The iPad as a Learning Tool: An Examination of Student Achievement on the ACT

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Abstract

Technology became increasingly important to schools as NCLB legislation required students to achieve at higher levels. The purpose of this study was to investigate whether there was a difference in students' ACT composite scores, and mathematics, reading, science, and English subtest scores on the ACT as affected by iPad implementation, and if these scores were affected by student gender or ethnicity on the ACT one and two years before the iPad implementation, and during, one, and two years after iPad implementation. A quasi-experimental research design was used to measure the association between quantitative variables. The time prior to, during, and after iPad implementation, and gender and ethnicity were the independent variables, while student achievement on the ACT composite, and mathematics, reading, science, and English subtest scores were the dependent variables. The population included students in grades 9-12 who took the ACT from the 2010-2012 to the 2012-2014 school years. The results revealed that for students in grades 9-12 no statistically significant differences existed in the means for the ACT composite scores, or the mathematics, reading, and English subtest scores based on the years of iPad implementation. The results revealed that there was a statistically significant difference in students' science subtest scores on the ACT based on the interaction between years of implementation (two years before, one year before, during, one year after, and two years after) and student ethnicity. Although, neither the Tukey HSD (very conservative) nor the Fisher LSD (very liberal) post hoc indicated any means to be different, the lowest mean two years before iPad implementation and highest mean during the first year of iPad implementation were significantly different. There was no statistically significant difference in students'

composite and subtest scores on the ACT two years before, one year before, during, one year after, and two years after iPad implementation as affected by student gender or ethnicity. There were no other statistically significant results from the hypotheses testing.

Dedication

I dedicate this work to God for allowing me to accomplish my dreams, to reach for the stars, and to learn so I can help someone else. This work is also dedicated to my family, Teresa, Aaron, Victoria, Lily, Scarlett, Adina, Abigail, Desiree, and Destinee, who supported me through my journey. For my wife, Teresa, you have stood by my side through many obstacles. Your continuous encouragement and support helped me become who I am today. I hope to make you proud and promise, to the best of my ability, to be the best educator I can be.

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To my lovely wife, Teresa, and my family, Aaron, Victoria, Lily, Scarlett, Adina, Abigail, Desiree, and Destinee, I want to especially say “thank you” for enduring and sacrificing during this journey. I pray I can always make them proud and live up to their expectations.

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Chapter One

Introduction

Technology has become an integral part of instruction, and the development of new technology has been driven by the need for schools to attain even higher levels of achievement (Daniel, 1999). Since the introduction of the iPad, an increasing amount of interest in understanding its usefulness as an educational aide in the classroom has been investigated. Research on this topic is imperative, as schools have invested in 1.5 million iPads for the more than 55 million students in K-12 schools in hopes of increasing academic success in the classroom and on state assessments (Norris & Soloway, 2012).

In 1965, the Elementary and Secondary Education Act (ESEA) was enacted to provide money to help schools close the gap for low-income students; then, in 1994 the ESEA was reauthorized, leading to President George W. Bush's No Child Left Behind Act (NCLB) being signed into law in 2002. NCLB established school accountability for student test scores in mathematics, reading, and science; in addition, the federal government required school districts to demonstrate adequate yearly progress (AYP) with increased percentages of students meeting or exceeding proficiency on the state assessments (Guilfoyle, 2006). The NCLB Act has pushed educators to close the achievement gap so that all students can achieve at high levels.

Pitler, Hubbell, Kuhn, and Malenoski (2007) addressed potential technological uses in the classroom to differentiate instruction and "change [teachers'] classrooms into dynamic learning environments" (p. 2). These authors produced a guide to help direct teachers into technology integration. With the hope that technology would be an effective tool in the hands of students and teachers, many school districts began adopting

1:1 initiatives, allocating a computing device for all students, including students from low socioeconomic backgrounds or students without personal computing devices at home. The need to decrease the differences in existing resources among students with different socioeconomic statuses also led to the utilization of technologies like the iPad and the many applications that meet educators' needs in closing those gaps. As a result, schools are investigating the influence the iPad has had on teaching and learning (Foote, 2012a).

Background

Before 21st century learners learn to speak, they often have utilized and embraced digital tools such as iPods, iPads (tablet technology), cellular phones, gaming devices, and plasma screen televisions (Payne, 2011). Unfortunately, upon becoming school age, some students encounter a non-engaging learning environment and find classrooms and teachers to be ill-equipped to meet their students' learning needs and interest. Payne (2011) provided this insight into the need for connecting to modern-day students in the context of where they are:

> There is an element of knowledge construction in that students are required to select and organize information: an element of discipline inquiry since they must use evidence to support their arguments; and a connection to students' interests outside of school since [interest] allows students to select a topic they care about. (p. 85)

Student growth in the classroom can be only realized when teachers implement effective learning strategies and integrate appropriate tools; therefore, teachers must provide students a relevant education that meets students' learning needs (Saravia-Shore, 2012).

Differentiated instruction is the tool needed to maximize the potential in each student. Fortunately, technology has made communication, research, collaboration, and differentiation possible today. Educators have found that students are more engaged in active learning when using technology (Haydon et al., 2012), as students have immediate access to the world and are becoming accountable for their learning (Donaldson, 2012).

Kansas Assessments, which are designed to measure student learning, changed during the 2013-2014 school year, and there may be other changes in the near future (High Plains Educational Cooperative, 2014). This modification in the test limits the ability of a school to compare changes in curriculum and instruction over the course of several years to a state standardized test; as a result, districts can choose other assessments to demonstrate academic achievement. For example, instead of using individual state tests to demonstrate academic achievement and improvement as required by NCLB, states now can use the ACT, a curriculum and standards-based educational and planning tool, to replace the state assessment tool.

Three districts in Kansas have sought waivers from the NCLB law, which requires improvements schools could not produce. McPherson, Kansas City, and Clifton-Clyde school districts received the waivers needed to use only ACT tests instead of the Kansas Assessments; as a result, they will not utilize state assessments to test eighth grade and high school students in mathematics, reading, and science. Instead, these districts were allowed to use the ACT college entrance exam for high school students and the ACT Explore for eighth grade students. McPherson was the only district in Kansas permitted to use the Explore exam with sixth and seventh graders (Hollingsworth, 2012).

The ACT is an important assessment tool because the ACT provides data on the percentage of students who meet college readiness benchmarks, making the test a good measure of student improvement (ACT, 2014). The increasing importance of the ACT as an assessment for college and career readiness has been demonstrated by the fact that the state of Mississippi began administering the ACT to all students classified as juniors, starting in the 2014-2015 school year (Mississippi Department of Education, 2012). The number of students in Kansas and the U.S. taking the ACT assessment is increasing. Table 1 displays the number of ACT tests taken by students in Kansas and the nation during the years of 2010-2014.

Table 1

Number of Students Administered the ACT

	2010	2011	2012	2013	2014
Kansas	23,342	23,628	23,907	24,268	23,924
National	1,568,835	1,623,112	1,666,017	1,799,243	1,845,787

Note: KS = Kansas. Adapted from "Table 1.2 Five Year Trends—Average ACT Scores," by ACT, 2014, p. 7, Retrieved from http://www.act.org/newsroom/data/2014/pdf/profile/Kansas.pdf

Even though more students are taking the ACT assessment, there has not been a significant change in scores for the years from 2010 to 2014 on its mathematics, reading, and English subtests. In contrast, there has been a slight decrease in the percentage of students meeting college and career readiness benchmarks on the mathematics and English subtest scores, whereas there has been an even greater decrease in the percentage of students meeting college and career readiness benchmarks on the reading subtest. At the same time, the science subtest scores have increased during the last five years. Table

2 displays the five-year ACT trends regarding the percentage of students who met college and career readiness benchmarks on each subtest of the ACT (ACT, 2014).

Table 2

Percentage of Students Who Met College Readiness Benchmarks

	2010	2011	2012	2013	2014
English					
Kansas	74	73	73	72	72
National	66	66	67	64	64
Mathematics					
Kansas	51	51	52	51	50
National	43	45	46	44	43
Reading					
Kansas	60	60	60	51	51
National	52	52	52	44	44
Science					
Kansas	34	34	35	42	44
National	29	30	31	36	37

Note: Adapted from “Table 1.1 Five Year Trends—Percent of Students Who Met College Readiness Benchmarks,” by ACT, 2014, p. 7, Retrieved from http://www.act.org/newsroom/data/2014/pdf/profile/Kansas.pdf

Table 2 describes the trends for the percentage of students who met college readiness benchmarks for each of the subtest areas. The trends represented in the table show slight decreases in percentages of students who met college readiness benchmarks, except for science, which has a notable increase in the percentage of students who met college readiness benchmarks. In comparison, in Table 3, the five-year trends of ACT scores for students who met all four benchmarks in Kansas and the nation are compared to one another and the average ACT composite scores. While the number of students who met all four benchmarks is increasing, the average ACT composite subtest score has been relatively unaffected during the five-year period (ACT, 2014).

Table 3

Percent of Students Who Met All Four College Readiness Benchmarks compared to the Average ACT Composite Score

	Met All Four Benchmarks		Average ACT Composite Score	
Year	KS	National	KS	National
2010	28	24	22.0	21.0
2011	28	25	22.0	21.1
2012	29	25	21.9	21.1
2013	30	26	21.8	20.9
2014	31	26	22.0	21.0

Note: KS = Kansas. Adapted from "Table 1.3 Five Year Trends—Average ACT Scores Nationwide," by ACT, 2014, p. 7, Retrieved http://www.act.org/newsroom/data/2014/pdf/profile/Kansas.pdf

The ACT subtests are averaged together to make the composite score. Located in Table 4 are the trends for the average ACT subtest scores and the average ACT composite score. There is little variation in the scores during the five-year period from 2010 to 2014.

Table 4

Average ACT Composite and Subtest Scores, Comparing Kansas and National Averages

	2010	2011	2012	2013	2014
Composite					
Kansas	22.0	22.0	21.9	21.8	22.0
National	21.0	21.1	21.1	20.9	21.0
English					
Kansas	21.4	21.4	21.3	21.2	21.4
National	20.5	20.6	20.5	20.2	20.3
Mathematics					
Kansas	21.7	21.8	21.8	21.7	21.7
National	21.0	21.1	21.1	20.9	20.9
Reading					
Kansas	22.3	22.3	22.3	22.3	22.5
National	21.3	21.3	21.3	21.1	21.3
Science					
Kansas	22.0	22.0	21.9	21.8	22.0
National	21.0	21.1	21.1	20.9	21.0

Note: Adapted from “Table 1.2 Five Year Trends—Average ACT Scores,” by ACT, 2014, p. 7, Retrieved http://www.act.org/newsroom/data/2014/pdf/profile/Kansas.pdf

Located in a rural Midwestern county north of Kansas City, Kansas, the Rail School District (RSD) serves more than 1,700 students who live within a 52-square mile area (USD [redacted], 2014). In the 2014-2015 school year, Rail High School (RHS) had an enrollment of 418 students (Superintendent, personal communication, April 27, 2015), and district enrollment trends had been declining from 1,737 in 2010 to 1,719 in 2011-

2012, 1,701 in 2012-2013, 1,657 in 2013-2014, and 1,679 in the 2014-2015 school year. RHS has shown a fluctuation in Hispanic enrollment starting at 83 students in 2010 -2011 increasing to 102 students in 2012-2013 then ending with 83 students in the 2014-2015 school year, an increase in Asian enrollment in 2014-2015, and a decrease in White and Black enrollment. The enrollment history by ethnicity is located in Table 5.

Table 5

Rail School District Enrollment Disaggregated by Ethnicity

	Years				
Ethnicity	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
White	1,299	1,292	1,248	1,223	1,234
Black	220	219	208	202	207
Hispanic	83	87	102	94	83
A.Ind/AN.	12	9	5	7	8
Asian	14	17	16	15	22
Haw.Is.	3	3	0	0	0
Multiple	106	92	128	116	125
Total	1,737	1,719	1,701	1,657	1,679

Note: A.Ind/AN. = American Indian/Alaskan, Haw. Is. = Hawaiian Islander. The data from 2010-2013 are adapted from "Enrollment History by Race," by USD [redacted] Public Schools, 2010, p. 4, Retrieved from http://www.usd[redacted].net/education/page/download.php?fileinfo= MjAxMS0xMiBEaXN0cmljdCBQcm9maWxlOjo6L3d3dzcvc2Nob29scy9rcy9hdGNoaXNvbi9pbWFnZXMvYXR0YWNoLzE0MTgvMTM2OV8xNDE4X2F0dGFjaF81Mi5wZGY, and the data from 2013-2015 are adapted from "[redacted] Public Schools USD [redacted] Statistics:" by Kansas K-12 Reports, 2014, p. 1, Retrieved from http://online.ksde.org/k12/CountyStatics.aspx?org_no=D0[redacted]

RSD has a high percentage of students on free and reduced lunches. Table 6 shows the current percentage of students eligible for free and reduced lunch, as well as the percentage of free and reduced lunch by building in RSD. A family's reported income determines a student's socioeconomic status (SES). This data for RSD for 2014-2015 is provided in Table 6.

Table 6

Rail School District Current Eligibility by Building

	Enrollment	Free/Reduced Lunch	Percent F&R
High School	418	243	58.1%
Alternative School	37	28	75.7%
Middle School	358	231	64.5%
Elementary School	866	624	72.1%

Note: F&R=Free and Reduced Lunch students. Adapted from "Kansas K-12 Reports," by Kansas Department of Education, 2015, p. 1, Retrieved from http://online.ksde.org/k12/CountyStatics.aspx?org_no=D[redacted]

Statement of the Problem

The technology department in RSD "recommended the usage of iPads as a way to remove barriers and promote equal opportunities for success by all students" (Superintendent, personal communication, May 27, 2015). The technology department, along with teachers and administrators, visited other schools to view 1:1 initiative implementation and then presented reports to faculty and the board of education, testified at board meetings, and adjusted budgets. This recommendation became a reality after the technology department researched the possibilities and the costs involved with the implementation of a 1:1 initiative. As a result, RHS in rural Midwestern Kansas began a 1:1 initiative during the 2012-2013 school year, distributing an iPad to each student.

Foote (2012a) indicated educators have encountered the need for students to be technologically well informed due to the evolution of technology utilization in fast-food chains, education, home security, smartphones, and industry. For students to be ready for the 21st century and schools to close the achievement gap between those who can afford technology in the home and those who cannot afford technology in the home, schools are placing iPads, laptops, or other computing devices in the hands of all students. Foote (2012a) stated that this technology "levels the playing field" (p. 14). According to Kunzler (2011), "Schools in Clover, South Carolina are praising the iPad for classroom use…claiming that the iPads help their students learn" (p.1). Likewise, as students and teachers at RHS began to incorporate the iPad into daily routines, learning potentially changed for both the student and the teacher. Finding out about the nature of the change in learning brought about by this introduction of the iPad as an educational tool is crucial.

The primary method of measuring student achievement in Kansas school districts is by the Kansas Assessments. However, the Kansas Assessments have undergone changes in the last few years, thus, potentially preventing them from being a valid measure of learning for students at RSD. Because about 60% of all students graduating from RSD take the ACT prior to graduation, this assessment data could present RSD with a snapshot of changes in student achievement during the timeframe prior to and during the 1:1 iPad implementation at RSD. The RSD superintendent desired to determine whether the 1:1 iPad implementation affected the ACT scores of students.

Purpose Statement

The first purpose of this study was to determine to what extent there was a difference in students' composite scores on the ACT in the two years before the iPad implementation and during the two years after the iPad implementation. The second purpose of this study was to determine to what extent there was a difference in students' mathematics, reading, science, and English subtest scores on the ACT one and two years before the iPad implementation, and during, one, and two years after the iPad implementation. The final purpose of this study was to determine the extent to which the differences in students' composite scores and mathematics, reading, science, and English subtest scores on the ACT one and two years before the iPad implementation, and during, one, and two years after iPad implementation were affected by student gender or ethnicity.

Significance of the Study

The use of the iPad and other devices has been studied in recent years to determine the potential impact on student learning in the classroom, although few studies have tried to measure the impact on standardized tests. While studies involving iPads have focused on student achievement based on perceptions of students and teachers, the current study focused on the impact of the iPad on student achievement in mathematics, reading, science, and English as measured by scores on the ACT.

The incorporation of new technologies always has an impact on the teaching and learning environment, and each year schools evaluate the availabilities of applications and techniques to ensure technology use is effective (Cennamo, Ross, & Ertmer, 2010). The implementation of iPads has potentially changed the way learning occurs in the RSD, and the information gathered from the ACT scores may contribute to the field of knowledge related to 1:1 initiatives. The gender, composite scores, and individual subtest scores from the ACT and demographic data may also reveal how the implementation of the iPad has changed the achievement of males and females, as well as ethnic groups.

Delimitations

"Delimitations are self-imposed boundaries set by the researcher on the purpose and scope of the study" (Lunenburg & Irby, 2008, p. 134).

This study was delimited to

- those students who have taken the ACT at RHS in grades nine through twelve.
- data collection during five school years: 2010-2011, 2011-2012, 2012-2013, 2013-2014, and 2014-2015.
- ACT composite, mathematics, reading, science, and English scores as measures of student achievement.
- the use of each student's highest ACT score attained.
- demographic data, including gender and ethnicity, provided by RSD.

Assumptions

Assumptions are referred to as the "postulates, premises, and propositions that are accepted as operational for purposes of the research" (Lunenburg & Irby, 2008, p. 135). The following assumptions were made in order to conduct the research:

1. All students in the study had the same iPad training.
2. All students had access to the same programs on the iPad.

3. All students performed to their best abilities in their mathematics, reading, science, and English subtests of the ACT Assessment.
4. All ACT Assessment data retrieved from RSD were complete and accurate.
5. All school and student demographic data reported from RSD were complete and accurate.
6. The ACT is a valid and reliable assessment of students' abilities in mathematics, reading, science, and English.

Research Questions

The use of iPad and other devices has been studied in recent years to determine their potential impact on student learning in the classroom, although few studies have tried to measure the impact on standardized tests. This study focused on the following research questions:

RQ1. To what extent is there a difference in students' composite scores on the ACT one and two years before the iPad implementation, and during, one, and two years after iPad implementation?

RQ2. To what extent is the difference in students' composite scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation affected by student gender or ethnicity?

RQ3. To what extent is there a difference in students' mathematics subtest scores on the ACT one and two years before the iPad implementation, and during, one, and two years after iPad implementation?

RQ4. To what extent is the difference in students' mathematics subtest scores on the ACT one and two years before the iPad implementation, and during, one, and two years after iPad implementation affected by student gender or ethnicity?

RQ5. To what extent is there a difference in students' reading subtest scores on the ACT one and two years before the iPad implementation, and during, one, and two years after iPad implementation?

RQ6. To what extent is the difference in students' reading subtest scores on the ACT one and two years before the iPad implementation, and during, one, and two years after iPad implementation affected by student gender or ethnicity?

RQ7. To what extent is there a difference in students' science subtest scores on the ACT one and two years before the iPad implementation, and during, one, and two years after iPad implementation?

RQ8. To what extent is the difference in students' science subtest scores on the ACT one and two years before the iPad implementation, and during, one, and two years after iPad implementation affected by student gender or ethnicity?

RQ9. To what extent is there a difference in students' English subtest scores on the ACT one and two years before the iPad implementation, and during, one, and two years after iPad implementation?

RQ10. To what extent is the difference in students' English subtest scores on the ACT one and two years before the iPad implementation, and during, one, and two years after iPad implementation affected by student gender or ethnicity?

Definition of Terms

According to Roberts (2004), terms that "do not have a commonly known meaning or terms that have the possibility of being misunderstood" (p. 129) should be operationally defined. The following terms are defined for the purpose of this study:

1:1 initiative. A 1:1 initiative is a model of technology integration in which a school provides each of its students with a personal device for the duration of a specified time, such as a school year or semester. The device is available to the student around the clock and is integrated into the instructional approach and classroom activities of the majority of the students' classes (Benton, 2012).

ACT composite scores. The composite scores for the ACT are determined by averaging the scale scores of each of the four subtests of each test and rounding to the nearest whole number (ACT, 2014).

ACT subtest scores. The ACT has mathematics, reading, science, and English subtests. These subtests are averaged together to determine the composite score. The raw scores on each subtest of the ACT, regardless of the number of questions, are converted to scale scores, scaled to a range of 1 to 36. The score of 1 is the lowest score, and 36 is the highest score (ACT, 2014).

Overview of the Methodology

The design of this study was a quasi-experimental method. The independent variables of the study were years of iPad implementation, gender, and ethnicity. The dependent variables of the study are the ACT composite score and mathematics, reading, science, and English subtest scores. ACT data were provided by the RSD. The population for this study was all RHS students in grades 9 through 12 who have taken the

ACT. The student data were divided into two groups: one group of 140 students who used iPads from the fall of 2012 until the fall of 2014, in a 1:1 initiative setting prior to taking the ACT, and the other group of 155 students who did not use iPads from the fall of 2010 through the spring of 2012, in a 1:1 initiative setting prior to taking the ACT. The students who did not use iPads in a 1:1 initiative setting took the ACT prior to the implementation of the 1:1 initiative.

ACT assessment scores for the 2010-2011, 2011-2012, 2012-2013, 2013-2014, and 2014-2015 school years were used to measure student achievement. Participant selection was by purposive sampling. Multiple two-factor analysis of variance (ANOVAs) were performed to determine the significant difference in student achievement between the two means of (ACT) scores of students who used iPads and students who did not use iPads and two subgroups (gender and ethnicity) for each subtest on a given variable to determine the difference in student achievement.

Organization of the Study

Chapter one included the background for the study, statement of the problem, the purpose of the study, the significance of the study, delimitations and assumptions, research questions, definition of terms, and an overview of the methodology used. Chapter two reviews pertinent literature related to the history of technology use in schools, the importance of student and teacher perception of technology use on student achievement, 1:1 initiatives and student achievement, and concludes with a summary. Chapter three includes an explanation of the design of the study and the methodology used to conduct the research. Chapter four contains the results of the hypothesis testing for each hypothesis associated with the research questions. Finally, Chapter five includes a summary of the study, the major findings related to the literature, implications for action, and recommendations for further research.

Chapter Two

Review of Literature

The American desire for technological superiority and ease of life in the political and personal realm has pushed our businesses and schools for more technological advancements. Both government and society are continually looking to technology as the answer to today's problems. Schools have not only embraced technology but also have integrated technology into the classroom to face the challenge to "leverage the opportunities technology creates to prepare learners for a globally connected, information-saturated world" (Boss, 2011, p. 1). This chapter includes a review of the history of technology use in schools, the importance of student and teacher perception of technology use on student achievement, and 1:1 initiatives and student achievement. The summary completes the literature review.

History of Technology Use in Schools

Classrooms have benefitted from new technological advancements (Usselman, 2010). For example, "educators have been using projectors to integrate technology into classrooms since the late 1800s" (Akanegbu, 2013, p. 1). In 1870, the Magic Lantern was introduced as a precursor to a slide projector (Dunn, 2011). Although school dropout rates decreased and class sizes increased, classroom instruction changed very little in terms of the incorporation of technology and teacher-led instruction during the 19th century (Usselman, 2010).

During the early part of the 20th century, American schools realized few technological advances, but then the development of technology had increased in momentum. In 1905, the stereoscope, a device that has two eyepieces that allows two separate images to become one three-dimensional image for viewing smaller specimens, was introduced, and in 1922, "Thomas Edison predicted that television would largely replace textbooks" (Lim, Zhao, Tondeur, Chai, & Tsai, 2013, p. 57). In addition, the film projector and radio were introduced in 1925, the mimeograph was introduced in 1940, and the overhead projector, which was "initially used by the U.S. military for training purposes in World War II…quickly spread to schools and other organizations around the country" (Dunn, 2011).

Even though Americans led the world in the advancement of technology, little technology was used in schools other than the television in the early 1950s. According to Murdock (2011), vacuum tube-based computers were developed in 1946 and universities began to assist in further developing computer technology. Headphones and the slide rule were introduced around 1950 (Dunn, 2011). In 1954, businesses such as General Electric followed suit and began to order their own computers, whereas schools lagged behind without the new technology (Murdock, 2011).

The desire for technological superiority was a driving force behind new education reform and many new advances in computer technology. For example, Murdock (2011) suggested Russia sent up Sputnik in 1956 in an attempt to demonstrate technological superiority. The continuing cold war allowed schools in the United States to benefit, as new money and technology were made available through The National Defense Education Act of 1958. In 1962, President Kennedy allocated even more money to education (Murdock, 2011). In 1963, after the Vocational Education Act provided school districts with new money, BASIC programming language emerged, and the IBM 360 computers were developed using punched cards and line printers (Murdock, 2011). The

Elementary and Secondary Education Act (ESEA) was passed in 1964, bringing new money into schools for technology. In 1967, Fortran, a high-level programming language, was being taught in universities, while vocational education included the maintenance of computers. In 1970, Pascal was created, and mainframe and minicomputers were used in some schools, but not for instruction. Intel's first microprocessor was introduced in 1971 along with the first personal computers (PCs) (Murdock, 2011). Additionally, hand-held calculators and Scantrons were introduced to education in 1971 (Dunn, 2011).

Other technological advances, such as computers, were developed to meet the needs of cultural values and institutions (Usselman, 2010). In 1974, the Apple I computer was sold to the public in a kit form. To promote the use of computers in 1975, some Apple I PCs were donated to schools, but, as a whole, schools still resisted the use of PCs. By 1979, an estimated 15 million PCs were in use worldwide. Microcomputers and mainframes increased in popularity and the development of spreadsheets on a PC emerged as a powerful tool for schools. The most popular PC, the TI-99, which used a TV for a monitor, and the Plato Computer were introduced in 1980 (Dunn, 2011). In 1981, mainframe manufacturer IBM developed a PC; at the same time, schools began to see the benefit of drill-and-practice programs that were developed for PCs and were designed to help students learn. A second mainframe manufacturer, Sperry Corporation (through Mitsubishi in Japan), developed a PC in 1983, and teachers began to use Apple II computers on a large-scale basis. In 1984, 13,000 PCs were used in 31 states for career guidance (Usselman, 2010). On average, in 1984, public schools had about one computer for every 92 students (Dunn, 2011), and Papert (1984) predicted that computers would become a key instructional tool. In 1985, hand-held graphing calculators were introduced (Dunn, 2011). In addition, the Apple Macintosh computer was developed, along with educational games and computer-guided tutorials. By 1986, 25% of high school and college guidance counselors used PCs (Usselman, 2010). However, today “schools are still largely reliant upon teachers and textbooks” (Lim, et al., 2013, p. 1).

An influx of modern computers, including iPads, became integral to everyday life, especially in education. Laptops were developed in 1988, and 60% of all U.S. workers used computers (Usselman, 2010). Computers in schools slowly replaced typewriters, and in 1990, PCs with multimedia capabilities were developed and schools incorporated simulations, videos, and databases into the curriculum. By 1992, Gopher servers, which are servers that lead “the user through a series of menus organized by common subjects or areas of interest” (Gilbert, 1995, p. 1), provided online information to schools. Two years later, U.S. classrooms had at least one PC for instruction, and digital video and virtual reality were used when object-oriented, authoring systems became more popular. In 1995, the Internet and the World Wide Web usage increased in schools (Usselman, 2010). Then, in 1996, Internet access and servers that provided faculty with webpage-creating capabilities became available for schools (Murdock, 2011). From 1997 to 2007, the Internet expanded at an astounding rate as streaming video, graphics, and information from databases became accessible, and student engagement increased as video and graphics were added to educational software and as Internet search engines were made available to students (Murdock, 2011). More educational applications were the direct result of the development of larger memory storage capacity in computers, and the introduction of CD-ROM and DVD drives promoted the development of more educational applications (Murdock, 2011).

Tapscott (2009) explained how “Net Geners” (people proficient with Internet usage) grew up with technology and how their experience would help to shape the future of technology. For example, Net Geners use technology naturally and easily and enjoy innovation, choice, entertainment, collaboration, and speed. However, Tapscott (2009) noted Net Geners have a hard time distinguishing between their public and private lives, as they often post information others would deem private on social media. Additionally, Tapscott indicated that Net Geners might process information differently from previous generations, as they change topics more frequently. Tapscott (2009) also stressed that education needed to evolve to accommodate for the differences in how Net Geners learn.

Dunn (2011) stated that interactive whiteboards were introduced in education in 1999, followed by the iClicker in 2005, the XO Laptop in 2006, and the Apple iPad in 2010. As a result of these introductions, educators began to understand the potential importance of technology integration in the classroom in a 1:1 setting and began to examine the benefits of this technology. For example, the Tigua Independent School District (ISD), located in Texas, was the site of a qualitative, multi-case study in which migrant students were given laptops for the purpose of determining how students viewed student success (Levy, 2004). Site coordinator relationships, home-school-community relationships, levels of personal satisfaction, and high school credit recovery success were considered in this study of laptop usage. Levy (2004) concluded that working together as a school and community promoted a culture of change that brought about by the integration of 1:1 laptop initiatives, could affect student and teacher perceptions of achievement.

The Importance of Student and Teacher Perception of Technology Use on Student Achievement

Computers and technology have changed the ways we present information. Specifically, Means (1994) advocated for technology usage in schools to help facilitate student achievement. According to Means (1994), this new technology use in the classroom could further improve student and teacher perceptions of the benefits of technology and its ensuing influence on student learning.

Kirkpatrick and Cuban (1998) conducted a study to determine the effectiveness of computer usage in the classroom. This study included both meta-analyses and critical reviews of flawed single-studies and meta-analyses. The study also addressed the different characteristics of computer-assisted, computer-managed, and computer-enhanced instruction and teachers' roles while using the computer-based instruction. Their findings indicated educators needed to have clear goals for technology use in the classroom. Furthermore, they indicated schools' actual uses of technology were not as high as what technology proponents expected it to be.

> Over the past 30 years, studies of classroom use of computers have indeed found evidence of moderate effectiveness when it comes to the academic performance of students who use them. They also have found evidence of minimum effectiveness. And of no effectiveness at all. (Kirkpatrick & Cuban, 1998, p. 2)

Jenkins and Keefe (2001) conducted a study that investigated the creation of personalized instructional practices using technology with special needs students who worked at a pace that met their individual needs. Jenkins and Keefe (2001) described the importance of pedagogically sound, individualized, and differentiated instruction as strategies to personalize instruction; furthermore, they claimed that personalized instruction is imperative if all students are required to achieve mastery on state assessments. “Personalized instruction is a direction that schools should take in the new century if the diverse needs of students are to be served” (Jenkins & Keefe, 2001, p. 9). They indicated that using computers was one way of differentiating instruction to meet the diverse needs of students.

Student achievement can be assessed in many ways. For example, in one study of 59 elementary schools in a southwestern U.S. city, Johnson and Stevens (2005) used structural equation modeling and examined the relationships among student achievement, community and school context, and school climate. The results of their study revealed, “A statistically significant, positive relationship was found between school mean teachers’ perceptions of school climate and school mean student achievement” (p. 111). As a result, Johnson and Stevens suggested that changes in the educational environment could affect the way a student or teacher perceives the educational experience and, therefore, could influence student achievement to some degree.

Teacher perceptions of the effectiveness of technology use in the classroom are critical to incorporating technology in the classroom, but just as important are student perceptions of the effectiveness of technology use in the classroom. Warschauer (2006) conducted qualitative research on teacher and student perceptions of the effectiveness of technology use in the classroom using case studies, interviews, questionnaires, and analysis of websites. His work originated from a conference in 2004 at the Institute of

Education in London and included a mixture of contributions from European and American universities. Warschauer examined student attitude upon incorporation of technology in mathematics lessons and concluded that student engagement increased in most of the case studies of 1:1 computer initiatives. He also determined that student access to computers promoted motivation, flexibility, and communication. He noted that the use of technology could increase students' critical thinking, analyzing, and studying.

Johnson (2009) studied the need for staff and student preparation so they can be competitive in the 21st century for work and education. In a rural Virginia high school division, he evaluated educational support factors that were necessary for teachers to integrate technology effectively into the classroom by asking 91 teachers to identify rationale and procedures for technology integration into lessons. The results suggested that teachers had adequate access to technological equipment needed for instruction, but lacked training, collaboration opportunities, networking, and planning opportunities to incorporate technology meaningfully into the curriculum.

Collins and Halverson (2009) noted that as technologies change, new literacies arise. This concept may affect how students learn and future testing methods used in educating students, as well as may present a need for testing new literacies for proficiency. They concluded that time needs to be spent teaching students to solve sophisticated problems using computers, rather than spending time solving algorithms and memorizing facts that computers can store for them. Collins and Halverson also concluded that students need to find information, recognize when they need information, and evaluate what they find. They indicated staying current with technological changes is paramount for schools if schools were to remain relevant to today's needs.

Along the same lines, Annetta, Minogue, Holmes, and Cheng (2009) conducted a quasi-experimental study in which a genetics game, created by a high school teacher, was evaluated based on its affective and cognitive impact on students. Although the results showed no significant difference in student learning, significant differences were noted in student engagement. Student perceptions of how successful they were in learning using the technology improved, even if there was no significant difference in student learning in areas where academic testing for proficiency occurred (Annetta, et al., 2009).

Basham, Meyer, and Perry (2010) conducted a study in a rural high school on whether the use of the digital media contained in a backpack, a specifically designed grouping of student iPad programs in which many pieces of digital media were placed, would enhance classroom instruction. The purpose of the study was to determine which technology pieces included in the backpack enhanced student learning with each group of students. The researchers believed the simple design of the backpack was a possible means for individual teachers and districts to enhance classroom instruction. This particular design of the backpack included technology needed to establish a baseline for best learning, modular technology, and technology supports for instruction needed to "provide students with multiple means for representation, expression, and engagement in the learning environment" (Basham et al., 2010, p. 340). During the first part of the study, the participants were 11^{th} and 12^{th} grade technology students; the participants in the second part of the study were 14 students in 11^{th} grade; and the participants in the third part of the study were 14 ninth grade students. All the students in all parts of the study had a general knowledge of the hardware and software used, and each group of participants had four to five hours to develop a media production. The data were gathered through observation of participants, artifacts from students, student surveys, and student interviews. The results of the study indicated that the scaffolding design of the digital backpack was important to the success of the study, as it engaged all learners. Furthermore, when students were provided the appropriate supports, structure, and focus, they could master the intended learning, regardless of their technological background. According to Basham et al. (2010), the utilization of applications loaded onto the iPad had a direct bearing on the perceptions of its use and ultimately helped prepare staff and students for 21st century learning.

In the fall of 2010, Handy and Suter (2011) conducted a study with students and faculty from five sections of two courses across two colleges and two campuses at Oklahoma State University. The purposes of the study were to determine if the use of iPads enhanced the students' academic experience and to determine the impact of the expense of the iPad purchase on the student, the viability of the iPad as an eReader, the utilization of the iPad, and the improvement of students' academic performance. The results of the study indicated that there was an increased pace to the courses in which the iPads had been completely integrated. At the same time, the number of student textbooks, and the amount of paper and printing decreased, reducing overall student cost. Most significantly, 75% of the students who completed the survey believed the iPad enhanced their academic experience.

In May 2009, the Riverside Unified School District (RUSD), located 60 miles east of Los Angeles, went digital with its 44,000 students by introducing interactive e-textbooks, which included embedded videos (Ash, 2011). While the goals of the district were to increase learning time and eliminate socio-economic barriers, this study gathered student and teacher perceptions of iPad usage in the classroom. Ash found that student and teacher perceptions of learning using the iPad drove the use of iPads in the classroom. In other words, related to student perceptions, if a teacher did not see the iPad as a powerful tool, its use would be minimal.

A study conducted in an alternative school in an urban area in the Midwestern United States examined increased student classroom active involvement of three students and identified procedures that effectively modify student behavior (Haydon et al., 2012). The researcher wanted to determine which strategy was more effective: the use of worksheets or the use of iPads. Effective instruction theory suggests when praise is used specific to a behavior, when corrective feedback is given, and when high rates of active student response occur, greater rates of successful practice are created, and more students are engaged in the lesson (Haydon et al., 2012). The researchers used alternating treatments designed to compare using worksheets and working on an iPad to determine the effects on math fluency and active academic engagement. Students did independent seatwork by completing one of two assignments. The results of the study demonstrated that students were more actively engaged when utilizing the iPad versus completing worksheets and produced more correctly-solved math problems in less time. In addition, teachers observed that social skills improved with iPad usage during the math lessons. All three students had higher increases in the number of correctly completed problems per minute with the iPad compared to their achievement prior to using the iPad. Haydon et al. (2012) explained that the applications on the iPad gave immediate responses to students for incorrect answers and allowed students to try the problems again, leading to a higher degree of beneficial practice and increased rates of success.

Focusing on one student with severe ADHD, McClanahan, Williams, Kennedy, and Tate (2012) conducted research in a K-8 school in the Swink Public Schools in southeast Oklahoma. The purpose of the study was to determine if the student could be moved to grade level by addressing the use of context cues, recognition of compound words, and word recognition strategies. To improve comprehension issues, the teacher decided to incorporate the use of the iPad while implementing several learning strategies to work on remembering sequence details, identifying cause and effect, and drawing inferences. Graphic organizers and the iPad were also used as a way to enhance learning. The researchers concluded that the use of the iPad made learning more enjoyable for the student. Over the six weeks, the student developed a better attitude, including demonstrating excitement, compared to prior practice without the iPad use, and made significant progress in his reading ability. When the student was retested on first and second grade assessments after a six-week period, he demonstrated one full grade level of improvement in reading, and researchers noted his eagerness for learning had changed considerably. The researchers suggested the potential for helping students learn and transferability of this study to other students with reading problems are possible. They also noted the touchscreen might have promoted the use of several modalities for this student, including visual and tactile/kinesthetic. Recording his voice helped the student hear and identify mistakes. Due to the success of this student using the iPad, McClanahan et al. (2012) suggested that the use of iPads was worthy of serious consideration for increased reading achievement, yet further research was needed in similar contexts, specifically regarding how the different components of learning can be facilitated with the experience of using the iPad.

Cennamo et al. (2010) indicated that teachers needed to experience a series of developmental stages of technology integration as they move from novice user to a facilitator of technology. They noted that teachers initially tended to have a negative outlook on the use of technology in the classroom, but that teacher perception seems to be more positive with more training. Additionally, the researchers advocated for teachers to become self-directed learners so they could make informed decisions on technology usage to support student engagement and learning in the classroom.

In a study conducted at Briarcliff University, Thompson (2011) set up iPads with file folders containing specific subject-matter applications to support students. Usage logs were implemented by teachers to monitor the use of the iPads and to evaluate the most desired and useful applications. At the conclusion of the study, students were surveyed about their use of the iPads and future needs for applications. Thompson concluded that when applications for the iPad were tailor-made for educational programs with specific goals in mind, time was saved, and student achievement was potentially increased.

During the 2010-2011 school year, Geist (2011) researched the teacher-preparation program at Ohio University. A teacher-level preparation class met for four hours a week. In addition, these student teachers spent 4-5 hours per week in elementary school classrooms. This study looked at ways to incorporate iPads into the classroom and the perceptions of the iPad's effectiveness as a tool for both students and teachers during the implementation process. Surveys were administered to teachers and students, and interviews were held with the elementary school faculty focusing on the use of iPads as a teaching tool in elementary classrooms, faculty resistance to the use of mobile devices during classroom lectures, and change to classroom interaction. Elementary student survey results indicated that the implementation of the iPad changed how students interacted with the instructor, as data from the Internet was instantly available, instead of students having to go to a computer lab. Additionally, group work became more efficient. Learning management systems, such as Moodle, which are designed to compartmentalize assignments and organize information for students and teachers, were beneficial in keeping students on task and organized. Furthermore, using an iPad allowed children to explore independently, as using the device allowed students to make choices among the games and experiences. In fact, students claimed that the iPad helped them stay focused. In contrast, some of the elementary teachers resisted student use of the iPads during class, claiming the devices were a distraction. Geist claimed that schools need a 21st century learning environment to teach 21st century skills in the classroom and that teachers can easily change their attitudes and ideas about teaching to include the use of mobile devices. The results of this study indicate that student learning and achievement can be facilitated with appropriate iPad use in the classroom.

Hooker (2011) conducted a study in the Eanes Independent School District in Austin, Texas, focusing on a cost analysis on whether the use of iPads saved the district money. The objectives of 1:1 initiative for innovation in Eanes were to create a digital and global culture for learning, make real-world connections, and allow for differentiated instruction. During the study, 38 teachers and 862 students received iPads. Analysis of the data indicated that there was an initial decrease in learning, but then learning followed as distractions subsided. While iPads were first used to substitute some components of teachers’ lessons, teachers began to use iPads to enhance entire lessons, thus redefining how teachers taught overall. The study resulted in all the teachers wanting more training and support in integrating iPads into their daily lessons.

Another study examining the 1:1 iPad initiative was conducted by Foote (2012b) who focused on 11th and 12th grade students at Westlake High School in Austin, Texas, during the spring semester of 2011. The purpose of the study was to determine the effect student and teacher iPad usage had on teaching and learning. Data compiled from teachers' and students' surveys were used to describe quantitatively the various ways iPads were used, as well as the degree to which iPads affected planning, teaching, communicating, and learning. The results indicated that the iPad was useful for both teachers and students, cutting costs in copying, saving time in preparation, increasing communication, increasing creativity, providing valuable resources, and making lessons more relevant and fun overall.

Additionally, in August 2011, Hooker (2012) examined the Westlake Initiative for the same purpose of determining the effect iPad usage by students and teachers had on teaching and learning. He found from surveys administered to students and teachers that the iPads created a culture of digital and global learning. Specifically, the iPads served as a tool through which students could readily learn from the Internet.

Benton (2012) conducted a study in which eighth grade teachers and students in the Jobs School District, located in a south-central state, were given an iPad for use as an instructional tool. More than half the students in the district qualified for free and reduced-priced meals and, therefore, were unable to purchase their own devices. Administrators, recognizing the necessity for district support, needed to justify that the money spent on iPads was a good investment in their students' education. The goals of the study were to examine approaches to iPad instructional implementation, to understand whether connections in the curriculum are made using the device, to determine what changes in teaching and learning happened as a result of iPad integration, and to determine how students' interactions with one another changed when students used the devices. A qualitative research design was used, including observations, interviews, and analysis of data using multiple levels of abstraction. The results of the study revealed that teachers needed more support to be successful in iPad implementation. Although teachers relied on colleagues and students for that support, teacher pedagogical behaviors did not change. At the same time, teacher perceptions indicated that the implementation of iPads had a great impact on student engagement and learning.

Hahn and Bussell (2012) conducted a study in which the iPad 2 supplemented first-year undergraduate learning community coursework at the University of Illinois. The purpose of the study was to see if the device was beneficial in helping students prepare for college research. The students were lent computers on a weekly basis; however, the students were allowed to use the computers as if the students actually owned them. At the end of the study, the students were surveyed through an online web-based program. In addition, focus groups discussed how iPads were used in the curriculum. Hahn and Bussell's (2012) findings showed that there were in-class iPad 2 uses that allowed students to connect with course management sites for online quizzes, class outlines, and lecture material. In addition, collaboration with other students was easier, and videos and resources were more accessible. Hahn and Bussell (2012) also determined that future applications with more functionality are needed to meet student needs.

In the fall of 2010, Miller (2012) conducted a study with eight instructors who pioneered the use of mobile tablets and iPads in the classrooms at Indiana University-Purdue University Indianapolis. The purpose of the study was to determine how allowing each student the use of an iPad affected the perceptions of students and teachers on student learning across the curriculum. Also, Miller examined instructional approaches across disciplines when iPads were used and obtained student perceptions of learning and engagement. Students were surveyed and were asked to rate items using a Likert scale, ranging from Strongly Agree (5) to Strongly Disagree (1), after being given instruction on various ways to use the iPad for the specific discipline; they were then allowed to work with the device and discover its uses and limitations. Miller (2012) stated that the results were extremely positive overall, including that the iPad allowed for easy access to information, was more efficient for groups to use and improve group cohesiveness, and was convenient and fun. Overall, the iPad was perceived as being an extremely beneficial tool in the classroom, although a few students felt the iPad was a distraction. Miller recommended that further research be conducted involving comparing students using iPads with students not using iPads.

The purpose of Rossing's (2012) study was to determine the perceptions university teachers had of student iPad usage while iPads were incorporated in communication courses. Each faculty member received an iPad during the 2010-2011 academic year and had access to a set of iPads for in-class use. Indiana University-Purdue University-Indianapolis faculty attempted to determine how mobile technology might promote the values and outcomes of liberal education. Rossing used observations, discussions, and experiences to capture the perceptions of teachers on the use of iPads.

The findings indicated the use of mobile devices invited collaboration and cooperation, as well as changed the way students interacted with one another and applied their knowledge. Rossing suggested that students in higher education be provided specific guidance as new technology is introduced.

Norris and Soloway (2012) conducted a study in McAllen (Texas) Independent School District, where over 25,000 devices were purchased from Apple to start a 1:1 iPad initiative. The researchers indicated that data supported student achievement increases when students use mobile devices to learn, use a broad range of applications for 50 to 75 percent of the day, and use the devices after school. Because there were conditions placed on using iPads during the study, the researchers concluded that the iPad could not be used as just a supplemental tool. As a result, teachers need ongoing, continuous professional development to help guide them through the process of implementing iPads effectively to ensure achievement gains.

In a study conducted by Ucak and Bag (2012), the level of student self-efficacy towards science and technology lessons using iPads was investigated. The study sample consisted of 705 Turkish sixth, seventh, and eighth grade students. The researchers investigated the degree of confidence students had with science and technology when difficult situations were presented to the students and the differences in students' self-efficacy of science and technology based on gender, grade level, parents' educational level, scientific book reading, and science documentary watching. Because self-efficacy affects the perceptions of teachers and students, the influence of the iPad on students' self-confidence and problem-solving ability may connect to how well they can problem-solve utilizing the technology correctly. The findings indicated that self-efficacy appeared to be positive. For example, those who had higher self-efficacy were more concerned with the subjects and were deeply involved in the activities, set persevering goals, and had a strong sense of responsibility. Additionally, the students believed that they could succeed in science and technology. According to Ucak and Bag, if the iPad is to be used as an educational tool to improve achievement, students and teachers must be able to incorporate the iPad easily into everyday practices.

Walsh (2012) conducted a study of student and teacher use of iPads at Longfield Academy in Kent, England. Over 800 students ranging from 11 to 18 years of age and 71 faculty members were surveyed to determine the impact the 1:1 iPad initiative had on the level of student motivation, achievement, quality of work, and collaboration. Walsh concluded that most teachers who regularly used the iPads in their teaching experienced a decreased workload and cost savings from decreased photocopying, observed student work quality improve, and noted that the appropriate use of applications helps learning. At the same time, students indicated a desire for teachers to use the iPad more because student motivation increased when using iPads. According to Walsh, the pedagogical changes that occurred during the study allowed new learning experiences with continuous information availability and created a significant and positive impact on learning and teaching. Walsh conjectured that the changes brought about by implementing the iPad initiative would increase achievement and attainment.

Finally, Bennett (2014) conducted a qualitative study in a small Midwestern town that began a 1:1 iPad initiative. The purpose of the study was to determine the administrator and teacher perceptions of the effectiveness of iPad integration into curriculum and instruction. Teacher semi-structured interviews, an administrator focus group, a document review, and observations were used in this research. Bennett (2014) stated, "Whether or not technology should be used in the classroom is no longer debated; instead, the emphasis is ensuring that technology is integrated into instruction to promote student achievement and future success" (p. 8). She found that a school considered being technologically-rich needed to improve the integration of technology and instruction for all teachers and students. Furthermore, having technology is not enough in a school district; instead, teachers and students must be properly trained and develop good habits concerning technology for it to be optimized as an educational tool.

1:1 Initiatives and Student Achievement

Many school districts have considered 1:1 Initiatives. Queener (2011) stated,

> The ultimate goal of implementing any educational initiative is to improve student achievement. Some initiatives are targeted to directly affect student achievement while others focus on conditions that help to create an environment for students to be successful in and ultimately, improve student achievement. (p. 119)

High school classes around the country have integrated iPads into their curriculum, and entire schools are adopting 1:1 initiatives to place iPad technology into the hands of every student. For example, art classes are incorporating applications for drawing (Tomczak, 2011), English language learners are utilizing applications to help with language acquisition (Demski, 2011), and students with special needs are using iPad applications to support their learning (Pitler, et al., 2007). As a result, there is a real need to determine whether the use of iPads is affecting student achievement.

Stratham and Torell (1996) examined ten meta-analyses of research related to the effectiveness of technology supporting student learning from 946 studies in grades K-12.

They concluded that students with learning disabilities appeared to benefit from direct instruction and the increased structure offered with technology. Stratham and Torell (1996) also determined that more students attended college and were awarded better scholarships for students resulted from a learning environment infused with technology. They also indicated that the technology had to be portable and affordable for school districts.

A quasi-experimental longitudinal study with sixth grade students from a south Florida middle school was conducted by Lewis (2004). His purpose was to determine the difference between an experimental group using technology and the comparison group without technology, using SAT and Florida Comprehensive Assessment Tests to compare reading comprehension and mathematics application. English pre- and post-test writing assessments were used to determine writing improvements. Additionally, parents and students were surveyed at the end of the year to determine their perceptions of learning using the technology. The results indicated that full-time computer access did not improve student achievement in reading comprehension, math application, and writing. Lewis recommended examining the principal’s involvement and instructional design, as well as determining how instructional uses affected student achievement.

In the Scottsdale Unified School District in Scottsdale, Arizona, Boyle (2005) conducted a case study that explored the teacher and technology support provided to eighth grade students attempting to pass a computer proficiency test. Boyle sought to determine why student technology proficiency had not improved to the extent that every student was technologically proficient by the end of the eighth grade year. Although the school provided technology and instruction using the technology, 100% of eighth grade students did not pass the computer proficiency test required by the school district. Therefore, Boyle concluded that teachers did not have the right curriculum to utilize the technology correctly.

In another study of eighth grade students in Louisiana, Nicholas (2006) investigated student achievement on three years of Louisiana Educational Assessment Program tests and proficiency self-assessments as students used two mobile labs of laptops with a one-to-one computing program. The purpose of the study was to investigate student achievement and attitude toward technology within a 1:1 laptop initiative. The findings revealed no significant relationship between the 1:1 initiative and the exams; however, a significant improvement in student attitude toward technology occurred during the three years of surveys.

Overall (2007) researched the association among laptop usage, calculator usage, and gender on the mathematics subtest of the Maine Educational Assessment (MEA) with 182 eighth grade students. Using a pre-experimental, correlational research design, Overall implemented two forms of technology (calculators and laptops) and then examined the extent to which technology usage was associated with averages of eighth grade mathematics achievement on the MEA. Although, the results of the study revealed a positive correlation between mathematics achievement and gender, no positive correlation was determined to exist between laptop usage and achievement in mathematics for gender. In addition, girls in the lower 25% of the class had better scores on the assessment than did boys.

In a study investigating the effect that 1:1 laptop initiatives had on English Language Arts (ELA) test scores among 108 California fourth grade students, Suhr

(2008) also considered the relationship of students' background on ELA scores. The students were split into two groups: one using laptops, one with no access to laptops. After two years of using laptops, those "students outperformed non-laptop students on the California Standards Test (CST) ELA total scaled scores" (p. 70). Suhr (2008) concluded that 1:1 laptop program participation did have a weak to moderate effect on the CST ELA performance.

Another study during the 2007-2008 academic year evaluated the effect that 1:1 laptop initiatives had on fourth grade reading, writing, and computer learning (Bird, 2008). Students from two classes were classified into one of two categories: Omaha Public School Digital Divide Learners, 10 students who did not have home access to computers and the Internet, and Digital Native Learners, 15 students who did have home access to computers and the Internet. The dependent variables included the California Achievement Tests Normal Curve Equivalent scores for reading, and the Omaha Public Schools District Writing Assessment fourth grade scores. Fourth grade digital divide learners were the independent variable. Bird's results indicated a gain in reading comprehension, reading vocabulary, and writing pretest-posttest test scores for digital divide learners during the 1:1 laptop initiative.

According to Whidden (2008), eighth grade students from 40 randomly selected schools in Maine experienced an increase in standardized test scores after students were given laptops. The purpose of the study was to determine if there was a link between student ethnicity, student SES, and rural/urban location of the school and the effect of student-dedicated laptops on standardized test scores. The composite, reading, math, and science test scores from the Maine Educational Assessment were included in the study for the years 1998-2005. Whidden concluded there was a positive relationship between a 1:1 laptop initiative and standardized composite test scores in three schools, as well as between a 1:1 laptop initiative and math test scores in six schools. There were no differences in standardized test scores and specific demographic markers (e.g., ethnicity, SES, rural/urban location).

In a study focused on 79 students enrolled in the 11th and 12th grade and 16 classroom teachers, Burgad (2008) sought to determine if a 1:1 laptop initiative in a small North Dakota school had any significant impact on student achievement in reading, language arts, and mathematics on the Northwest Evaluation Association Measure of Academic Progress (NWEA MAP). The two variables in the study were NWEA MAP scores and the perceived student performance skills based on survey results from parents, students, and teachers. Significant gains on the mathematics achievement test were experienced by students who had laptops, as compared to students who did not have the technology. However, the 11th grade students with laptops had significant negative differences in reading, and senior students with laptops experienced significant negative differences in language arts as compared to the MAP scores of juniors and seniors who did not have the technology.

In an Early Childhood Longitudinal study, Kao (2009) investigated the relationship between the frequency of computer usage and mathematics achievement on the National Assessment of Educational Progress based on standards from the National Council of Teachers of Mathematics. Kao considered third and fifth grade student achievement as the dependent variable, and SES, ethnicity, frequency of computer use, and homework completion as the independent variables. The results of the study showed that computer use had no relationship to achievement among third grade students and computer use at least once a week among fifth grade ethnic groups resulted in lower scores for White, but not Hispanic students. Additionally, higher scores were associated with Black third graders and with students living below the poverty threshold using computers once or twice per month. In addition, Kao (2009) found that using computers at least once per week was associated with higher third grade scores. However, the results showed that Black fifth grade students who did not do homework problems but used technology at least once per week had significantly improved scores. “Overall, these findings suggest that policy efforts to include technology in elementary mathematics education have fallen short of their goal of improving student performance” (Kao, 2009, p. xii).

As a result of the Classrooms for the Future Initiative, a study in Pennsylvania by McFall (2009) was conducted using 11th grade Pennsylvania System of School Assessment math and reading scores to investigate the impact of a 1:1 laptop initiative on student achievement. The classes of 2010 from three high schools in Delaware County in southeast Pennsylvania were evaluated in the study. McFall found no significant differences in student achievement due to the 1:1 initiative implementation.

Mills (2010) investigated a 1:1 laptop initiative with 105 10^{th}-12^{th} grade students from Fertile-Beltrami School District, a small rural Minnesota high school. Both student and teacher perceptions of technology use were surveyed. Graduation and grade point averages were used to determine the effect laptops had on academic performance (Mills, 2010). Mills concluded that the 1:1 computer initiative positively affected student engagement, learning, and achievement. Furthermore, Mills concluded that the impact computer integration has on student performance is directly related to the amount of faculty laptop integration in the classroom. From the analysis of the student and teacher survey results, Mills determined that student skills and engagement improved using computers. Grade point average differences earned by students using laptops in comparison with students not using laptops were 1.21 grade points higher for 10th grade students, 1.29 grade points higher for 11th grade students, and 1.04 grade points higher for 12th grade students.

Aql (2011) discussed the effect of using the “I CAN Learn” computer system, created by John R. Lee and marketed by JRL Enterprises, Inc., on student MAP achievement in eighth grade mathematics in the Kansas City, Missouri Consolidated School District, the Grandview Consolidated School District, and the Hickman Mills Consolidated School District during the 2006-2007 and 2007-2008 school years. While some students received instruction using the “I CAN Learn” computer system, another set of students did not incorporate the computer system into their learning. The independent variable in the study was the instructional method, as the control group received traditional math instruction. The study looked at iPad usage and student and teacher perception of how that usage affected learning. Guiding the study were five main questions dealing with the effects of this computer program on MAP scores among all student groupings. Students receiving instruction utilizing the “I CAN Learn” computer system had a higher mean MAP mathematics score compared to the scores of students who did not use the computer system. Specifically, the mean math scores were higher for students with special educational needs using the “I CAN Learn” computer system. Aql discussed the connection between technology usage and student performance, including explaining that advances in technology led to increased scores and provided insight into potential future gains in student learning for students in the study. In addition, Aql concluded that implications for action for educators include staying current with advances in technology and finding ways to embrace the technology as it emerges to keep students and faculty current. Furthermore, finding specific applications relevant to curriculum could help educators effectively use the technology in the classroom to increase student achievement.

In another investigation, 50 fourth and fifth grade teachers from the Santee School District in Santee, California, participated in a correlational study in which Spencer (2010) administered a survey and correlated faculty attitudes toward applications for software in class and student achievement data. Spencer found a relationship existed between teacher attitude toward software and student achievement on the Houghton Mifflin's California Summative Tests. Students performed better in classes where the teacher liked the software students used.

Bryan (2011) examined the effect of a 1:1 program on fourth and fifth grade students' reading fluency and comprehension. The study involved 1,048 students from six elementary schools in the Lee County School District in North Carolina, with a high percentage of low-socioeconomic status students. The control group included 697 students who did not have laptops while the treatment group included 351 students who did have laptops. Pre- and post-test scores on AIMSweb R-CBM fluency and Maze-CBM comprehension tests were administered. Findings indicated that reading fluency and comprehension test scores were statistically significant from pre- to post-tests for students who received laptops.

Similarly, a study of two suburban junior high schools indicated the laptop initiative had a positive effect on student achievement (Queener, 2011). The study was a casual-quantitative analysis of MAP test scores from Northwest Evaluation Association (NWEA). The first year was a base year prior to implementing the 1:1 initiative at one school and a 3:1 initiative in the other school. The second year was a target year, and the third year was a final year to consider longitudinal effects. Queener found there to be a statistically significant difference between MAP mathematics scores for the 1:1 and 3:1 initiatives, initially. The students receiving laptops in a 1:1 initiative outperformed students in the 3:1 initiative. He also concluded that when test data were disaggregated by specific demographics of gender, low SES, and minority status, the 1:1 laptop initiatives did not appear to have significant effects on student achievement. Queener (2011) concluded that technology initiatives do positively affect student achievement in mathematics.

A quantitative quasi-experiment was conducted with 104 fifth grade students to study a pre-test, post-test (Scott Foresman-Addison Wesley fifth-grade mathematics Virginia standards of learning aligned assessment) design in which one group used iPads as 1:1 computing devices and one group did not use iPads (Carr, 2012). The purpose of the study was to identify any differences between the two groups' mathematics achievement. The results indicated no significant differences between the two groups. The recommendation for further research were to increase the duration of iPads from nine weeks to a longer period of time – perhaps to a 24-hour day, seven days a week access to the iPads.

Eight rural Minnesota school districts' sixth grade students' reading achievement was studied to determine the impact of the iPad on the rate of fluency gain (Swanson, 2013). For 10 weeks in the fall of 2012, the iPad was used as a recording device for students to read along with prerecorded stories from the Read Naturally placement system. Swanson considered the changes in students' fluency and found that the range of improvement in words per minute was from -1 to 30 and that the accuracy range of improvement was from 1% to 6%. Findings revealed there was no notable gain in the rate of fluency due to iPad usage.

Riconscente (2013) conducted a study with 122 fifth grade students using Motion Math by GameDesk, an iPad fractions application for elementary students. The purpose of the study was to determine if playing Motion Math led to increased achievement on fractions and improved attitudes. The findings of the study indicated, on average there was a 15% increase in fractions knowledge. Additionally, there was a 10% increase in student self-efficacy for fractions. According to Riconscente (2013), "The results of this study suggest that what children learn through gameplay can help them perform better on the kinds of questions asked on state and national standardized tests" (p. 4).

Comstock (2013) conducted a study at the University of California Irvine's (UCI) iMedEd program. The purpose of the study was to determine what effect using the iPad had on learning and achievement. The 104 students in the class of 2014 had Medical College Admissions Test (MCAT) admission scores and GPAs that were comparable to previous classes. With the class of 2014, UCI utilized iPads as a learning tool. The iPads were fully loaded with electronic textbooks, podcasts of lectures, class management systems, and other tools specifically designed for medical students. At the end of the program, students scored 23% higher on The United States Medical Licensing Examination than previous classes had scored.

In 2013, Cottone examined a 1:1 laptop initiative and its impact on student achievement for fourth through sixth grade intermediate school students in Mooresville, North Carolina. The purpose of this quantitative study was to compare pre-1:1 laptop standardized test scores to post-1:1 laptop scores in math and reading on state end-of-grade assessments. Results of the study revealed a statistical difference between the pre-1:1 laptop total group and the post-1:1 laptop total group in math. Specifically, the achievement gaps in math that narrowed were among Black and low SES students. In contrast, no measurable difference in reading scores occurred during the study.

Handwerk (2013) conducted research with high school students in Bedford, Massachusetts to attempt to understand how tablets "tap neurocognitive abilities that help students understand enormous scale and other difficult concepts" (p. 1). The students used the Solar Walk simulation from Vito Technology and the students' pinch-to-zoom capability to explore 3-D display in Orrery (exaggerated planet size) display and a true-to-scale mode. Handwerk determined that improved learning on standard astronomy tests was demonstrated when students used both modes and that the true-scale representations were more effective in guiding students to fewer misconceptions about scale and neighboring celestial bodies. "Students saw learning gains after as little as 20 minutes of study on the iPad, the research found, and if supported with guidance from an instructor their improvement may have been even more pronounced" (Handwerk, 2013. para. 2).

A study in a southeast region middle school was conducted by Lambert (2014) over two school years, 2006 – 2007 (students received laptops) and 2007 – 2008 (students did not receive laptops), to determine whether there was a difference in sixth grade mathematics scores as measured by South Carolina Palmetto Achievement Challenge Test (PACT). Lambert used an ex post facto research design with cluster sampling from pre-existing data from the sixth grade (267 students) PACT scores. The laptop initiative was the independent variable, and the dependent variable was the students' standardized mathematics mean test scores. Results of the research revealed a statistically significant difference in achievement between students who used laptops and students who did not use laptops in the sixth grade mathematics classes. Lambert (2014) concluded, "The findings may serve as a catalyst for researchers to use modern technology such as tablets and phones to improve student achievement" (p. 3).

In Charleston County, South Carolina, Ikiz (2014) conducted a study in three schools in which 10,930 students were given iPads. The researcher compared student test scores (aligned with state standards) one year prior to and one year after the implementation of the 1:1 iPad initiative. The results indicated no overall increase in the percentage of students meeting or exceeding standards established by the state. When grade-level scores were examined closely, some gains were realized by fifth and eighth grade Hispanic students and English language learners. Hispanic, Black, and English language learners in the eighth grade demonstrated gains in math. Inez purported that teachers using the iPad as a tool to teach 21st century skills, engage students, and differentiate instruction would produce more gains in student achievement. When parents, teachers, and students were surveyed, the results indicated that the iPad increased motivation and engagement as well as decreased behavior problems. One of the recommendations from the study was to re-evaluate the impact the iPad has on student test scores in the future.

Finally, a quasi-experimental, pre-test-post-test study was conducted on six classes of second grade students, three with eBooks and three with printed text, comparing the use of multimodal features of eBooks read on an iPad and printed books on reading comprehension as assessed by CBMs (Reichenberg, 2014). The results of the research indicated that students in the iPad group who used multimodal features had a higher rate of comprehension than standard iPad users. Both groups exhibited increases in their easy CBM post-test scores. Reichenberg (2014) stated, “Engagement of technology is a solid way to reach reluctant readers” (p. 83).

Summary

In chapter two, the literature available on the topics related to the history of technology use in schools was reviewed. In addition, a discussion on the importance of student and teacher perception of technology use on achievement, and 1:1 initiatives and student achievement completed the chapter. Chapter three contains the study’s methodology, including research design, population and sample, sampling procedures, and instrumentation (including measurement, validity, and reliability). Chapter three also includes data collection procedures, data analysis and hypothesis testing, and limitations.

Chapter Three

Methods

The purpose of this study was to determine the differences in students' achievement on the composite, mathematics, reading, science, and English scores for the ACT assessment between students who did and did not use iPads while attending the RSD. An additional purpose of the study was to determine if the differences in students' achievement on the composite, mathematics, reading, science, and English scores for the ACT assessments for students who did or did not use iPads were affected by student gender or ethnicity. Chapter three contains information on the quantitative research methodology and procedures used in this study. The sections included in this chapter are research design; population and sample; sampling procedures; instrumentation, including measurement and validity and reliability; data collection procedures; data analysis and hypothesis testing; limitations of the study; and a summary of the main points from the chapter.

Research Design

The design of this study was a quasi-experimental method, which is used when "causal inference cannot be conducted under true experimentation due to the inability to randomly assign participants to experimental and control groups or the inability to secure a control or comparative group" (Lunenburg & Irby, 2008, p. 49). The independent variables of the study are years of iPad implementation, gender, and ethnicity. The dependent variables of this study were the ACT composite score and the mathematics, reading, science, and English subtest scores from ACT.

Population and Sample

The population for this study was all RHS students in grades 9 through 12. The sample was limited to students who had verifiable composite, mathematics, reading, science, and English scores for the ACT assessment. Students were assessed on the ACT during the 2010-2011, 2011-2012, 2012-2013, 2013-2014, or 2014-2015 school years.

Sampling Procedures

The participants for this study were identified by purposive sampling, which is a sampling technique in which a sample is justified by clearly describing specific criteria involved in that selection process (Lunenburg & Irby, 2008). Eligibility for participation in this research included all students who attended RHS from fall 2010 to fall 2014. Additionally, students must have taken the ACT assessment during the 2012-2013 and 2013-2014 school years.

Instrumentation

The ACT is a curriculum and standards-based educational and planning tool. There are four multiple-choice subtests (mathematics, reading, science, and English). The mathematics subtest items "cover four cognitive levels: knowledge and skills, direct application, understanding concepts, and integrating conceptual understanding" (ACT, 2014, p. 6). The reading subtest items "comprises four sections, each containing one long or two shorter prose passages that are representative of the level and kinds of text commonly encountered in first-year college curricula" (ACT, 2014, p. 6). The science subtest items contain "several sets of scientific information, each followed by a number of multiple-choice test items. The scientific information is conveyed in one of three different formats: data representation research summaries or conflicting viewpoints"

(ACT, 2014, p. 7). The English subtest items "consists of five essays, or passages, each accompanied by a sequence of multiple-choice test items" (ACT, 2014, p. 7). Table 7 provides details regarding the number of items, time limits, and content for each subtest that comprises the ACT assessment.

Table 7

ACT Subtest Item Information

ACT Subtest	Number of Items	Time Limit (minutes)	Content
Mathematics	60	60	pre-algebra, elementary algebra, intermediate algebra, coordinate geometry, plane geometry, and trigonometry
Reading	40	35	reading comprehension as a product of skill in referring and reasoning
Science	40	35	biology, chemistry, physics, and the earth/space sciences
English	75	45	understanding of the conventions of standard written English (punctuation, grammar and usage, and sentence structure) and of rhetorical skills(strategy, organization, and style)

Note: Adapted from "ACT Technical Manual," by ACT, 2014, p. 20. Retrieved from http://www.act.org/research/researchers/index.html.

The subtests of the ACT were designed to measure skills that are acquired in secondary education and are most important for student success in postsecondary education (ACT, 2014).

Measurement. The composite ACT score is the average of four subtest scores (mathematics, reading, science, and English) rounded to the nearest whole number. The raw scores on each subtest of the ACT, regardless of the number of questions, are converted to scale scores, scaled to a range of 1 to 36. The score of 1 is the lowest score, and 36 is the highest score (ACT, 2014). Gender (male, female), ethnicity (non-minority, minority), and time (two years before the iPad implementation, the year before, the year of, the year after, and two years after the implementation of the iPad) were collected along with the ACT scores.

In research question one, the dependent variable is the student's highest ACT composite score and the independent variable is the ACT assessment time (two years before the implementation, the year before, the year of, the year after, and two years after the implementation of the iPad). In research question two, the dependent variable is the highest ACT composite score. There were three independent variables: ACT assessment time, gender, and ethnicity. A student's gender (male, female) was assigned an M or an F. Student ethnicity (Asian, Black, Hispanic, Other, and White) was collapsed into two categories. The White category was labeled non-minority and all other ethnicity categories were collapsed into a single category labeled minority. In research question three, the dependent variable is the highest ACT mathematics subtest score, and the independent variable is the ACT assessment time (two years before the implementation, the year before, the year of, the year after, and two years after the implementation of the iPad). In research question four, the dependent variable is the highest ACT mathematics subtest score, and the independent variable is the ACT assessment time (two years before the implementation, the year before, the year of, the year after, and two years after the implementation of the iPad). Gender and ethnicity were also addressed and the descriptions are above in the explanation of the research question two variables. In research question five, the dependent variable is the highest ACT reading subtest score, and the independent variable is the ACT assessment time (two years before the implementation, the year before, the year of, the year after, and two years after the implementation of the iPad). In research question six, the dependent variable is the highest ACT reading subtest score, and the independent variable is the ACT assessment time (two years before the implementation, the year before, the year of, the year after, and two years after the implementation of the iPad). Gender and ethnicity were also addressed and the descriptions are above in the explanation of the research question two variables. In research question seven, the dependent variable is the highest ACT science subtest score, and the independent variable is the ACT assessment time (two years before the implementation, the year before, the year of, the year after, and two years after the implementation of the iPad). In research question eight, the dependent variable is the highest ACT science subtest score, and the independent variable is the ACT assessment time (two years before the implementation, the year before, the year of, the year after, and two years after the implementation of the iPad). Gender and ethnicity were also addressed and the descriptions are above in the explanation of the research question two variables. In research question nine, the dependent variable is the highest ACT English subtest score, and the independent variable is the ACT assessment time (two years before the implementation, the year before, the year of, the year after, and two years after the implementation of the iPad). In research question ten, the dependent variable is the highest ACT English subtest score, and the independent variable is the ACT assessment time (two years before the implementation, the year before, the year of, the year after, and two years after the implementation of the iPad). Gender and ethnicity were also addressed and the descriptions are above in the explanation of the research question two variables.

Validity and reliability. Validity is the degree to which an instrument measures what it is purported to measure (Lunenburg & Irby, 2008). The degree to which an instrument consistently measures whatever it is measuring is its reliability (Lunenburg & Irby, 2008). The ACT has been tested for validity and reliability. Two of the five most common interpretations and uses for validity related to this study were “evaluating the effectiveness of high school college-preparatory programs, and evaluating students’ probable success in the first year of college and beyond” (ACT, 2014, p. 64). ACT (2014) conducted validity (convergent and discriminant validity) and reliability (internal consistency and test-retest stability) studies on the use of ACT scores to evaluate programs and concluded that the ACT tests, high school coursework, and grades are conceptually and psychometrically linked to one another making them appropriate for measuring student academic achievement over time.

ACT (2014) explained that the reliability of the ACT composite score (theoretical correlation in the entire applicant population) is approximately 0.96. “Internal consistency reliability coefficients for the six 12-item scales range from 0.84 to 0.91 (Med = 0.87)” (ACT, 2014, p. 139). In summary, evidence exists for both validity and reliability when the ACT is used for “evaluating the effectiveness of high school college-preparatory programs, and evaluating students’ probable success in the first year of college and beyond” (ACT, 2014, p. 64).

Data Collection Procedures

The researcher received verbal permission to collect data from RHS upon submission of the Institutional Review Board (IRB) for the 2014-2015 school year and then received formal confirmation by email to continue with the research in the early spring of 2015 (see Appendix A). The Baker University IRB form was submitted in the winter of 2015 (see Appendix B). On February 20, 2015, the researcher received permission from the IRB committee, which allowed the researcher to continue with the study (see Appendix C).

Upon approval of the IRB committee, the researcher requested the data from RHS. An assistant principal at RHS collected the data, removed any identifying names of the students, and replaced the names with a number. The data included composite, mathematics, reading, science, and English scores from the ACT, gender, and ethnicity. These data were later downloaded into IBM® SPSS® Statistics Faculty Pack 23 for Windows for analysis.

Data Analysis and Hypothesis Testing

This study used quantitative methods of data analysis. The quantitative data were organized in Microsoft Excel, checked for accuracy, and then input into SPSS for statistical analysis. The quantitative analysis focused on 10 research questions and associated hypotheses testing. Multiple ANOVAs were utilized to conduct the hypothesis testing.

RQ1. To what extent is there a difference in students' composite scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation?

***H*1.** There is a statistically significant difference in students' composite scores on the ACT one and two years before the iPad implementation, and during, one, and two years after iPad implementation.

A two-factor ANOVA was conducted to test H1 and H2. The two categorical variables used to group the dependent variable, the ACT composite score, were years of iPad implementation (two before, one before, one after, two after, and three after) and gender (male, female). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for gender, and a two-way interaction effect (years of iPad implementation x gender). The main effect for years of iPad implementation was used to test H1. The level of significance was set at .05.

RQ2. To what extent is the difference in students' composite scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation affected by student gender or ethnicity?

***H*2.** The difference in students' composite scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student gender.

The interaction effect (years of iPad implementation x gender) from the first ANOVA was used to test H2. The level of significance was set at .05.

***H*3.** The difference in students' composite scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student ethnicity.

A second two-factor ANOVA was conducted to test H3. The two categorical variables used to group the dependent variable, the ACT composite score, were years of iPad implementation (two before, one before, one after, two after, and three after) and ethnicity (non-minority, minority). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for ethnicity, and a two-way interaction effect (years of iPad implementation x ethnicity). The interaction effect (years of iPad implementation x ethnicity) was used to test H3. The level of significance was set at .05.

RQ3. To what extent is there a difference in students' mathematics subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation?

***H*4.** There is a statistically significant difference in students' mathematics subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation.

A third two-factor ANOVA was conducted to test H4 and H5. The two categorical variables used to group the dependent variable, the ACT mathematics subtest score, were years of iPad implementation (two before, one before, one after, two after, and three after) and gender (male, female). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for gender, and a two-way interaction effect (years of iPad implementation x gender). The main effect for years of iPad implementation was used to test H4. The level of significance was set at .05.

RQ4. To what extent is the difference in students' mathematics subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation affected by student gender or ethnicity?

***H*5.** The difference in students' mathematics subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student gender.

The interaction effect (years of iPad implementation x gender) from the third ANOVA was used to test H5. The level of significance was set at .05.

***H*6.** The difference in students' mathematics subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student ethnicity.

A fourth two-factor ANOVA was conducted to test H6. The two categorical variables used to group the dependent variable, the ACT mathematics subtest score, were years of iPad implementation (two before, one before, one after, two after, and three after) and ethnicity (non-minority, minority). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for ethnicity, and a two-way interaction effect (years of iPad implementation x ethnicity). The interaction effect (years of iPad implementation x ethnicity) was used to test H6. The level of significance was set at .05.

RQ5. To what extent is there a difference in students' reading subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation?

***H*7.** There is a difference in students' reading subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation.

A fifth two-factor ANOVA was conducted to test H7 and H8. The two categorical variables used to group the dependent variable, the ACT reading subtest score, were years of iPad implementation (two before, one before, one after, two after, and three after) and gender (male, female). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for gender, and a two-way interaction effect (years of iPad implementation x gender). The main effect for years of iPad implementation was used to test H7. The level of significance was set at .05.

RQ6. To what extent is the difference in students' reading subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation affected by student gender or ethnicity?

***H*8.** The difference in students' reading subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student gender.

The interaction effect (years of iPad implementation x gender) from the fifth ANOVA was used to test H8. The level of significance was set at .05.

***H*9.** The difference in students' reading subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student ethnicity.

A sixth two-factor ANOVA was conducted to test H9. The two categorical variables used to group the dependent variable, the ACT reading subtest score, were years of iPad implementation (two before, one before, one after, two after, and three after) and ethnicity (non-minority, minority). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for ethnicity, and a two-way interaction effect (years of iPad implementation x ethnicity). The interaction effect (years of iPad implementation x ethnicity) was used to test H9. The level of significance was set at .05.

RQ7. To what extent is there a difference in students' science subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation?

***H*10.** There is a statistically significant difference in students' science subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation.

A seventh two-factor ANOVA was conducted to test H10 and H11. The two categorical variables used to group the dependent variable, the ACT science subtest score, were years of iPad implementation (two before, one before, one after, two after, and three after) and gender (male, female). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for gender, and a two-way interaction effect (years of iPad implementation x gender). The main effect for years of iPad implementation was used to test H10. The level of significance was set at .05.

RQ8. To what extent is the difference in students' science subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation affected by student gender or ethnicity?

***H*11.** The difference in students' science subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student gender.

The interaction effect (years of iPad implementation x gender) from the seventh ANOVA was used to test H11. The level of significance was set at .05.

***H*12.** The difference in students' science subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student ethnicity.

An eighth two-factor ANOVA was conducted to test H12. The two categorical variables used to group the dependent variable, the ACT science subtest score, were years of iPad implementation (two before, one before, one after, two after, and three after) and ethnicity (non-minority, minority). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for ethnicity, and a two-way interaction effect (years of iPad implementation x ethnicity). The interaction effect (years of iPad implementation x ethnicity) was used to test H12. The level of significance was set at .05.

RQ9. To what extent is there a difference in students' English subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation?

***H*13.** There is a statistically significant difference in students' English subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation.

A ninth two-factor ANOVA was conducted to test H13 and H14. The two categorical variables used to group the dependent variable, the ACT English subtest score, were years of iPad implementation (two before, one before, one after, two after, and three after) and gender (male, female). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for gender, and a two-way interaction effect (years of iPad implementation x gender). The main effect for years of iPad implementation was used to test H13. The level of significance was set at .05.

RQ10. To what extent is the difference in students' English subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation affected by student gender or ethnicity?

H*14*. The difference in students' English subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student gender.

The interaction effect (years of iPad implementation x gender) from the ninth ANOVA was used to test H14. The level of significance was set at .05.

***H*15.** The difference in students' English subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student ethnicity.

A tenth two-factor ANOVA was conducted to test H15. The two categorical variables used to group the dependent variable, the ACT English subtest score, were years of iPad implementation (two before, one before, one after, two after, and three after) and ethnicity (non-minority, minority). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for ethnicity, and a two-way interaction effect (years of iPad implementation x ethnicity). The interaction effect (years of iPad implementation x ethnicity) was used to test H15. The level of significance was set at .05.

Limitations

Lunenburg and Irby (2008) defined limitations as "factors that may have an effect on the interpretation of the findings or on the generalizability of the results" (p. 133). The sample used was limited to the students who chose to take the ACT assessment. The population used was also limited by the unavailability of SES data. Not all students at RHS completed an ACT assessment, limiting student data for each graduating class. These limitations could impact the ability to generalize the study to the entire population of students.

Summary

This study was designed to determine the differences in students' achievement on the composite, mathematics, reading, science, and English portions of the ACT between students who used iPads and those who did not use iPads in the RSD. The research design, population and sample, sampling procedure, instrumentation, measurement, validity and reliability, data collection procedures, data analysis and hypothesis testing, and limitations of the study were included. Chapter four contains the descriptive statistics and hypothesis testing and other additional analyses that were required to address the research questions of this study.

Chapter Four

Results

The purpose of this study was to determine to what extent there was a difference in students' composite scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation. The second purpose of this study was to determine to what extent there was a difference in students' mathematics, reading, science, and English subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation. The final purpose of this study was to determine the extent to which the differences in students' composite scores and mathematics, reading, science, and English subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation were affected by student gender or ethnicity. The results of quantitative data analysis that addressed the 10 research questions and specific hypotheses posed for this study about the use of iPads at RSD in determining the effectiveness of iPad usage to improve ACT scores are presented in this chapter.

Hypothesis Testing

The results of the 10 ANOVAs are presented in the order of the numbered research questions. Each research question is followed by the associated hypothesis statement, the analysis used, and the results of the hypothesis testing.

RQ1. To what extent is there a difference in students' composite scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation?

H1. There is a statistically significant difference in students' composite scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation.

A two-factor ANOVA was conducted to test H1 and H2. The two categorical variables used to group the dependent variable, the ACT composite score, were years of iPad implementation (two before, one before, during, two after, and three after) and gender (male, female). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for gender, and a two-way interaction effect (years of iPad implementation x gender). The main effect for years of iPad implementation was used to test H1. The level of significance was set at .05. The results of the analysis indicated there was not a statistically significant difference between at least two of the means, $F = 0.840$, $df = 4, 285$, $p = 0.501$. See Table 8 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. On average, ACT composite scores were not statistically different two years before, one year before, during, one year after, or two years after iPad implementation.

Table 8

Descriptive Statistics for the Results of the Test for H1

Years	*M*	*SD*	*N*
Two Before	21.563	4.442	71
One Before	21.274	4.556	84
During	21.647	4.397	68
One After	21.881	3.846	42
Two After	20.200	4.937	30

Note: Years = years of implementation.

RQ2. To what extent is the difference in students' composite scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation affected by student gender or ethnicity?

H2. The difference in students' composite scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student gender.

The interaction effect (years of iPad implementation x gender) from the first ANOVA was used to test H2. The level of significance was set at .05. The results of the analysis indicated there was not a statistically significant difference between at least two of the means, $F = 1.072$, $df = 4, 285$, $p = 0.371$. See Table 9 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The difference in students' composite scores on the ACT two years before, one year before, during, one year after, and two years after iPad implementation was not affected by student gender.

Table 9

Descriptive Statistics for the Results of the Test for H2

Gender	Years	*M*	*SD*	*N*
Female	Two Years Before	21.405	4.567	37
	One Year Before	20.609	4.349	46
	During	20.636	4.064	44
	One Year After	21.087	3.410	23
	Two Years After	18.647	4.061	17
Male	Two Years Before	21.735	4.365	34
	One Year Before	22.079	4.727	38
	During	23.500	4.462	24
	One Year After	22.842	4.207	19
	Two Years After	22.231	5.388	13

Note: Years=Years of Implementation.

H3. The difference in students' composite scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student ethnicity.

A second two-factor ANOVA was conducted to test H3. The two categorical variables used to group the dependent variable, the ACT composite score, were years of iPad implementation (two before, one before, during, one after, and two after) and ethnicity (non-minority, minority). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for ethnicity, and a two-way interaction effect (years of iPad implementation x ethnicity). The interaction effect (years of iPad implementation x ethnicity) was used to test H3. The level of significance was set at .05. The results of the analysis indicated a marginally significant difference between at least two of the means, $F = 2.360$, $df = 4$, $p = 0.078$. See Table 10 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The difference in students' mean composite scores for minority students on the ACT two years before iPad implementation ($M = 18.222$) appears to be less than the mean composite score one year before iPad implementation ($M = 20.133$). The difference in students' mean composite scores for minority students on the ACT appears to be less than during iPad implementation ($M = 24.000$). The mean minority composite score during iPad implementation appears to be higher than the mean composite score one year after iPad implementation ($M = 21.250$), as well as appears to be higher than two years after iPad implementation ($M = 18.364$).

Table 10

Descriptive Statistics for the Results of the Test for H3

Ethnicity	Years	*M*	*SD*	*N*
Minority	Two Years Before	18.222	4.056	9
	One Year Before	20.133	4.502	15
	During	24.000	4.342	8
	One Year After	21.250	3.454	8
	Two Years After	18.364	4.273	11
Non-Minority	Two Years Before	22.048	4.313	62
	One Year Before	21.522	4.562	69
	During	21.333	4.344	60
	One Year After	22.029	3.966	34
	Two Years After	21.263	5.086	19

Note: Years = years of implementation.

RQ3. To what extent is there a difference in students' mathematics subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation?

H4. There is a statistically significant difference in students' mathematics subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation.

A third two-factor ANOVA was conducted to test H4 and H5. The two categorical variables used to group the dependent variable, the ACT mathematics subtest score, were years of iPad implementation (two before, one before, during, one after, and two after) and gender (male, female). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for gender, and a two-way interaction effect (years of iPad implementation x gender). The main effect for years of iPad implementation was used to test H4. The level of significance was set at .05. The results of the analysis indicated there was not a statistically significant difference between at least two of the means, $F = 0.331$, $df = 4, 285$, $p = 0.857$. See Table 11 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. On average, ACT mathematics subtest scores were not statistically different two years before, one year before, during, one year after, and two years after iPad implementation.

Table 11

Descriptive Statistics for the Results of the Test for H4

Years	*M*	*SD*	*N*
Two Before	21.028	3.989	71
One Before	21.131	4.477	84
During	20.529	4.423	68
One After	20.786	3.835	42
Two After	19.900	5.013	30

Note: Years = years of implementation.

RQ4. To what extent is the difference in students' mathematics subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation affected by student gender or ethnicity?

H5. The difference in students' mathematics subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student gender.

The interaction effect (years of iPad implementation x gender) from the third ANOVA was used to test H5. The level of significance was set at .05. The results of the analysis indicated there was not a statistically significant difference between at least two of the means, $F = 0.876$, $df = 4, 285$, $p = 0.479$. See Table 12 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The difference in students' mathematics subtest scores on the ACT two years before, one year before, during, one year after, and two years after iPad implementation was not affected by student gender.

Table 12

Descriptive Statistics for the Results of the Test for H5

Gender	Years	*M*	*SD*	*N*
Female	Two Years Before	20.405	3.715	37
	One Year Before	20.500	4.426	46
	During	19.773	4.108	44
	One Year After	19.609	3.381	23
	Two Years After	18.000	3.953	17
Male	Two Years Before	21.706	4.218	34
	One Year Before	21.895	4.477	38
	During	21.917	4.727	24
	One Year After	22.2105	3.952	19
	Two Years After	22.3846	5.300	13

Note: Years = years of implementation.

***H*6.** The difference in students' mathematics subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student ethnicity.

A fourth two-factor ANOVA was conducted to test H6. The two categorical variables used to group the dependent variable, the ACT mathematics subtest score, were years of iPad implementation (two before, one before, during, one after, and two after) and ethnicity (non-minority, minority,). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for ethnicity, and a two-way interaction effect (years of iPad implementation x ethnicity). The interaction effect (years of iPad implementation x ethnicity) was used to test H6. The level of significance was set at .05. The results of the analysis indicated there was not a statistically significant difference between at least two of the means, F = 1.389, df = 4, 285 p = 0.238. See Table 13 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The difference in students' mathematics subtest scores on the ACT two years before, one year before, during, one year after, and two years after iPad implementation was not affected by student ethnicity.

Table 13

Descriptive Statistics for the Results of the Test for H6

Ethnicity	Years	*M*	*SD*	*N*
Minority	Two Years Before	18.778	3.833	9
	One Year Before	20.467	4.224	15
	During	22.250	4.979	8
	One Year After	19.625	3.852	8
	Two Years After	18.182	4.956	11
Non-Minority	Two Years Before	21.355	3.934	62
	One Year Before	21.275	4.547	69
	During	20.300	4.339	60
	One Year After	21.059	3.837	34
	Two Years After	20.895	4.898	19

Note: Years = years of implementation.

RQ5. To what extent is there a difference in students' reading subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation?

H7. There is a difference in students' reading subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation.

A fifth two-factor ANOVA was conducted to test H7 and H8. The two categorical variables used to group the dependent variable, the ACT reading subtest score, were years of iPad implementation (two before, one before, during, one after, and two after) and gender (male, female). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for gender, and a two-way interaction effect (years of iPad implementation x gender). The main effect for years of iPad implementation was used to test H7. The level of significance was set at .05. The results of the analysis indicated there was not a statistically significant difference between at least two of the means, $F = 1.277$, $df = 4, 285$, $p = 0.279$. See Table 14 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. On average, ACT reading subtest scores were not statistically different two years before, one year before, during, one year after, and two years after iPad implementation.

Table 14

Descriptive Statistics for the Results of the Test for H7

Years	*M*	*SD*	*N*
Two Before	22.239	5.900	71
One Before	21.393	5.716	84
During	22.441	5.377	68
One After	23.214	4.667	42
Two After	21.100	5.874	30

Note: Years = years of implementation.

RQ6. To what extent is the difference in students' reading subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation affected by student gender or ethnicity?

H8. The difference in students' reading subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student gender.

The interaction effect (years of iPad implementation x gender) from the fifth ANOVA was used to test H8. The level of significance was set at .05. The results of the analysis indicated there was not a statistically significant difference between at least two of the means, $F = 1.340$, $df = 4, 285$, $p = 0.255$. See Table 15 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The difference in students' reading subtest scores on the ACT two years before, one year before, during, one year after, and two years after iPad implementation was not affected by student gender.

Table 15

Descriptive Statistics for the Results of the Test for H8

Gender	Years	*M*	*SD*	*N*
Female	Two Years Before	22.351	6.038	37
	One Year Before	20.630	5.551	46
	During	21.091	4.675	44
	One Year After	22.652	4.448	23
	Two Years After	19.588	5.523	17
Male	Two Years Before	22.118	5.835	34
	One Year Before	22.316	5.850	38
	During	24.917	5.785	24
	One Year After	23.895	4.954	19
	Two Years After	23.077	5.937	13

Note: Years = years of implementation.

H9. The difference in students' reading subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student ethnicity.

A sixth two-factor ANOVA was conducted to test H9. The two categorical variables used to group the dependent variable, the ACT reading subtest score, were years of iPad implementation (two before, one before, during, one after, and two after) and ethnicity (non-minority, minority). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for ethnicity, and a two-way interaction effect (years of iPad implementation x ethnicity). The interaction effect (years of iPad implementation x ethnicity) was used to test H9. The level of significance was set at .05. The results of the analysis indicated there was not a statistically significant difference between at least two of the means, F = 1.650, df = 4,285, p = 0.162. See Table 16 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The difference in students' reading subtest scores on the ACT two years before, one year before, during, one year after, and two years after iPad implementation was not affected by student ethnicity.

Table 16

Descriptive Statistics for the Results of the Test for H9

Ethnicity	Years	*M*	*SD*	*N*
Minority	Two Years Before	19.000	3.808	9
	One Year Before	20.133	5.111	15
	During	23.750	5.175	8
	One Year After	24.125	4.643	8
	Two Years After	18.364	5.025	11
Non-Minority	Two Years Before	22.710	6.023	62
	One Year Before	21.667	5.838	69
	During	22.267	5.421	60
	One Year After	23.000	4.716	34
	Two Years After	22.684	5.860	19

Note: Years = years of implementation.

RQ7. To what extent is there a difference in students' science subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation?

H10. There is a statistically significant difference in students' science subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation.

A seventh two-factor ANOVA was conducted to test H10 and H11. The two categorical variables used to group the dependent variable, the ACT science subtest score, were years of iPad implementation (two before, one before, during, one after, and two after) and gender (male, female). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for gender, and a two-way interaction effect (years of iPad implementation x gender). The main effect for years of iPad implementation was used to test H10. The level of significance was set at .05. The results of the analysis indicated there was not a statistically significant difference between at least two of the means, $F = 1.331$, $df = 4, 285$, $p = 0.258$. See Table 17 for the means and standard deviations for this analysis. A follow-up post hoc was not warranted. On average, ACT science subtest scores were not statistically different two years before, one year before, during, one year after, and two years after iPad implementation.

Table 17

Descriptive Statistics for the Results of the Test for H10

Years	*M*	*SD*	*N*
Two Before	21.324	4.671	71
One Before	21.179	4.505	84
During	22.059	4.182	68
One After	21.524	4.346	42
Two After	20.433	4.256	30

Note: Years = years of implementation.

RQ8. To what extent is the difference in students' science subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation affected by student gender or ethnicity?

H11. The difference in students' science subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student gender.

The interaction effect (years of iPad implementation x gender) from the seventh ANOVA was used to test H11. The level of significance was set at .05. The results of the analysis indicated there was not a statistically significant difference between at least two of the means, $F = 0.911$, $df = 4, 285$, $p = 0.458$. See Table 18 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The difference in students' science subtest scores on the ACT two years before, one year before, during, one year after, and two years after iPad implementation was not affected by student gender.

Table 18

Descriptive Statistics for the Results of the Test for H11

Gender	Years	*M*	*SD*	*N*
Female	Two Years Before	20.973	4.400	37
	One Year Before	20.370	4.187	46
	During	20.841	3.809	44
	One Year After	20.652	4.174	23
	Two Years After	19.177	3.746	17
Male	Two Years Before	21.706	4.988	34
	One Year Before	22.158	4.734	38
	During	24.292	3.973	24
	One Year After	22.579	4.426	19
	Two Years After	22.077	4.462	13

Note: Years = years of implementation.

H12. The difference in students' science subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student ethnicity.

An eighth two-factor ANOVA was conducted to test H12. The two categorical variables used to group the dependent variable, the ACT science subtest score, were years of iPad implementation (two before, one before, during, one after, and two after) and ethnicity (non-minority, minority,). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for ethnicity, and a two-way interaction effect (years of iPad implementation x ethnicity). The interaction effect (years of iPad implementation x ethnicity) was used to test H12. The level of significance was set at .05. The results of the analysis indicated a statistically significant difference between at least two of the means, F = 4.266, df = 4, 285, p = 0.002. See Table 19 for the means and standard deviations for this analysis. A follow-up post hoc was conducted to determine which pairs of means were different. The Tukey's Honestly Significant Difference (HSD) critical value was 4.297. The differences between the means had to be greater than this value to be considered significantly different (α = .05). Four of the differences were greater than this value. The minority students from two years before iPad implementation had a mean science score (M = 17.222) that was lower than the minority students during iPad implementation (M = 25.500). The minority students from one year before iPad implementation had a mean science score (M = 18.800) that was lower than the minority students during iPad implementation (M = 25.500). The minority students from one year after implementation had a mean science score (M = 20.500) that was lower than the minority students during iPad implementation (*M* = 25.500). The minority students from two years after iPad implementation had a mean science score (*M* = 19.909) that was lower than the minority students during iPad implementation (*M* = 25.500). The difference in students' science subtest scores on the ACT two years before, one year before, during, one year after, and two years after iPad implementation was affected by student ethnicity.

Table 19

Descriptive Statistics for the Results of the Test for H12

Ethnicity	Years	*M*	*SD*	*N*
Minority	Two Years Before	17.222	5.019	9
	One Year Before	18.800	5.361	15
	During	25.500	4.751	8
	One Year After	20.500	3.964	8
	Two Years After	18.909	3.270	11
Non-Minority	Two Years Before	21.919	4.347	62
	One Year Before	21.696	4.163	69
	During	21.600	3.920	60
	One Year After	21.765	4.452	34
	Two Years After	21.316	4.583	19

Note: Years = years of implementation.

RQ9. To what extent is there a difference in students' English subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation?

H13. There is a statistically significant difference in students' English subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation.

A ninth two-factor ANOVA was conducted to test H13 and H14. The two categorical variables used to group the dependent variable, the ACT English subtest score, were years of iPad implementation (two before, one before, during, one after, and two after) and gender (male, female). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for gender, and a two-way interaction effect (years of iPad implementation x gender). The main effect for years of iPad implementation was used to test H13. The level of significance was set at .05. The results of the analysis indicated there was not a statistically significant difference between at least two of the means, $F = 0.990$, $df = 4, 285$, $p = 0.413$. See Table 20 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. On average, ACT English subtest scores were not statistically different two years before, one year before, during, one year after, and two years after iPad implementation.

Table 20

Descriptive Statistics for the Results of the Test for H13

Years	*M*	*SD*	*N*
Two Before	21.056	5.879	71
One Before	20.893	5.504	84
During	21.015	5.752	68
One After	21.643	4.616	42
Two After	18.900	6.150	30

Note: Years = years of implementation.

RQ10. To what extent is the difference in students' English subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation affected by student gender or ethnicity?

H14. The difference in students' English subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student gender.

The interaction effect (years of iPad implementation x gender) from the ninth ANOVA was used to test H14. The level of significance was set at .05. The results of the analysis indicated there was not a statistically significant difference between at least two of the means, F = 0.838, df = 4, 285, p = 0.502. See Table 21 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The difference in students' English subtest scores on the ACT two years before, one year before, during, one year after, and two years after iPad implementation was not affected by student gender.

Table 21

Descriptive Statistics for the Results of the Test for H14

Gender	Years	*M*	*SD*	*N*
Female	Two Years Before	21.297	6.574	37
	One Year Before	20.674	5.433	46
	During	20.432	5.671	44
	One Year After	21.304	4.247	23
	Two Years After	17.294	4.806	17
Male	Two Years Before	20.794	5.104	34
	One Year Before	21.158	5.650	38
	During	22.083	5.868	24
	One Year After	22.053	5.115	19
	Two Years After	21.000	7.223	13

Note: Years = years of implementation.

H15. The difference in students' English subtest scores on the ACT one and two years before the iPad implementation and during, one, and two years after iPad implementation is affected by student ethnicity.

A tenth two-factor ANOVA was conducted to test H15. The two categorical variables used to group the dependent variable, the ACT English subtest score, were years of iPad implementation (two before, one before, during, one after, and two after) and ethnicity (non-minority, minority). The two-factor ANOVA can be used to test three hypotheses, including a main effect for years of iPad implementation, a main effect for ethnicity, and a two-way interaction effect (years of iPad implementation x ethnicity). The interaction effect (years of iPad implementation x ethnicity) was used to test H15. The level of significance was set at .05. The results of the analysis indicated there was not a statistically significant difference between at least two of the means, *F* = 1.858, *df* = 4, 285, *p* = 0.118. See Table 22 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The difference in students' English subtest scores on the ACT two years before, one year before, during, one year after, and two years after iPad implementation was not affected by student ethnicity.

Table 22

Descriptive Statistics for the Results of the Test for H15

Ethnicity	Years	*M*	*SD*	*N*
Minority	Two Years Before	17.000	5.431	9
	One Year Before	20.800	5.046	15
	During	23.625	5.012	8
	One Year After	20.500	3.423	8
	Two Years After	17.727	5.101	11
Non-Minority	Two Years Before	21.645	5.746	62
	One Year Before	20.913	5.633	69
	During	20.667	5.792	60
	One Year After	21.912	4.858	34
	Two Years After	19.579	6.719	19

Note: Years = years of implementation.

Summary

Chapter four contained the results of the data analysis and hypotheses testing related to 1:1 initiative at RHS. The interpretations of the findings and the recommendations for future research are presented in chapter five. This chapter includes a discussion of the study summary, which includes the overview of the problem, the purpose statement and research questions, the review of methodology, and the major findings. A discussion of the findings related to the literature follows the study summary. The chapter concludes with implications for action, recommendations for future research, and conclusions.

Chapter Five

Interpretation and Recommendations

The previous chapter presented the results of the data analysis for this study. This chapter contains a study summary, which includes the overview of the problem, the purpose statement and research questions, the methodology, and the major findings of this research. Next, findings related to the literature are discussed. Finally, the chapter concludes with the implications for action, the recommendations for future research, and concluding remarks.

Study Summary

The following section provides a summary of the current study, which includes an overview of the problem concerning the use of 1:1 iPad implementation in the classroom and its effects on student achievement. The purpose statement and the research questions follow. Finally, a review of methodology and the study's major findings are provided.

Overview of the problem. Today, many students have access to various technologies in their day-to-day lives. When students have access to technological devices in 1:1 settings, learning becomes relevant (Foote, 2012a). For this reason, many schools are implementing 1:1 programs in schools, thus presenting a need to determine the effectiveness of these 1:1 initiatives. Summative evaluation of a program, "can only go so far in suggesting areas of improvement since the information it provides is used to 'summarize' evidence concerning the impact of the program" (Jason, 2008, p. 5). A considerable amount of money has been allocated to employ the 1:1 iPad initiative at RHS for the purpose of leveling the technological playing field and empowering students with 21st century tools to promote student achievement and future success. Kunzler

(2011) suggests that assigning iPads to each student can lead to increased student motivation and achievement. RHS needed to evaluate the effectiveness of the iPad as a source of student achievement.

Purpose statement and research questions. Ten research questions were developed to address the purpose of this study. The first purpose of this study was to determine to what extent there was a difference in students' composite scores and mathematics, reading, science, and English subtest scores on the ACT before, during, and after iPad implementation. An additional purpose of this study was to determine the extent to which the differences in students' composite scores and mathematics, reading, science, and English subtest scores on the ACT before, during, and after iPad implementation were affected by student gender or ethnicity.

Review of the methodology. This quantitative study was designed to investigate and examine the effect the implementation of iPad usage has on student achievement on the ACT. Data obtained from the ACT were provided by the RSD and divided into two groups: one group of 140 students who used iPads and another group of 155 students who did not use iPads in a 1:1 initiative setting. The students who did not use iPads in a 1:1 initiative setting took the ACT prior to the implementation of the 1:1 initiative.

ACT scores from the years 2010-2014 were used to measure student achievement. Multiple two-factor ANOVAs were conducted to compare the means of the two groups of students and two subgroups (gender and ethnicity) for each subtest on a given variable to determine the difference in student achievement. The instructional method (iPad or no iPad), along with gender and ethnicity, served as the independent variables for this study while student ACT scores and subscores were the dependent variables.

Major findings. The results of the hypothesis tests related to the research questions indicated no statistically significant differences in the means for the ACT composite scores, mathematics, reading, and English subtest scores based on the years of iPad implementation. The results of the hypothesis test on science subtest scores indicated there were significant differences based on years of implementation. Although neither the Tukey HSD (very conservative) nor the Fisher LSD (very liberal) post hoc indicated any means to be different, the lowest mean science subtest score two years before iPad implementation and the highest mean science subtest score during the first year of iPad implementation at least were statistically different. There was a statistically significant difference in students' science subtest scores on the ACT based on the interaction between years of implementation and student ethnicity. The difference in non-minority students' scores two years before and minority students' scores two years before was significant. There was not a statistically significant difference in students' composite and subtest scores on the ACT two years before, one year before, during, one year after, and two years after iPad implementation as affected by student gender. There was a marginally significant difference in minority students' composite scores on the ACT two years before, one year before, during, one year after, and two years after iPad implementation. There was a statistically significant difference in minority students' science subtest scores on the ACT two years before, one year before, during, one year after, and two years after iPad implementation.

Findings Related to the Literature

This section examines the study's findings as they relate to the literature regarding 1:1 initiatives and student achievement. Specifically, this research focused on the relationship of iPad usage and student achievement as measured by ACT composite and mathematics, reading, science, and English subtest scores two years before, one year before, and during, one year after, and two years after iPad implementation. In addition, this research focused on the relationship of iPad usage and student achievement as affected by gender and ethnicity. Since little research exists in the literature concerning student achievement and student use of iPads, the findings from the current study had few comparative studies.

The findings from the current study are consistent with research findings between 2004 and 2014 (Carr, 2012; Ikiz, 2014; Kao, 2009; Lewis, 2004; McFall, 2009; Nicholas, 2006; Overall, 2007; Swanson, 2013; Whidden, 2008), whose results indicated full-time computer access did not improve student achievement. The results of the current study indicated that for high school students no direct correlation existed between the use of iPads in a 1:1 setting and academic achievement on the ACT, with the exception of minority students in science. A quasi-experimental longitudinal study on sixth grade students from a south Florida middle school was conducted by Lewis (2004). His results indicated that full-time computer access did not improve student achievement in reading comprehension, math application, and writing. Nicholas (2006) found no significant relationship between student achievement on Louisiana Educational Assessment Program tests and the implementation of a 1:1 laptop initiative. The eighth grade students did not see a difference in achievement when technology was introduced. Likewise, Overall (2007) found no correlation was determined to exist between laptop usage and achievement on the mathematics subtest of the Maine Educational Assessment for gender. Whidden (2008) found no differences in standardized test scores among specific demographic markers. Kao (2009) found that computer use had no relationship to achievement among third grade students. Similarly, McFall (2009) found 1:1 computing initiatives do not affect student achievement in math and reading on the Pennsylvania System of School Assessments for 11th grade students. Carr (2012) found no significant difference in fifth grade students' math achievement between those using technology and those not using technology. Swanson (2013) tested sixth grade students using the Read Naturally placement system to determine each student's reading level and found no notable gain for student fluency. Finally, Ikiz (2014) found no overall increase in the percentage of students meeting or exceeding standards established by the state after introducing technology. The fifth and eighth grade students did not exhibit a difference in achievement when technology was introduced.

On the other hand, the findings from the current study are not consistent with research findings between 2004 and 2014 (Aql, 2011; Bird, 2008; Bryan, 2011; Burgad, 2008; Comstock, 2013; Cottone, 2013; Handwerk, 2013; Kao, 2009; Mills, 2010; Queener, 2011; Reichenberg, 2014; Riconscente, 2013; Suhr, 2008; Whidden, 2008). In the current study, the results indicated that for high school students no direct correlation existed between the use of iPads in a 1:1 setting and academic achievement on the ACT, with the exception of minority students in science. Bird (2008) concluded that students in a 1:1 initiative outperformed non-laptop students on reading comprehension, reading vocabulary, and writing pretest-posttest test scores. Sixth grade students experienced a difference in achievement when technology was introduced. The findings of the current study are also not consistent with a small North Dakota school's 1:1 laptop initiative, which resulted in significant gains by students using laptops on the NWEA MAP mathematics achievement test (Burgad, 2008). The findings of the current study did not support Burgad's findings on the NWEA reading achievement test by students with laptops. Furthermore, Burgad indicated that junior students experienced a significant negative difference in reading and that senior students with laptops had significant negative differences in language arts as compared to the MAP scores of those juniors and seniors without laptops. Suhr (2008) concluded students in a 1:1 initiative outperformed non-laptop students on the ELA section of the California Standards Test. The fourth grade students' achievement changed when technology was introduced. Likewise, Whidden (2008) determined a positive relationship between a 1:1 laptop initiative and the Maine Educational Assessment composite test scores in three schools, and between a 1:1 laptop initiative and the Maine Educational Assessment math test scores in six schools.

Additionally, Kao (2009) found that computer use at least once per week among fifth grade ethnic groups resulted in lower scores for White but not Hispanic students. Students living below the poverty threshold and Black third graders using computers once or twice per month, along with weekly writing about mathematics, were associated with higher scores. Furthermore, Kao (2009) found that computer usage at least once per week was associated with higher third grade scores and Black fifth grade students who did not do homework problems but used technology at least once per week had significantly improved scores.

Mills (2010) found 1:1 computing initiatives positively affect student engagement, learning, and achievement as determined by grade point averages. In another study, Aql (2011) demonstrated that students receiving instruction utilizing the "I CAN Learn" computer software had a higher mean MAP mathematics score for students with special educational needs compared to the students who did not use the program. Interestingly, Bryan's (2011) research concluded that reading fluency and comprehension test scores were statistically significant from pre- to post-test after introducing iPads. Queener (2011) concluded that technology initiatives do positively affect student achievement in mathematics using the MAP mathematics test. Comstock (2013) found that even though entrance MCAT exams and GPAs were comparable to previous classes, when iPads were used as an instructional tool in a 1:1 setting, learning improved substantially as exhibited on the licensing exam. The medical students experienced a difference in achievement when technology was introduced. Cottone (2013) found a statistically significant difference between the pre-1:1 laptop total group and the post 1:1 laptop total group in mathematics for black and economically disadvantaged subgroups. Additionally, no measurable difference in reading scores occurred during the study. Handwerk (2013) determined that improved learning on standard astronomy tests was demonstrated when students used both modes of planetary representations using the iPad. The high school students experienced a difference in achievement when technology was introduced. Reichenberg (2014) found that although both groups exhibited an increase in their post-CBM scores, the second grade students in the iPad group who used multimodal features on the iPad had a higher rate of reading comprehension than standard iPad users. The second grade students experienced a difference in achievement when technology was introduced. Finally, Riconscente (2013) indicated a 15% increase in fractions knowledge, on average, and a 10% increase in self-efficacy while doing fractions as a result of a 1:1 iPad program. The fifth grade students experienced a difference in achievement when technology was introduced.

Conclusions

This section provides conclusions drawn from the present study on the relationship between the 1:1 iPad usage or non-usage and composite, mathematics, reading, science, and English scores on the ACT assessment. The findings from the current study have implications for RHS stakeholders. The following section details conclusions made from the present study, including implications for action, recommendations for future research, and concluding remarks.

Implications for action. The findings of this study have implications for schools. While the majority of the findings of this study indicate that the use of iPads did not make a difference on student performance on the ACT, this study found a statistically significant relationship between the implementation of the 1:1 iPad initiative and the ACT science subtest scores as affected by student ethnicity. The results of the present study indicate that minority students could potentially use iPads to improve their ACT science subtest scores. Since not all students in the study took the ACT, the district may want to require all students take the ACT as an academic measure and pay for the exam at least once. Based on the findings of the present study, it is incumbent upon school districts to survey teachers to determine their technology needs and future technology integration training to promote student achievement. Additionally, it may be important to survey students to determine their perceptions of the effect of iPad usage on their achievement. It is incumbent upon school districts to evaluate teachers on their use of technology as a means of increasing student achievement. The following section provides a discussion of recommendations for future research that might extend the findings of the present study.

Recommendations for future research. The purpose of this study was to determine the relationship between iPad usage and student academic achievement. While there is a plethora of research available on technology in education, there are few studies investigating the relationship between iPad usage and student achievement. There are even fewer studies investigating the effect of gender and ethnicity on the relationship between iPad usage and student achievement. While this study was useful in expanding the body of research related to iPad usage and achievement, there are several recommendations for future research.

- The ACT assessment is administered only to students desiring to attend college. This situation does not allow a complete assessment of all students while introducing the iPad. A future study could examine the relationship between iPad usage and student achievement with 100% of the student body completing the ACT assessment.
- A study could be conducted using the same variables as this study, except extending the length of time of the study for two more years.
- There are other assessments, such as the Kansas Assessments, designed to assess every student's college and career readiness. The newly revised Kansas Assessments in mathematics, reading, and science were introduced and normed during the 2013-2014 school year. Once new state assessment data become available to school districts, this study could be replicated utilizing the state assessments as the measure of student achievement. Additionally, other assessments, such as NWEA's MAP tests, could be

utilized to compare student achievement as iPads are introduced in school districts.

- This study could have attempted to determine the impact the iPad had on low SES student achievement. This data were not available to the researcher. Several studies found that the socioeconomic status of students does affect student achievement in 1:1 initiatives. This study could be replicated using student SES data.
- In addition, this study only included data from one district's high school. The results of the study might be different if multiple districts were included in the population.

Concluding remarks. The purpose of this study was to determine how introducing iPads affected learning as measured by the ACT assessment. The results of this study revealed that for all non-minority students, iPad use had no statistically significant impact on achievement on the ACT composite score, mathematics, reading, science, and English subtest scores. There were also no statistically significant differences for the ACT mathematics, reading, and English subtest scores for minority students. When technology, curriculum, and other potentially helpful professional development are presented to faculty, there needs to be a time of experimentation, training, and incorporation of strategies into the curriculum. Professional learning communities must evaluate ways to incorporate technology in meaningful ways to maximize the effectiveness of technology incorporation to facilitate greater gains in student achievement.

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Appendices

Appendix A: Permission for Study

Gmail by Google

Paul Ogle <pogle@riverbendis.org>

Dissertation Research

Paul Ogle <pogle@riverbendis.org> Mon, Dec 22, 2014 at 7:09 PM
To: [redacted]>

Dr. [redacted]s,

I do not want to assume you will allow my research to be done fro[redacted]AHS data. I need to know if I will be able to conduct the study fro[redacted] AHS data and possibly a survey I or someone else gives. I have to make sure it is a tool used and validated already in another study. I can also make sure you review the surveys and questions used, if they are used (the IRB makes sure you give permission before anything can be used in the study). I have asked Dr. Rogers if the data from the ACT is going to be enough for my study. I hope so. She is checking into that for me. Will I have preliminary permission to conduct the survey. I know you have given it to me before, but Dr. Rogers needs me to know right now so we can either switch to another study if needed or continue. Please let me know as soon as you can.

Thanks,

Paul
[Quoted text hidden]

Appendix B: IRB Application

BAKER UNIVERSITY
SCHOOL OF EDUCATION
GRADUATE DEPARTMENT

Date:___________________
IRB PROTOCOL NUMBER _______________
(IRB USE ONLY)

IRB REQUEST
Proposal for Research
Submitted to the Baker University Institutional Review Board

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

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

Name	Signature	
1. Dr. Susan Rogers	Susan K Rogers	Major Advisor
2. Margaret Waterman	Margaret Waterman,	Research Analyst
3. Russ Kokoruda		University Committee Member
4. Dr. Susan Myers		External Committee Member

Principal Investigator: Paul Ogle ________________________
Phone: 913-426-3411
Email: PaulLOgle@stu.bakeru.edu
Mailing address: 911 Santa Fe
Atchison, KS 66002

Faculty sponsor: Dr. Susan Rogers
Phone: (913) 344-1226 (office) or (785) 230-2801(mobile)
Email: srogers@bakeru.edu

Expected Category of Review: _X__Exempt ___ Expedited _ __Full

II: Protocol: (Type the title of your study)

The iPad as a Learning Tool: An Examination of Student Achievement on the ACT in Mathematics, Reading, Science, and English

Summary

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

The purpose of this study is to determine if there is a difference in student achievement as measured by the ACT scores (composite score and mathematics, reading, science, and English subscores) prior to and after the implementation of the 1:1 iPad initiative. A second purpose is to determine the affect of students' gender, ethnicity, and SES on the differences in ACT scores prior to and after the implementation of the 1:1 iPad initiative. [redacted] Public School is located in northeastern Kansas and has approximately 1,700 students. Currently, [redacted] High School ([redacted]HS) has adopted a 1:1 iPad initiative and are in the third year of implementation. The results from this study will help [redacted]HS administration and staff determine if the existing initiative meets the needs of students and the school district in terms of preparing students for the ACT exam. Permission to conduct the study was granted from the superintendent of USD [redacted] by email (see attached).

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

There is no condition or manipulation in this study. The research sample will consist of [redacted] High School Students who took the ACT in the years 2010, 2011, 2012, 2013, and 2014. The researcher will compile ACT composite scores, and mathematics, reading, science, and English subscores, along with gender, ethnicity, and SES for each student. After completing the data compilation, the identifiable student information will be removed from the spreadsheet.

What measures or observations will be taken in the study? If any questionnaire or other instruments are used, provide a brief description and attach a copy.
Will the subjects encounter the risk of psychological, social, physical or legal risk? If so, please describe the nature of the risk and any measures designed to mitigate that risk.

Archival data will be collected for this study. There will be no questionnaires or other instruments. There is no psychological, social, physical or legal risk involved in this study.

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

Subjects will not be exposed to stress as the research involves archival data only.

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

No participants will be deceived or misled in this study.

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

There is no request for information that subjects might consider to be personal or sensitive. No information will be requested. The research will be utilizing archival data involving ACT composite score, and mathematics, reading, science, and English subscores, along with gender, ethnicity, and SES as reported by [redacted]HS.

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

The subjects will not be presented with materials that might be considered to be offensive, threatening, or degrading in this study.

Approximately how much time will be demanded of each subject?

No extra time will be required because subjects will not actively participate in this study. All data will come from archival records.

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

Subjects in the study will not be contacted. The data used in the study is archival and has already been reported to the [redacted] Public School District.

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

Subjects will not participate in the study. The data used in the study is archival and has already been reported to the [redacted] Public School District.

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

The subjects will not need to consent for the study. The researcher will be using archival data that has been reported to the [redacted] Public School District.

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

There is not going to be any permanent record that can be identified with the subject. The researcher will temporarily use student names, if they are supplied by the school district, to compile data that currently exists within the [redacted] Public School system. After compilation of the data, the students' names will be removed from all Excel spreadsheets created as a part of this study and a random number will be assigned in place of each student's name.

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

There will not be a permanent record of any subject to identify because archival data will be used and no subject will be identified for purposes of this research. Data regarding specific subjects will not be made a part of my permanent record.

What steps will be taken to insure the confidentiality of the data? Where will it be stored? How long will it be stored? What will be done with it after the study is completed?

To insure the confidentiality of the data, either the researcher will compile the data from various historical sources within the [redacted] Public School System, or an employee of [redacted] Public School system will collect the data for the researcher. After the data has been compiled, the researcher will delete all identifiable information from the compiled data. The data will be stored no more than 3 months on a secure password protected computer for electronic data and in a binder locked in a filing cabinet in the researcher's home library to ensure that all data are entered correctly, then any paper copies of the data will be shredded and electronic data will be deleted.

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

There are no risks involved in this study.

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

This study is based solely on data from archival files provided by [redacted] Public Schools. These files include ACT composite scores, mathematics, reading, science, and English subtest scores and gender, ethnicity, and SES as stored in Student Information Systems.

Appendix C: IRB Approval

Baker University Institutional Review Board

2/20/2015

Dear Paul Ogle and Dr. Rogers,

The Baker University IRB has reviewed your research project application and approved this project under Exempt Status Review. As described, the project complies with all the requirements and policies established by the University for protection of human subjects in research. Unless renewed, approval lapses one year after approval date.

Please be aware of the following:

1. Any significant change in the research protocol as described should be reviewed by this Committee prior to altering the project.
2. Notify the IRB about any new investigators not named in original application.
3. When signed consent documents are required, the primary investigator must retain the signed consent documents of the research activity.
4. If this is a funded project, keep a copy of this approval letter with your proposal/grant file.
5. If the results of the research are used to prepare papers for publication or oral presentation at professional conferences, manuscripts or abstracts are requested for IRB as part of the project record.

Please inform this Committee or myself when this project is terminated or completed. As noted above, you must also provide IRB with an annual status report and receive approval for maintaining your status. If you have any questions, please contact me at CTodden@BakerU.edu or 785.594.8440.

Sincerely,

Chris Todden EdD
Chair, Baker University IRB

Baker University IRB Committee
Verneda Edwards EdD
Sara Crump PhD
Erin Morris PhD
Scott Crenshaw