumrill, 2004).

Validity and Reliability

A major threat to the internal validity of a causal-comparative study is the possibility of a subject selection bias. This threat can be reduced by matching subjects (such as Title I schools or school size) on a related variable or creating homogenous subgroups (Fraenkel & Wallen, 2010). Other threats to internal validity in causal-comparative studies include location, instrumentation, and loss of subjects (attrition) (Fraenkel & Wallen, 2010). To address subject selection bias and location, all Georgia public schools that met the criteria for small rural and small non-rural were included in the study. In addition, all schools participated in the GHSGT which was found to meet nationally recognized professional and technical standards for assessment programs (GADOE, 2012).

Limitations of the Study

There are two weaknesses in causal-comparative research: lack of randomization and inability to manipulate an independent variable. As with correlational studies, causal-comparative studies may identify relationships but they cannot establish causation (Fraenkel & Wallen, 2010). This study may show that there is a relationship between the incorporation of technology in small schools and/or small rural schools and student achievement in Georgia. However, it cannot lead the researcher to identify the incorporation of technology as the cause of student achievement in small or small and rural schools in Georgia.

Setting and Participants

In this design, random sampling of small, public Georgia schools and small, public and rural Georgia schools was not used. Rather, all small Georgia schools and small rural Georgia schools were used in the sample. Georgia schools were categorized as *small* based on 2008-2010 Georgia High School Association (GHSA) Class A classification. The GHSA is a voluntary organization composed of over 400 public and private high schools that strives to promote good sportsmanship and a cooperative spirit among its member schools. The GHSA operates under a constitution which outlines the scope and purpose of the Association. It contains the standards of eligibility to be met by high school pupils for attaining the privilege of participation in interschool contests, and rules controlling the participation among schools (GHSA, 2012). Schools are divided in classification according to size so that schools will have an opportunity to compete for honors among schools of their own size. The GHSA uses the smallest 21-22% of its member schools to create the Class A classification which included all schools with less than 350 students (GHSA, 2012).

Schools were categorized *rural* based on FY09 Rural Education Achievement Program eligibility criteria. According to GADOE (2012), Title VI, Part B-Rural Education Achievement Program (REAP) "is designed to assist rural school districts in using Federal resources more effectively to improve the quality of instruction and student academic achievement" (para. 1). REAP consists of two programs: the Small, Rural School Achievement (SRSA) program and the Rural and Low-Income Schools (RLIS) program. In order to be eligible to receive REAP funds, school districts must have a specific locale code. Title VI, Part B formula funds are allocated based on locale codes of 6, 7, and 8. According to the U.S. Census Bureau, a locale code of *6* indicates an area outside of a metropolitan statistical area (MSA) and has a population of at least 2,500 persons, but fewer than 25,000 persons. A locale code of *7* indicates a place outside a MSA and has a population of fewer than 2,500 persons. A locale code of *8* indicates a place that is inside a MSA and has a population of fewer than 2,500 persons (GADOE School Locales). In FY09, 83 out of the 180 (46.1%) school districts in Georgia received REAP Funds (GADOE, 2009) with a total of 188 rural high schools.

The number of small Georgia schools according to the 2008-2010 GHSA classification Class A was 55 public high schools. Forty Georgia high schools met both the *small* and *rural* criteria. Of the Class A public high schools, 34 schools are Title I schools. To be a Title I school, at least 40% of a school's students must be from low-income families under the United States Census's definition of low-income (NCES, 2012). A total of 23 schools are *rural*, *small*, and are labeled Title I schools.

Instrumentation

Annual School Technology Inventory Survey

In Georgia, public schools must submit an Annual School Technology Inventory Survey (GADOE, 2012). These include data such as: student population, total classrooms, type/speed of internet connection, types of computers, student per internet connected computer ratio, percentage of classrooms with high-speed internet access, percentage of instructional areas that currently have wireless connection, and various types of hardware (projectors, interactive whiteboards, student response devices, etc.). Because the hardware inventory varies widely among high schools, three consistent categories of data are: (a) Students per modern instructional computer; (b) Percentage of classrooms with high speed internet access and (c) the number of interactive whiteboards per classroom ratio. Each school was rated on an interval scale for each category (0 to 5) for the 2008 school year. The three categories were then summed across for an overall score. The higher the score indicated a higher level of technology incorporation. A copy of the Technology Inventory Survey appears in Appendix A.

Technology Integration Survey

The researcher created a survey to determine principals' perceptions of technology use in their schools. The Technology Integration Survey used an ordered response scale of 0-4. The survey contained 13 items: 12 items that are measured on a five-point ordered response scale with ratings ranging from *never* (0) to *almost always* (4) respectively and one *yes/no* question asking the participant if they hold any certification(s) or degree(s) in technology. Participants were asked if they possess any certification or degree in technology as this may impact their perception of the importance of technology integration and student achievement. Items were designed to elicit responses on the principal's perceptions of technology use, teacher training and support regarding technology, and the importance of technology incorporation regarding student achievement. For example, Item 4 stated: *I model the use of technology to complete professional tasks*; Item 11 stated: *Teachers receive regular training on incorporating instructional technology in the curriculum*; and Item 12 stated: *The incorporation of technology in my school has made an impact on student achievement*. Participants were asked how many years they have served as the principal at their current school and chose their highest degree earned from a list provided.

Content validity for the survey of principals was established by having the instrument reviewed by a team of experienced faculty from Valdosta State University. The survey was then piloted by using a convenience sample of principals not employed at small, rural schools. This survey is Appendix B.

Achievement Measure

For this study, the Georgia High School Graduation Test (GHSGT) math pass rates from the Georgia Department of Education (GADOE) were used as a measure of student achievement. The GHSGT was a state mandated test from 1995 until 2010 in which students had to pass a Writing Assessment, English Language Arts, Mathematics, Science, and Social Studies in order to qualify for graduation. The GHSGT was peer reviewed by a team of experts in the fields of standards and assessments convened by the U.S. Department of Education. This team considered evidence in the following areas: content and academic achievement standards; technical quality; alignment; inclusion; and scoring and reporting. The GHSGT was found to meet nationally recognized professional and technical standards for assessment programs (GADOE, 2012). Each individual high school administers the GHSGT, usually through the counseling department. Students took the graduation tests for the first time in the eleventh grade. Students who did not pass on the first attempt of the tests had multiple opportunities to receive additional instruction, retest, and qualify for graduation before the spring of the twelfth grade (GADOE, 2011).

Ethical Considerations

Prior to conducting this research, an application for Review of Research Involving Human Subjects was made to the Institutional Review Board (IRB) at Valdosta State University for approval (see Appendix C). After receiving IRB approval, archival data were retrieved from the Georgia Public Education Report Card published by the Georgia Department of Education.

The Council of American Survey Research Organizations (CASRO), the American Association for Public Opinion Research (AAPOR) and the National Council on Public Polls (NCPP) all have published guidelines to use when creating surveys. To ensure the survey of principals' perceptions of technology conformed to guidelines, it was compared to the major principles of these organizations summarized by Altizer (2004). The questions were designed so as not to be leading, relevant to the topic, non-threatening to participants, language appropriate to the participants, and organized in a logical manner. Confidentiality and anonymity were assured not only in the type of questions but also in future reporting.

Procedures

School Data

School GHSGT math scores were collected using archival data available from the Georgia Public Education Report Card. There were three categories: fail, pass and pass plus. For this study, the categories of *pass* and *pass plus* will be combined into one category (pass). Schools technology inventory was collected from the Annual School Technology Inventory Surveys and included: (a) students per modern instructional computer; (b) percentage of classrooms with high speed internet access and (c) the number of interactive whiteboards per classroom ratio (GADOE, 2012). The Technology Inventory can be found in Appendix C.

Principal Data

An email was sent to invite principals to participate in the study through an online survey (using Qualtrics) on three separate occasions at 2-week intervals. Participants used the hyperlink to connect to the website hosting the survey on-line. The website will not allow repeated submissions of completed surveys ensuring trustworthiness of the data. After closing the survey, a participation response rate was calculated and the collected data were downloaded from the website into the Statistics Package for the Social Sciences (SPSS), version 23, for analysis.

Data Analysis

Using SPSS, the data gathered from the GHSGT test results (available on the GADOE website) of each small school over the last 3 years were analyzed to determine if there was a significant growth in the mean pass rates. Data were checked for the assumption to the adherence of normality and homogeneity of variance for small and small rural schools. For reliability analysis of the principals' perception survey, Cronbach's α was run using SPSS with the value of α at .7 or .8 indicating internal consistency.

Repeated-measures analysis of variance (ANOVA) was conducted to compare the mean pass rates of the 3 years for small schools. Repeated-measures ANOVA is used when the independent variables have all been measured using the same participants in all conditions (Field, 2009). Pearson's correlation coefficient (*r*) was computed to assess the relationship between technology integration and Georgia High School Graduation Math pass rate. For all data analyzed, an α of .05 was used to determine statistical significance (Fields, 2009).

Principal responses to the survey items were summed across to create a technology perception score. Higher scores (3-4) will indicate a more positive perception towards technology while a lower score (0-2.99) will indicate a more negative perception towards technology.

Summary

This chapter described the quantitative research process that was used to conduct a study to determine if incorporating technology in small and small rural schools had an impact on GHSGT scores. Schools were categorized as *small* and *rural*, technology inventories were used to categorize *incorporation of technology*, and principals' technology use perception surveys compared to student achievement in their respective school. The survey was administered to all principals of small schools when gathering their perceptions about technology use in their school. Chapter 4 will contain the findings of the study and the statistical results and Chapter 5 includes conclusions, discussion, and recommendations for further research.

Chapter IV

RESULTS

Introduction

The purpose of this study was to determine if there were changes in the math pass rates of the GHSGT of public rural, small and small non-rural schools that incorporated technology from 2008-2010. Additionally, the principals' perceptions of technology use were assessed as a factor to consider when looking at student achievement in these schools.

GHSGT data for this study were gathered from the GADOE website. Data for the principal's perception of technology were gathered from a self-reported survey of public small schools and public small rural schools. Descriptions of data collection procedures, the survey instrument, sample, and quantitative analysis results are included in this chapter.

Instrumentation

Examination of the research question regarding principal's perception of technology was conducted by means of a self-reported survey of small public and small rural school principals in Georgia. The Technology Integration Survey contained 13 items: 12 items that were measured on a five-point ordered response scale with ratings ranging from *never* (0) to *almost always* (4) respectively and one *yes/no* question asking the participant if they hold any certification(s) or degree(s) in technology. Participants were asked if they possess any certification or degree in technology as this may impact their perception of the importance of technology integration and student achievement. Items were designed to elicit responses on principals' perceptions of technology use, teacher training and support regarding technology, and the importance of technology incorporation regarding student achievement. A copy of the Technology Integration Survey is located in Appendix A.

Data Collection Procedures

In order to ensure there was no difference in technology between the three groups, a technology survey was used to compare high speed internet connectivity, student-to-computer-ratio and interactive white boards per classroom. A K-S test was computed for the assumption of normality for scores on the Technology Inventory Survey. For the item high speed internet, large rural school results showed $D(124) = .46$, $p < .001$, small rural were $D(36) = .49$, $p < .001$ and small non-rural were $D(12) = .50$, $p < .001$, indicating that the assumption for normality was not met. For student-to-computer ratio, large rural school results showed $D(124) = .35$, $p < .001$, small rural were $D(36) = .28$, $p < .001$ and small non-rural were $D(12) = .37$, $p < .001$, indicating that the assumption for normality was not met. For interactive whiteboard to classrooms ratio, large rural school results showed $D(124) = .23$, $p < .001$ and small rural were $D(36) = .18$, $p = .004$, indicating that the assumption of normality was not met. However, small non-rural were $D(12) = .23$, $p = .068$, indicating the assumption of normality was met. When examining the homogeneity of Technology Inventory Survey scores, the Levene's test resulted in $F(2,169) = .58$, $p = .56$ indicating that the assumption homogeneity of variance was met.

A one-way ANOVA was conducted to examine the mean scores of the three groups' technology inventory score. For high speed internet connectivity, there was not a statistically significant difference between the group means, $F(2,169) = .213$, $p =. 81$. For student-to-computer ratio, there was a statistically significant difference between group means, $F(2,169) = 3.6$, $p = .03$. When comparing the means of interactive white boards per classroom, a statistically significant difference existed between the group means, $F(2,169) = 6.87$, $p = .001$. The assumption of homogeneity of variance was met for all three categories: high speed internet access $F(2,169) = .81$, $p = .45$; student to computer ratio $F(2,169) = .69$, $p = .51$; interactive whiteboards per classroom ratio $F(2,169) = 2.149$, $p = .12$. Table 1 displays the descriptive statistics for the Technology Inventory Survey. Table 2 displays descriptive statistics for individual survey items.

Table 1

Descriptive Statistics for Technology Inventory Survey

School Size/Type	*N*	*M*	*SD*
Large Rural	124	3.49	.64
Small Rural	36	3.75	.66
Small Non-Rural	12	4.06	.53
Total	172	3.58	.66

Table 2

Descriptive Statistics for Technology Inventory Survey by Item

Inventory Item	School Size/Type	*N*	*M*	*SD*
High Speed Internet Access	Large Rural	124	4.71	.71
	Small Rural	36	4.75	.6
	Small Non-Rural	12	4.83	.39
Student to Computer Ratio	Large Rural	124	3.73	.96
	Small Rural	36	4.22	.99
	Small Non Rural	12	3.75	.97
Interactive Whiteboards per Classroom Ratio	Large Rural	124	2.02	1.35
	Small Rural	36	2.28	1.56
	Small Non Rural	12	3.58	1.56

The math pass rates for the GHSGT from 2008 and 2010 were obtained from the GADOE website using the school report card. Data not available on the GADOE website were requested via email and obtained from the GADOE in an Excel spreadsheet. Principal perception data were obtained by emailing surveys to all Georgia public small school principals using Qualtrics at the end of May 2015. After two attempts, only three electronic responses were gathered from public small school principals. In order to increase response rate, a survey packet was then mailed to the remaining principals of public small schools in Georgia at the end of June of 2015. This packet contained the same survey administered electronically and a letter explaining the purpose of the survey and instructions on how to complete the questionnaire. A self-addressed stamped envelope addressed to the researcher was included for respondents to return completed surveys. A follow-up mailing containing the same survey packet was sent to those principals who had not responded in late July 2015.

Sample

For this study, all 243 Georgia public rural and small schools were considered as an accessible population meeting the criteria in this project. Because some of the schools were opened after 2008, were a freshman campus only or did not have enough students for GHSGT data for either 2008 or 2010, they were not included in this study (*N* - 71). The adjusted sample size for public rural and small schools was *N* = 172. Data pertaining to school type and size are represented in Table 3.

Table 3

Descriptive Statistics for School Size/Type

School Size/Type	Frequency	Percent
Large Rural	124	72.1
Small Rural	36	21
Small Non-Rural	12	6.9
Total	172	100

The survey was designed to measure principals' perceptions at all rural and small non-rural public schools (*N* = 48). Two surveys were voided and subtracted from the total number of surveys that were received because of participant errors (*N* - 2). Of the 24 surveys received, 22 were considered for data analysis in this study, which yielded a response rate of 45.8%. Data pertaining to survey participants are represented in Table 4.

Table 4

Descriptive Statistics of Small Rural and Small School Principals Responding to Survey

School Size	Frequency	Percent
Small Rural	18	81.8
Small Non-Rural	4	18.2
Total	22	100

Quantitative Data Analysis and Results

Research Questions 1 and 2 were examined using separate repeated-measures ANOVA that included all Georgia public rural and small school math GHSGT pass and pass plus scores from 2008 and 2010. These were obtained through the GADOE website using the school report card. Any missing data from the website were provided by the GADOE via an Excel spreadsheet. An independent-samples *t* test was conducted to compare changes in pass rates between small public and small public rural schools. Descriptive statistics for changes of mean math GHSGT pass rates for 2008 and 2010 are in Table 5.

Table 5

Descriptive Statistics for Changes of Mean Math GHSGT Pass Rates for 2008 and 2010

School Size/Type	2008 Mean Math Pass Rates	2010 Mean Math Pass Rates	Change in Mean Math Pass Rates	*SD*
Large Rural	78.33	73.14	-5.19	8.75
Small Rural	65.84	64.17	-1.67	11.34
Small Non-Rural	76.32	74.61	-1.7	5.56
Total	75.57	71.37	-4.21	9.27

To obtain results for the fourth research question, a Pearson's product-moment correlation was computed to determine if there was a relationship between principals' perception of technology on a self-reported survey and math pass rates for 2010 after three years of technology integration. The Statistical Package for the Social Sciences (SPSS) was used to analyze all data sets. An α of .05 was used to determine the statistical significance for all data analyzed (Field, 2009). Additional examination of the Technology Inventory Survey results was conducted using ANOVA to determine whether there were any significant differences between the mean scores of the three groups. Results are reported in this chapter for each research question.

Research Question 1. Is there statistically significant growth for large public rural Georgia schools in mean percentage of passing rates on the math portion of the Georgia High School Graduation Test over a 3-year period after incorporating technology such as computers, high speed internet access, and electronic white boards?

H_0 1: There is no statistically significant growth in large public rural schools' GHSGT math percent pass rate over a 3-year period when technology has been incorporated into the school.

A repeated measures ANOVA was conducted to compare the effect of technology on GHSGT math pass rates in large public rural Georgia Schools over a 3-year period (2008-2010). Levene's statistic, a common test used for the assumption of homogeneity of variance, showed equal variances among the three groups ($p = .51$). There was a statistically significant decline in GHSGT math pass rates, Wilks' Lambda = .74, $F(1,123) = 45.53$, $p < .001$.

Research Question 2: Is there statistically significant growth for small public rural Georgia schools in mean percentage of passing rates on the math portion of the Georgia High School Graduation Test over a 3-year period after incorporation of technology such as computers, high speed internet access, and electronic white boards?

$H_0 2$: There is no statistically significant growth in small public rural schools' GHSGT math percent pass rate over a 3-year period when technology has been incorporated into the school.

Levene's statistic (Field, 2009) was used to test for the assumption of homogeneity of variance in the mean pass rates for rural, small rural and small non-rural schools. For the three groups $F(2,169) = 3.01$, $p = .51$ indicating homogeneity of variance. The Kolmogorov-Smirnov (K-S) test is commonly used to examine the normality of distribution of scores (Field, 2009). The results of the K-S test for mean math pass rates for 2008 for large rural school results showed $D(124) = .08$, $p = .09$, small rural were $D(36) = .08$, $p = .20$ and small non-rural were $D(12) = .15$, $p = .20$, indicating that the assumption for normality was met within the three groups. A repeated measures ANOVA was conducted to compare the effect of technology on GHSGT math pass rates in small public rural Georgia Schools over a 3-year period (2008-2010). There was not a significant decline in GHSGT math pass rates, Wilks' Lambda = .98, $F(1,35) = .78$, $p = .38$.

Research Question 3. Is there a statistically significant difference between small public Georgia schools and small public rural Georgia schools in mean percentage of passing rates on the math portion of the Georgia High School Graduation Test over a 3-

year period after incorporation of technology such as computers, high speed internet access, and electronic white boards?

H_0 3: There is not a statistical difference in small public schools' and small public rural schools' GHSGT math percent pass rate over a 3-year period when technology has been incorporated into the school.

The Kolmogorov-Smirnov (K-S) test is commonly used to examine the normality of distribution of scores (Field, 2009). The results of the K-S test for mean math pass rates for 2008 for large rural school results showed $D(124) = .08$, $p = .09$, small rural were $D(36) = .08$, $p = .20$ and small non-rural were $D(12) = .15$, $p = .20$, indicating that the assumption for normality was met within the three groups. An independent-samples t-test was conducted to compare changes in GHSGT pass rates between small public and small public rural Georgia school after the incorporation of technology over a 3-year period. There was not a significant difference in GHSGT math pass rates between small public schools ($M = -1.71$, $SD = 5.56$) and small public rural schools ($M = -1.67$, $SD = 11.34$); $t\,(46) = .01$, $p = .99$.

Research Question 4. Is there a correlation between principals' perceptions of technology use and of percentage of passing rates on the math portion of the Georgia High School Graduation Test scores in small public schools in Georgia?

H_0 4: There is no correlation between a principal's perceptions of technology use and student achievement in small schools in Georgia.

Cronbach's α was computed in order to measure internal consistency of the Principal's Perception of Technology Survey. The survey was found to be highly reliable ($\alpha = .85$). To assess the relationship between principals' perception of technology and

2010 GHSGT math pass rates, a Pearson r correlation was computed, $r = -.12$, $n = 22$, $p = .58$. There was no correlation between principal's perception of technology and 2010 GHSGT math pass rates. A possible explanation for the lack of correlation is due to the small sample size ($n = 22$). Table 6 displays the descriptive statistics for the Principal's Perception of Technology Survey.

Table 6

Descriptive Statistics for Principal's Perception of Technology Survey

Survey Questions	*Mdn*	*M*	*SD*
1. I make accommodations for teachers to attend technology training.	3	3	.87
2. Teachers have appropriate access to various types of computer technology, including peripherals.	4	3.42	.75
3. I recognize teachers who effectively integrate technology into instructional curriculum.	2	2.55	.91
4. I model the use of technology to complete professional tasks.	2.5	2.59	1.0
5. Teachers are informed about available journals, conferences, or current research in the area of technology.	2	2.36	1.34
6. Incorporating technology into the curriculum is part of the School Improvement Plan	4	3.5	.74
7. Technical support personnel are readily available for teachers.	3	3.04	.84
8. Teachers include the use of instructional technology in their lesson plans.	3	2.91	.88

9. Technology is used to prepare students for the Georgia High School Graduation Test (2008-2010).	3.5	3.32	.78
10. Teachers use technology for instructional purposes more than administrative purposes.	3	3.04	.9
11. Teachers receive regular training on incorporating instructional technology in the curriculum.	3	2.73	.94
12. The incorporation of technology in my school has made an impact on student achievement.	3	2.91	.68

Summary

This chapter reported the procedures used in conducting this study including instrumentation, data collection procedures, data analysis and results from the statistical analysis of each research question. Question 1 focused on the statistically significant growth for large public rural Georgia schools in mean percentage of passing rates on the math portion of the GHSGT over a 3-year period after incorporating technology. Results showed a statistically significant decrease in mean pass rates from 2008 to 2010 (M = -5.19). Similar results were found for Question 2 which addressed statistically significant growth for small public rural Georgia schools in mean percentage of passing rates on the math portion of the GHSGT over a 3-year period after incorporation of technology. Mean pass rates decreased (M = -1.67), however the decline was not significant.

Question 3 addressed statistically significant difference between small public Georgia schools and small public rural Georgia schools in mean percentage of passing rates on the math portion of the GHSGT over a 3-year period after incorporation of technology such as computers, high speed internet access, and electronic white boards. An independent-samples *t* test was used to compare the changes in math pass rates and although both groups declined, no statistical difference was found.

A Pearson correlation was used for Question 4 to determine if there was a relationship between small school principals' perception of technology and math pass rates on the GHSGT in 2010. Results showed that there was no correlation between principals' perception of technology and math pass rates on the GHSGT in 2010.

Chapter 5 includes discussion, conclusions, limitations and implications for future practice and recommendations for further research.

Chapter V

FINDINGS AND CONCLUSIONS

Technology integration has become a focal point of educational reform over the last decade. Federal, state and local funds have been provided to implement educational policies and new technology integrations in school districts (Bailey, 2002; Christensen, & Knezek, 2007; Forte, 2010; Lowther, Inan, Strahl, & Ross, 2008). Small and rural schools have historically received fewer funds for education (Salzer, 2013). Despite receiving fewer funds, Georgia's rural and small schools had to adhere to the accountability mandates of No Child Left Behind. AYP required schools to improve annually on standardized tests such as the GHSGT. Technology was seen as a way to achieve that end. The GADOE (2008) stated that the primary purpose of the Georgia K-12 Technology Plan (2007-2012) was to have technology contribute to statewide goals for improving student achievement.

Purpose of Study

The purpose of this study was to determine if there was a difference in 2008-2010 GHSGT math pass rates in large rural, small rural and small non-rural schools and if there was a correlation between technology integration and student achievement. Because school leaders are important to the success of educational reform, a principal's perceptions of technology use survey was used to gauge the impact on student achievement as measured by percentage of students passing the GHSGT. This study will answer the following research questions:

Research Question 1. Is there statistically significant growth for large public rural Georgia schools in mean percentage of passing rates on the math portion of the Georgia High School Graduation Test over a 3-year period after incorporating technology such as computers, high speed internet access, and electronic white boards?

Research Question 2. Is there statistically significant growth for small public rural Georgia schools in mean percentage of passing rates on the math portion of the Georgia High School Graduation Test over a 3-year period after incorporation of technology such as computers, high speed internet access, and electronic white boards?

Research Question 3. Is there a statistically significant difference between small public Georgia schools and small public rural Georgia schools in mean percentage of passing rates on the math portion of the GHSGT over a 3-year period after incorporation of technology such as computers, high speed internet access, and electronic white boards?

Research Question 4. Is there a correlation between principals' perceptions of technology use and percentage of passing scores on the math portion of the Georgia High School Graduation Test scores in small public schools in Georgia?

Related Literature

The purpose of technology is to help mankind achieve an end more efficiently (Belcher, 2013). The passage of child labor laws (National Child Labor Committee, 2013) and mandatory school attendance laws (Katz, 1976) increased the need to educate masses of children beginning in the late 1800s culminating in the 1920s. In order to better prepare children for a future in the factories, educators began to borrow techniques from industries (Bobbit, 1918). In 1913, Franklin Bobbitt called for educators to employ the scientific techniques of production developed by industries (Schiro, 2013). This behavioristic approach to education sought the most efficient use of educational time, money, and human resources (Tyler, 1949). Educators used quantitative measures from professors and efficiency engineers in order to "embrace current innovations targeted at cutting costs while boosting productivity" (Cuban, 1986, p. 11).

Since the turn of the 20th Century, technology such as film, radio and instructional television has been seen as a way to revolutionize teaching and student achievement in the classroom (Saettler, 1968). Historically, these educational technologies failed to make headway in the classroom for four reasons: teacher's lack of skill in using equipment; cost of equipment/maintenance; inaccessibility of equipment; and, fitting the use of the equipment with the curriculum (Cuban, 1986; Office of Technology Assessment, 1988; Taylor 1975).

Regardless of the previous problems with technology integration in schools, Bork (1987) and Papert (1980) made a similar prediction for computers' positive impact on education and learning. In 1980, 5% of elementary and 20% of secondary schools in the United States had computers being used for instructional purposes; by 1983, it was 40% and 75% respectively (Center for Social Organization of Schools, 1983). Cuban (2001) noted the increasing growth of computers in the classroom. Cuban found that in 1981 there was a 125:1 student/computer ratio. By the year 2000, the student to computer ration it was 5:1.

The perceived impact of technology on classroom instruction became so great that states began developing technology plans. In 2001, the GADOE began work on a statewide technology initiative that culminated in the Georgia K-12 Technology Plan 2007-2012. The purposes of this plan included, establishing how technology can improve student achievement, publishing public goals for improving student achievement through technology, and addressing funding for the technology plan (GADOE, 2003).

Georgia's Office of Planning and Budget (2012) reported an investment of tens of millions of dollars per year in technology in an attempt to create 21st Century Schools. The technology tools of the 21st Century classrooms included high speed Internet access, interactive white boards, and computers for student use, teacher laptops, multimedia projectors, and student response systems (Caldwell, 2009). Georgia public schools must submit an Annual School Technology Inventory Survey to the GADOE so as to track progress toward the goals set out in the K-12 Technology Plan (GADOE, 2012).

Since the recession in 2008, Salzer (2013) indicated small rural schools have missed out on equalization funding in Georgia and have no hope of raising serious money from property taxes making them especially sensitive to cuts in state revenue. As noted in *Status of Education in Rural America* (2007), rural public schools tended to receive a smaller percentage of their revenues from federal sources: nine percent for rural public schools compared to 11% for city public schools. This is of importance because of the number of rural students in Georgia. The *Why Rural Matters Report 2011-12* states that Georgia has the third largest absolute rural student enrollment (as opposed to per capita rural student enrollment) in the nation and depends on the federal government for funding. In FY09, 83 of the 180 school districts in Georgia (46.1%) received REAP Funds (GADOE, 2009).

Although fewer funds were available to Georgia schools, they had to adhere to the accountability mandates of No Child Left Behind. AYP required schools to improve annually on standardized tests such as the GHSGT. Technology was seen as a way to achieve that end. The GADOE (2008) stated that the primary purpose of the Georgia K-12 Technology Plan (2007-2012) was, "To establish how technology can contribute to statewide goals for improving student achievement in Georgia's K-12 public schools" (p. i).

Partnership for 21st Century Schools (2014), an initiative that began in 2002, noted that future workers would need to use a range of critical thinking skills related to information and technology. National Education Association Executive Director John I. Wilson (2011) said 21st Century skills were a new way of thinking as well as an imperative aspect of modern classrooms so that students could compete in a global workforce. To achieve this, Anderson (2009) defined 21st Century Schools as including networked digital electronics such as computers, the Internet, interactive whiteboard, cell phones, portable media players, digital cameras, digital camcorders, etc., and the software developed with them. Clemmons (2013) acknowledged a need for new instructional models and that technology can provide a means to this end.

These new instructional models depend on connection to the Internet. Stevens (2011) discussed the importance of access via the Internet to a global source of information. U.S. public schools have increased their connectivity to the Internet since the mid-1990s. The majority of public schools reported a broadband connection (T1/DS1 line), a much faster connection than dial-up (Kleiner & Farris, 2002). Published in 2006, this study found the ratio of students to instructional computer with Internet access decreased from 12.1 to 1 ratio in 1998 to 3.8.1.

When examining the difference in academic achievement between large and small schools in Texas, Stewart (2009) used the University Interscholastic League for school size classification. The University Interscholastic League is an organization that establishes rules and conferences in Texas for participation in competitions among Texas public schools. The purpose of the study was to determine whether there exists a relationship between student achievement in Texas, as measured by the Texas Assessment of Knowledge and Skills (TAKS) test, and the size of the high school at different socioeconomic levels. Stewart compared five size categories of Texas high schools to determine which size high school had the highest percentage of eleventh grade students passing all four sections (reading, writing, math, and science) of the TAKS test. The findings indicated that smaller rural schools experienced higher percentages of students passing all four parts of the eleventh grade TAKS test in Texas than the larger urban and suburban schools where 25% or more of the students lived in low socioeconomic situations. Stewart listed possible explanations of the results of his study as lower student to adult ratio and the familial feeling of a smaller school.

Shapely (2011) investigated the effects of technology on students' academic achievement. The relationships among technology immersion and intervening factors at the school, teacher, and student levels were also examined. Findings revealed no statistically significant immersion effect on students' reading or mathematics achievement (based on the Texas state criterion-referenced tests).

Hancock (2005) attempted to determine if there was a relationship between expenditures on technology and student achievement in the state of Texas. He used the national standardized test scores of the SAT, and the ACT as well as Texas state standardized tests to measure student achievement. Hancock found strong patterns of relationship between technology expenditures and achievement on the Texas standardized tests. He reported, from 2001 to 2003, there was a positive relationship between technology expenditures and achievement.

Potter and Small (1998) studied a Title I junior high school for 2 years that had used Title I funds to purchase and implement a computer reading program. The criterion used in the study was the percentage of students meeting the minimum standard on the Stanford Achievement Test. Before the program began, only 65.5% met the minimum standard. After 2 years of implementation, 74.4% of students met the threshold. Potter and Small concluded that the Title I expenditures on technology played a vital part in the increase in student achievement.

After conducting a 3-year longitudinal study in Texas public high schools, Dorhout (2012) reached a different conclusion. The purpose of this study was to determine if a relationship existed between expenditures for technology, instructional resources, and professional development and a positive impact on at-risk student achievement. Results indicated no relationship existed between per student expenditure and at-risk student achievement on the state mandated eleventh grade test in ELA, math, science and social studies. This led Dorhout to conclude that there is no relationship between at-risk student achievement and per student expenditure in the area of technology access, implementation, and instructional integration.

In order to ensure students had access to technology, many schools across the nation implemented One-to-One computer initiatives (Saltpeter, 2006). Rosen (2011) proposed that these initiatives impacted student engagement and achievement if they were coupled with professional development for teachers. Griffin (2013) found overall math scores for sixth, seventh, and eighth graders increased in Illinois on the state standardized tests 1 year after the adoption of a One-to-One computer initiative.

Knight (2003) focused on the relationship between three sub-categories in technology (access to technology, usage of technology, and capacity for technology) and student achievement scores in reading and math. Using all U.S. fourth and eighth grade reading and math scores from the National Assessment of Educational Progress (NAEP) in 2003, 2005, and 2007, Knight found only a small positive correlation between access of technology and standardized achievement scores and a small negative correlation between usage of technology and standardized achievement scores. Analysis showed no correlation between capacity of technology and standardized achievement scores. Knight concluded that the combined results of access, usage, and capacity did not provide a clear correlation between technology and student standardized achievement scores.

Georgia’s test scores have not changed significantly in elementary or middle school in recent years (Nation’s Report Card, 2011). From 2009 to 2011, the average score of fourth-grade math students in Georgia increased by only two points. The 2011 score (236) was lower than the average score of 240 for public school students in the nation. The percentage of students in Georgia who performed at or above the NAEP *Proficient* level was 37% in 2011. This percentage was not significantly different from that in 2009 (34%). The percentage of students in Georgia who performed at or above the NAEP *Basic* level was 80% in 2011, which was not significantly different from that in 2009 (78%).

This trend continued for the eighth graders as well. In the same Nation's Report Card-A Snapshot (2011), the average score of eighth-grade math students in Georgia was 278. This was lower than the average score of 283 for public school students in the nation. The average score for students in Georgia in 2011 (278) was the same as their average score in 2009. The percentage of students in Georgia who performed at or above the NAEP *Proficient* level was 28% in 2011. This percentage was not significantly different from that in 2009 (27). The percentage of students in Georgia who performed at or above the NAEP *Basic* level was 68% in 2011. This percentage was not significantly different from that in 2009 (67%).

Koh, Steers, and Terborg (1995), reported that leadership is a strong predictor of teacher beliefs and practices, such as technology integration. Edmond, (1979) considered a pioneer in educational leadership and school effectiveness, concluded an involved principal is one of the most important components of an effective school. Witziers, Bosker, and Kruger (2003) added that the principal is responsible for professional development, supervision of teachers and achievement, and most importantly, instructional leadership. Suber (2011) describes transformational leadership in schools as directly affecting such school outcomes as teacher perceptions of student goal achievement and student grades. Reviews indicated that while the direct effect of principals on student achievement is near zero, they can have an indirect influence on achievement (Hallinger & Heck, 1996; Leithwood, Jantzi, & Steinbach, 1999). Hallinger, Bickman, and Davis (1996) found that when principals created a positive instructional environment (i.e., high teacher expectations, student opportunity to learn, clear mission, and grouping for instruction), it contributed to reading achievement.

Methodology

The research design utilized is referred to as causal-comparative (Fraenkel & Wallen, 2010). This design does not require random sampling. Shenker and Rumrill (2004) suggest the causal-comparative design is important when a comparison needs to be made after groups have been exposed to the dependent variable(s). Because there is a lack of manipulation of the independent variable or random assignment of participants to groups, the certainty of what effect the independent variable has on the dependent variable is limited.

In this design, random sampling of small, public Georgia schools and small, public and rural Georgia schools was not used. Rather, all small Georgia schools and small rural Georgia schools were used. Georgia schools were categorized as *small* based on 2008-2010 GHSA Class A classification. The GHSA is a voluntary organization composed of over 400 public and private high schools that strives to promote good sportsmanship and a cooperative spirit among its member schools. The GHSA operates under a constitution which outlines the scope and purpose of the Association. It contains the standards of eligibility to be met by high school pupils for attaining the privilege of participation in interschool contests, and rules controlling the participation among schools (GHSA, 2012). Schools are divided in classification according to size so that schools will have an opportunity to compete for honors among schools of their own size. The GHSA uses the smallest 21-22% of its member schools to create the Class A classification which included all schools less than 350 students (GHSA, 2012).

Schools were categorized *rural* based on FY09 Rural Education Achievement Program eligibility criteria. According to GADOE (2012), Title VI, Part B-Rural Education Achievement Program (REAP) "is designed to assist rural school districts in using Federal resources more effectively to improve the quality of instruction and student academic achievement" (para. 1). REAP consists of two programs: the Small, Rural School Achievement (SRSA) program and the Rural and Low-Income Schools (RLIS) program. In order to be eligible to receive REAP funds, school districts must have a specific locale code. Title VI, Part B formula funds are allocated based on locale codes of 6, 7, and 8. According to the U.S. Census Bureau, a locale code of *6* indicates an area outside of a metropolitan statistical area (MSA) and has a population of at least 2,500 persons, but fewer than 25,000 persons. A locale code of *7* indicates a place outside a MSA and has a population of fewer than 2,500 persons. A locale code of *8* indicates a place that is inside a MSA and has a population of fewer than 2,500 persons (GADOE School Locales). In FY09, 83 out of the 180 (46.1%) school districts in Georgia received REAP Funds (GADOE, 2009).

The number of small Georgia schools in the 2008-2010 GHSA classification Class A was 56 public high schools. Thirty-four Georgia high schools met both the *small* and *rural* criteria. Of the Class A public high schools, 34 schools are Title I schools. To be a Title I school, at least 40% of a school's students must be from low-income families under the United States Census's definition of low-income (NCES, 2012). A total of 23 schools are *rural*, *small*, and are labeled Title I schools.

Georgia public schools must submit an Annual School Technology Inventory Survey (GADOE, 2012). These include data such as student population, total classrooms, type/speed of Internet connection, types of computers, student per Internet connected computer ratio, percentage of classrooms with high-speed Internet access, percentage of instructional areas that currently have wireless connection, and various types of hardware (projectors, interactive whiteboards, student response devices, etc.). Because the hardware inventory varies widely among high schools, three consistent categories of data are: (a) students per modern instructional computer; (b) percentage of classrooms with high speed internet access and (c) the number of interactive whiteboards per classroom ratio. Each school was rated on an interval scale for each category (0 to 5) for the 2008 school year. The three categories were then summed across for an overall score. The higher the score indicated a higher level of technology incorporation. A copy of the Technology Index Survey is Appendix A.

A Technology Integration Survey was used to evaluate the principal's perceptions of technology in their schools. The survey contained 13 items: 12 items that are a five-point ordered response scale with ratings ranging from *never* (0) to *almost always* (4) respectively and one *yes/no* question asking the participant if they hold any certification(s) or degree(s) in technology. Participants were asked if they possess any certification or degree in technology as this may impact their perception of the importance of technology integration and student achievement. Items were designed to elicit responses on principal's perceptions of technology use, teacher training and support regarding technology, and the importance of technology incorporation regarding student achievement. Participants were asked how many years they have served as the principal at their current school and chose from a list their highest degree earned.

For this study, the GHSGT math pass rates from the Georgia Department of Education (GADOE) were used as a measure of student achievement. The GHSGT was a state mandated test from 1995 until 2010 in which students had to pass a Writing Assessment, English Language Arts, Mathematics, Science, and Social Studies in order to qualify for graduation. Each individual high school administers the GHSGT, usually through the counseling department. Students took the graduation tests for the first time in the eleventh grade. Students who did not pass on the first attempt of the tests had multiple opportunities to receive additional instruction, retest, and qualify for graduation before the spring of the twelfth grade (GADOE, 2011).

School GHSGT math scores were collected using archival data available from the Georgia Public Education Report Card. There were three categories: fail, pass and pass plus. For this study, the categories of *pass* and *pass plus* will be combined into one category (pass). Schools technology inventory was collected from the Annual School Technology Inventory Surveys and included: 1) students per modern instructional computer; 2) percentage of classrooms with high speed Internet access and 3) the number of interactive whiteboards per classroom ratio (GADOE, 2012).

An email was sent to invite principals to participate in the study through an online survey (using Qualtrics) on three separate occasions at 2-week intervals. Participants used the hyperlink to connect to the website hosting the survey on-line. In order to increase response rate, a survey packet was then mailed to the remaining principals of public small schools in Georgia at the end of June of 2015. After closing the survey, a participation response rate was calculated and the collected data were downloaded from the website into the Statistics Package for the Social Sciences (SPSS), version 23, for analysis.

Data Analysis

Using SPSS, the data gathered from the GHSGT test results (available on the GADOE website) of each small school over the last 3 years were analyzed to determine if there was a significant growth in the mean pass rates. Data were checked for the assumption to the adherence of normality and homogeneity of variance for small and small rural schools. For reliability analysis of the principals' perception survey, Cronbach's α was run using SPSS with the value of α at .7 or .8 indicating internal consistency.

Repeated-measures ANOVA were conducted to compare the mean pass rates for small schools in 2008 and 2010. Repeated-measures ANOVA is used when the independent variables have all been measured using the same participants in all conditions (Field, 2009). Pearson's correlation coefficient (*r*) was computed to assess the relationship between technology integration and Georgia High School Graduation Math pass rate. For all data analyzed, an α of .05 was used to determine statistical significance (Field, 2009).

Principal responses to the items were summed across to create a technology perception score. Higher scores (3-4) indicated a more positive perception towards technology while a lower score (0-2.99) indicated a more negative perception towards technology.

Summary of Findings

Research Question 1 sought to determine if there was statistically significant growth for large public rural Georgia schools in mean percentage of passing rates on the math portion of the GHSGT in 2008 and 2010 after incorporating technology such as computers, high speed internet access, and electronic white boards. The decrease in mean pass rates from 2008 to 2010 (M = -5.19, SD = 8.75) was statistically significant. Both the small rural and small non-rural schools had lower rates of decrease in math pass rates than large rural schools. This could have been the result of less technology integration. Large rural schools had the lowest mean score (M = 3.49, SD = .64) on the Technology Inventory Survey.

Stewart (2009) compared high school student pass rates on the Texas Assessment of Knowledge and Skills (TAKS) test between large and small schools. His findings indicated that it was the small rural schools, not the large rural schools, where students had a higher percentage of students passing all four parts of the TAKS test. His possible explanations included lower student to adult ratios and the familial feeling of a small school, not technology integration. Dorhout (2012) reached a similar conclusion after conducting a 3-year longitudinal study in Texas public high schools. He found no relationship between at-risk student achievement and per student expenditure in the area of technology access, implementation, and instructional integration.

A possible explanation for the significant decline in mean pass rates is the math courses offered at rural schools. Anderson and Chang (2011) found a higher percentage of rural high school students started their high school math on a lower level ended their math studies at a level below that of students in other locations. They also found the rural students were more likely to take their last math class earlier. Studies indicate this could be caused by limited course access. Students who attend rural schools have only four courses to choose from in advanced math (Graham & Provost, 2012).

Research Question 2 sought to determine if there was statistically significant growth for small public rural Georgia schools in mean percentage of passing rates on the math portion of the Georgia High School Graduation Test over a 3-year period after incorporation of technology such as computers, high speed Internet access, and electronic white boards. Mean math pass rates decreased from 2008 to 2010 (M = -1.67, SD = 11.34). This was the smallest amount of decrease among the three categories of schools. These results are consistent with another study conducted by Egalite and Kisida (2013) using data from over one million students in 2,715 unique schools in different regions of the United States. They found that small school size had significant impact on student achievement in math with a -.011 of a standard deviation drop for every 100-student-increase in school size.

A study conducted in New York (Schwartz, Stiefel, & Wiswall, 2013) evaluated small high school reform in New York City. Using multiple cohorts of students in the country's largest public school system led to a richly diverse data set. A coefficient estimate of 0.108 indicted that students from small schools were nearly 11% more likely to graduate if they attended small rather than large high schools. Passing standardized math tests are a part of graduation requirements in New York.

In order to study the impact of school size on achievement, Werblow and Duesbery (2013) examined data from 16,081 students in 752 schools in the Education Longitudinal Study from 2002. In order to isolate the effect of school size, control variables such as urbanicity, SES and LEP were added to the model. Results showed the curvilinear effect on math learning was significant ($t = 2.47$, $p < .001$), and were less likely to drop out than students from larger schools.

The third research question investigated whether or not there was a statistically significant difference between small public Georgia schools and small public rural Georgia schools in mean percentage of passing rates on the math portion of the Georgia High School Graduation Test over a 3-year period after incorporation of technology such as computers, high speed internet access, and electronic white boards. Mean math pass rates decreased for both groups (small rural $M = -1.67$, $SD = 11.34$ and small non-rural $M = -1.71$, $SD = 5.56$). There was not a significant difference in pass rates between small rural and small non-rural math pass rates, $t\ (46) = .01$, $p = .99$

The small difference in change of mean math pass scores from small and small non-rural schools is consistent with the findings of Werblow and Duesbery (2009). The only significant difference was between urban and suburban schools. Urban schools gained more in math achievement than suburban schools, $t = 2.76$, $p < .001$. This trend reflects research conducted by Graham and Provost (2012). They studied learning curves in mathematics achievement from kindergarten to the eighth grade. They found the trajectory of both the urban and rural student achievement in math were practically indistinguishable

After running two separate independent-samples *t* tests were run, a statistically significant difference in the mean pass rates was found in 2008 when comparing small non-rural schools and small rural schools, $t\ (46) = 2.5$, $p = .015$ ($M = 10.48$), and in 2010, $t\ (46) = 2.3$, $p = .024$ ($M = 10.44$). Graham & Provost (2012) suggested that this could be attributed to rural school children being less likely to attend preschool than urban children. Howley, Showalter, Klein, Sturgill and Smith (2013) found that parents of rural children exhibit lower educational attainment leading to less parental involvement at home. Finally, Provost et al. (2007) stated that there is a positive impact of technology on mathematics learning but rural schools are less likely to have adequate technology resources. Findings from this study were consistent with Provost, et. al (2007). Small rural schools had a lower Technology Inventory Survey score (M = 3.75, SD = .66) compared to small non-rural schools (M = 4.06, SD = .53).

In reviewing the survey data for the fourth question, principals' perceptions of technology use and percentage of math pass rates, no correlation was found. In fact, there was a negative relationship between principals' perceptions and math pass rates (r = -1.2, p = .58). A possible explanation for this is the use of a self-reporting survey, small sample size (n = 22) and only 55.4% of respondents had been at their current school over 5 years. Another possibility is only two respondents (less than 10%) held any technology certification or degree.

Salazar (2007) reported principals identified one of their most important professional development needs as facilitating the change process. Tirozzi (2000) argued it would require enlightened leadership in order to reform educational practice and increase student achievement. Seashore Louis, Leithwood, Wahlstrom, & Anderson (2010) concluded after 6 years of research that leadership is second only to classroom instruction as a factor in determining student achievement. The two items with the highest mean on the Principal's Perception of Technology Survey were teachers having appropriate access to technology and incorporation of technology into the curriculum was part of the School Improvement Plan. A possible problem with implementation of technology could be attributed to the survey item with the lowest mean score, informing teachers about current research in the area of technology.

Implications

The goal of this study was to determine if the incorporation of technology had an impact on student achievement for students attending large rural, small rural and small public schools in Georgia. Georgia has one of the largest rural student populations in the country and continues to spend billions of dollars on educational technology. These suggestions are of practical importance to Georgia education. Although the GHSGT is no longer mandatory, End of Course Tests (EOCT) and other state mandated tests continue to be used for accountability purposes to measure student achievement.

Although all three groups saw a decrease in mean math pass rates on the GHSGT, small rural schools decreased the least. Large rural school administrators should investigate how small rural schools incorporated technology into the curriculum. Principals may want to consider acquiring a technology certification to better support educational technology. Most public schools in the state of Georgia have technology in the classrooms. Funds should be directed to training administrators and lead teachers on best practices for implementation of the technology in classrooms.

The Technology Inventory Survey provided data that could help guide future studies and provide possible explanations for results. The overall technology score for all of the schools fell within the average range (M = 3.58, SD = .66). Large rural schools had the lowest score (M = 3.49), small rural schools were next (M = 3.75, SD = .66) and small non-rural schools had the highest score (M = 4.06, SD = .53). Large rural schools mean math pass rates showed a statistically significant decrease and also had the lowest student-to-computer ratio (*M* = 3.73, *SD* = .96). Small rural schools' mean pass rate decreased the least and had the highest student-to-computer ratio (*M* = 4.22, *SD* = .99). These results differed from Talley (2012) who concluded low-achieving schools tended to have higher student-to-computer ratios and support. Griffin (2013) found overall math scores increased on standardized tests after a one-to-one computer initiative.

Rural and small schools remain a priority for public education. According to the National Center for Educational Statistics (2013), nineteen percent of rural students live in poverty. Socio-economic status has been connected to lower achievement on state and national tests (Caldas & Bankston, 1997; Campbell & Silver, 1999). This remains an important educational issue for the state of Georgia because it has the third highest absolute population of rural students in the nation (Strange, Showalter, & Klein, 2011). Although the current integration of the state's technology is not having a statistically significant impact on math achievement in large rural, small rural and small non-rural schools, technology is part of the educational landscape for the foreseeable future. Georgia's educational leaders must focus on an effective vision of technology integration with ongoing professional development for both principals and teachers.

While small schools (both rural and non-rural) in this study saw a less than two point decrease in math pass rates compared to over a five-point decrease for large rural schools, caution is advised in drawing conclusions about small school success. Schwartz, Stiefel and Wiswall (2013) found that although small schools performed better than large schools, the statistical difference in achievement among small schools applied only to those established since 2002. Data from older small schools did not indicate the same positive effects on student achievement as newer ones.

Limitations of the Study

History, selection, maturation and implementation have been identified as threats to the internal validity of research (Frankel & Wallen, 2010). Math pass rates from the GHSGT were used as data for determining student achievement. Although there was not a new version of the test introduced during the 3-year period studied, a different group of students were administered the tests in 2008 and 2010.

Population validity (Onwuegbuzie, 2000) could have been a threat to external validity in this study since data from 172 public high schools in Georgia were made up of mostly large rural schools (n = 124) with only 36 small rural and 12 small non-rural schools. Limiting the survey recipients to only small schools could have been a threat to external validity of principals' perception of technology and student achievement. The response rate was only 22 respondents instead of a possible 172.

Recommendations for Further Research

With public school remaining committed to incorporating more technology in the classrooms, educators must continue to seek data on technology usage. Student achievement is a method to validate the massive expenditures for educational technology. Because End of Course Tests (EOCT) are administered at the completion of the particular course, scores may indicate more accurately technology's impact on student achievement. Another recommendation could have been to expand the principal's perception of technology integration survey to other groups. In order to increase response rates, the self-reported survey should be administered earlier in the school year rather than at the end.

Further research should focus on how the technology is used in schools that have increased student achievement, especially small schools that have been established since 2002. A study comparing student achievement of schools with administrators holding a technology degree or certificate with those administrators that do not hold any technology degree or certificate could more accurately determine if there is a correlation between school leadership, technology and student achievement.

A qualitative study of teachers who are successfully integrating technology in the classrooms would add much to the literature in educational research. This research would allow the voices of teachers to describe their practices so that administrators could incorporate results-oriented training in their school improvement plan.

Expanding the scope of this study is also a recommendation for future studies. Incorporating large rural, small rural and small non-rural schools from several states would reduce the threats to validity of this study. Finally, formative and summative evaluations of technology integration as an ongoing staff development program could enhance the use of technology's impact on student achievement.

Conclusions

Math pass rates on the GHSGT did not significantly increase after the incorporation of technology such as computers, high speed Internet access and interactive white boards over a 3-year period for public large rural, small rural and small non-rural schools. In fact, all three groups' mean pass rates declined from 2008 to 2010. The decline in math pass rates of large public rural schools was statistically significant and by a larger margin than both the small rural and small schools (*M* = -5.19; *M* = -1.67; and *M* = -1.71 respectively). No statistical differences were found in pass rates of small rural schools from 2008 and 2010 or when comparing changes in mean pass rates of small rural and small non rural schools in the same years.

However, a statistically significant difference in the mean pass rates was found in 2008 when comparing small non-rural schools and small rural schools, t (46) = -.25, p = .015 (*M* = -10.48), and in 2010, t (46) = -.23, p = .024 (*M* = - 10.44) between small schools and small rural schools. These results seem to contradict the findings of Stewart (2009) when investigating the relationship between school size and student achievement on the Texas Assessment of Knowledge and Skills (TAKS) test. Findings indicated that smaller rural schools experienced higher percentages of passing all four parts of the test when compared to large schools.

One consistent negative impact on student achievement is low socio-economic status (SES). Morgan, Farkas, Hillemeier, and Maczuga (2009) indicated that children from low-SES households and communities developed academic skills more slowly compared to children from higher SES groups. According to the American Psychological Association (APA) (2015), foundational academic skills are correlated with the home, where low literacy rates and increased stress negatively affect a child’s pre-academic skills. The school systems in low-SES communities are often under resourced, negatively affecting students’ academic progress (Aikens & Barbarin, 2008). This leads to a cycle of increased dropout rates that in turn affect children’s academic achievement, perpetuating the low-SES status of the community (APA, 2015). In a recent study released by the Urban Institute (2013), there is a rural poverty belt of that stretches across

Georgia where 60% or more of students are from low-income families. The low-SES status of the students could have impacted the mean math pass rates in 2008 and 2010 for both large and small rural schools.

The role of the principal is of upmost importance for successful integration of technology. Technology should be a part of the school's vision which has a significant effect on the school's organizational learning (Kurland, Peretz, & Hertz-Lazarowitz, 2010). Dawson and Rakes (2003) found that schools whose principals received training in technology integration had higher levels of technology integration compared to those principals' schools who did not receive the training. They added that the principals' attitude had a specific influence on the success of technology integration. Principals that were most effective in technology integration were those who created a school-wide vision and provided teachers with on-going professional development (Macahdo & Chung, 2015). The Principal's Perception of Technology Survey in small rural and small non-rural schools showed a negative relationship between their perceptions and math pass rates. As the research has shown, principals must engage in their own personal professional development as well as providing it for their teachers which is expressed in the ITSE (2009) standard for administrators, excellence in professional practice.

In conclusion, the incorporation of technology into Georgia schools was not determined to have a positive impact on math pass rates. Nonetheless, the importance of technology in schools should not be overlooked. The survey item with the highest mean (M = 3.46) was *Incorporating technology into the curriculum is part of the School Improvement Plan*. The survey item with the lowest mean (M = 2.21) was *Teachers are informed about available journals, conferences, or current research in the area of* *technology.* This seems to support what has historically been the case for the lack of educational technologies making headway in schools: fitting the use of the equipment with the curriculum (Cuban, 1986; Office of Technology Assessment, 1988; Taylor, 1975). School system administrators should evaluate their school improvement plan in regards to keeping teachers informed about how to most effectively use the technology in the classrooms.

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APPENDIX A:

Technology Inventory Survey

Technology Inventory Survey

School	Percentage of Classrooms with High Speed Internet Access	Student to Computer Ratio	Interactive Whiteboards per Classroom Ratio	Score
2010	• 0%=0 • 1%-25%=1 • 26%-50%=2 • 51%-75%=3 • 76%-99%=4 • 100%=5	• 0=0 • 11.1+=1 • 8.1-11=2 • 5.1-8=3 • 2-5=4 • .5-1.99=5	• 0%=0 • 1%-19%=1 • 20%-43%=2 • 44%-66%=3 • 67%-89%=4 • 90-100%=5	• .1-1.99=Very Low • 2-2.99=Low • 3-3.99=Average • 4-4.5=High • 4.51-5=Very High

APPENDIX B:

Technology Integration Survey

Technology Integration Survey

You are being asked to participate in a survey research project entitled *"Technology in Small Schools,"* which is being conducted by *Brad Lawson,* a *student* at Valdosta State University. The purpose of this survey is to determine if there is a correlation between administrator's perception of technology and student achievement on GHSGT Math scores in small and rural schools. This survey is anonymous. Responses will be coded to ensure the anonymity of respondents. Your participation is voluntary. You may choose not to take the survey, to stop responding at any time, or to skip any questions that you do not want to answer. You must be at least 18 years of age to participate in this study. Your completion of the survey serves as your voluntary agreement to participate in this research project and your certification that you are 18 or older.

Questions regarding the purpose or procedures of the research should be directed to *Brad Lawson* at *(229) 559-5131* or *bllawson@valdosta.edu*. This study has been exempted from Institutional Review Board (IRB) review in accordance with Federal regulations. The IRB, a university committee established by Federal law, is responsible for protecting the rights and welfare of research participants. If you have concerns or questions about your rights as a research participant, you may contact the IRB Administrator at 229-259-5045 or irb@valdosta.edu.

Years at Current School as Principal:____Circle Highest Degree: BA/BS M.Ed Ed. S. Ed. D. Ph. D

Do you hold any certification(s)/degree(s) in technology? Circle: Yes No

Directions: Please read each statement carefully and circle the one best answer that reflects your current situation.

	Never	Seldom	Sometimes	Usually	Almost Always
I make accommodations for teachers to attend technology training.	0	1	2	3	4

Teachers have appropriate access to various types of computer technology, including peripherals.	0	1	2	3	4
I recognize teachers who effectively integrate technology into instructional curriculum.	0	1	2	3	4
I model the use of technology to complete professional tasks.	0	1	2	3	4
Teachers are informed about available journals, conferences, or current research in the area of technology.	0	1	2	3	4
Incorporating technology into the curriculum is part of the School Improvement Plan.	0	1	2	3	4
Technical support personnel are readily available for teachers.	0	1	2	3	4
Teachers include the use of instructional technology in their lesson plans.	0	1	2	3	4
Technology is used to prepare students for the Georgia High School Graduation Test (2008-2010).	0	1	2	3	4
Teachers use technology for instructional purposes more than administrative purposes.	0	1	2	3	4
Teachers receive regular training on incorporating instructional technology in the curriculum.	0	1	2	3	4
The incorporation of technology in my school has made an impact on student achievement.	0	1	2	3	4

APPENDIX C:

Institutional Review Board Protocol Exemption Report

Institutional Review Board (IRB) for the Protection of Human Research Participants

PROTOCOL EXEMPTION REPORT

PROTOCOL NUMBER: **IRB-03209-2015** **INVESTIGATOR:** **Brad Lawson**

PROJECT TITLE: **Technology in Small Schools**

INSTITUTIONAL REVIEW BOARD DETERMINATION:

This research protocol is **exempt** from Institutional Review Board oversight under Exemption Category(ies) 1. You may begin your study immediately. If the nature of the research project changes such that exemption criteria may no longer apply, please consult with the IRB Administrator (irb@valdosta.edu) before continuing your research.

ADDITIONAL COMMENTS/SUGGESTIONS:

Although not a requirement for exemption, the following suggestions are offered by the IRB Administrator to enhance the protection of participants and/or strengthen the research proposal:

NONE

☐ If this box is checked, please submit any documents you revise to the IRB Administrator at irb@valdosta.edu to ensure an updated record of your exemption.

Elizabeth W. Olphie 4/16/15

Thank you for submitting an IRB application.

Elizabeth W. Olphie, IRB Administrator Date

Please direct questions to irb@valdosta.edu or 229-259-5045.

Revised: 12.13.12