The Impact of One-to-One iPad Technology on Student Achievement as Measured by MAP Mathematics Assessments

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Abstract

The purpose of this study was to determine whether there were differences in third through sixth grade student achievement, as measured by the change in MAP mathematics RIT assessment scores, between students who participated in a one-to-one iPad initiative and students who participated in a one-to-many initiative and whether those differences were affected by student gender, race, or socioeconomic status. An additional purpose of this study was to determine whether there were differences in fourth through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in a one-to-one iPad initiative for one school year and students who participated in the initiative for two years and whether those differences were affected by student gender, race, or socioeconomic status. A quantitative quasi-experimental design was used for this study using archived data. The independent variables included student participation in the one-to-one initiative, student participation in the one-to-one initiative for one or two years, student gender, student SES, and student race. The dependent variable was student gain on the MAP mathematics assessment from fall to spring. The population for this study included all third through sixth grade students in thirty-three elementary schools in District S.

The results of the analysis indicated that there was no significant difference in mathematics gain between students who participated in the one-to-one initiative and students who participated in the one-to-many initiative. The data analysis showed no interaction effects for student gender, race, or student SES, but there were four main effects. Fifth grade White students had a significantly higher mean gain than did Black and Hispanic students. Fifth grade students on full pay lunch status had a significantly higher mean gain than did free/reduced lunch status students. In sixth grade, females had a significantly higher mean gain than did males. Sixth grade students on full pay lunch status had a significantly higher mean gain than free/reduced lunch status students.

When comparing students who participated in the initiative for one year versus two years, the results of the analysis indicated that there were significant differences in the mean gain for fourth and sixth grade students. The results of the data analysis also showed that student race and student SES affected the mathematics gain of sixth grade students. The results of the study prompt districts to implement technology initiatives conscientiously to provide the full benefits of technology to all students.

Dedication

This work is dedicated to the following people:

To God, who has shown me even more of His encompassing love, compassion, and grace.

To my husband, Joe, who has motivated me, supported me, and helped me believe in myself when I did not think I was good enough. I love you more than you know.

To my sweet baby, Fitzgerald Fox, who has been my joy during my last year of writing. I pray that this work will inspire you to work hard to achieve your own dreams someday.

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Chapter One

Introduction

As technology permeates our modern society, it is changing the way that people live, work, and learn. Elementary school teachers are confronted with the issues regarding the implementation of technology in classrooms (Harold, 2016). Many argue that daily access to technological tools should be provided to prepare students for their future jobs in the 21st Century. White and Martin (2012) believe that technology integration in schools can increase student learning especially in science, technology, engineering, and mathematics (STEM) skills. Others believe technology use can adversely affect student creativity, critical thinking skills, and processing abilities (Wolpert, 2009). As educators grapple with when and how to use technology in the classroom, more ways to enhance education with technology are being developed.

At the turn of the 21st Century, educators implemented programs that provided students with a personal technological device throughout the school day (Goodwin, 2011). These one-to-one initiatives helped bridge the gap between students who had access to the Internet at home and those students who did not have access to the Internet at home (Bird, 2008). Using these devices, students have access to people and events outside of their classroom and school, broadening their educational experiences. Teachers also used technological tools to enhance student performance in a variety of content areas. White and Martin (2012) argued that digital experiences in school can "provide uniquely powerful resources around which to organize innovative and engaging instructional approaches" (p. 23). Because students used these tools so often in their personal lives, using them in school can provide them with relatable and meaningful learning opportunities (White & Martin, 2012). Larkin (2014) believes that, if used appropriately, technological applications can improve student performance, specifically in mathematics.

Background

District S is a suburban school district located in Northeast Kansas. District S serves approximately 27,000 students in Kindergarten through twelfth grades at 33 elementary schools, five middle schools, and five high schools. Kindergarten through sixth grade students attend elementary schools, seventh and eighth grade students attend middle schools, and ninth through twelfth grade students attend the high schools (KSDE, 2016a).

In the past five years, the district has shown a slow increase in non-white student population (see Table 1). Though the change in each ethnicity category is relatively small from year to year, the steady increase of minority students created a shift in overall district demographics. As the Black and Hispanic populations rise, the White student population declines. The Other category shows relatively small changes.

Table 1

District S Race Percentages

	Black	Hispanic	White	Other[a]
2010-2011	8.0	15.2	67.8	9.0
2011-2012	8.6	16.0	66.6	8.8
2012-2013	8.6	16.8	66.0	8.5
2013-2014	8.8	17.2	65.5	8.5
2014-2015	9.0	17.8	64.7	8.5
2015-2016	9.2	18.2	64.2	8.4

Note: [a] = Other races include American Indian, Asian, Multi-racial, and Pacific Islander/Hawaiian. *K*ansas State Assessment Data, November 2016, Retrieved from http://ksreportcard.ksde.org/demographics.aspx?org_no=D0[redacted]&rptType=2

The district has also experienced an increase in the population of students who are from a low socioeconomic status (SES), as seen by increased enrollment in the lunch assistance program (see Table 2). The district currently has fourteen schools that qualify for Title I federal funding. This status occurs when a school has at least 40% of its students identified as economically disadvantaged, which means the student qualified for free/reduced lunch (KSDE, 2016b). Table 2 includes the percent of students who are in the full pay and free/reduced categories.

Table 2

District S SES Percentages

School year	Free/reduced	Full pay
2010-2011	35.50	64.50
2011-2012	35.51	64.49
2012-2013	36.87	63.13
2013-2014	37.81	62.19
2014-2015	37.40	62.60
2015-2016	37.41	62.59

Note: Kansas State Assessment Data, November 2016, retrieved from http://ksreportcard.ksde.org/demographics.aspx?org_no=D0[redacted]&rptType=2

These changes provide different challenges for district teachers and leaders. However, even with these population shifts in the districts, it continues to boast academic excellence, as compared with state and national peers. District S had a graduation rate of 88.6% in 2015 (KSDE, 2016a) as compared with the state graduation rate of 85.7%. According to the district website, the district also has higher college entrance exam scores than its state and national counterparts (District S, 2016).

In 2013, the district hired a new superintendent. This change in administration brought many shifts within the district, and an increased focus on technology. District leaders felt that access to the technology needed to be improved to provide students with meaningful learning opportunities and experience with tools that would prepare them for future jobs. According to District S (2014), the district's goal for the digital initiative was to "transform teaching and learning in the classroom" (para. 2). The district also cites individualizing instruction for each student, increasing project-based learning opportunities, and providing students with multiple ways to learn and gain new information as goals for the initiative (District S, 2014). On January 27, 2014, the Board of Education from District S approved the Technology Initiative by a vote of 7-0 (District S, 2014). Capital outlay funds were used to support the initiative (Haake, 2014).

The Technology Initiative provided both iPads and mobile laptop devices to each teacher in the district in the spring of 2013. Apple TVs were installed in every classroom. Teachers received immediate training on usage of the devices during instruction. At the beginning of the 2014 school year, all high school students received a MacBook Air laptop, and all middle school students received an iPad (Haake, 2014).

The district took a different approach with elementary students. District S had ten elementary schools implement one-to-one technology with Apple iPads during the 2014-2015 school year (see Table 3). These students had access to a personal iPad during the entire school day. Twenty-three elementary schools had limited use of iPads, which the district referred to as one-to-many (see Table 4). These students had shared access to iPads during the school day. This study intended to find a difference between the Math MAP scores of students attending the one-to-one schools with the students attending one-to-many.

Table 3 includes the enrollment and percent of free and reduced lunch students attending the 10 schools that started the one-to-one initiative. These elementary schools have diverse populations, with the enrollment and percent of low SES students differing greatly. The number of students enrolled ranged from 285 to 511 students, and the percent of students on free/reduced lunch ranged from 7.82% to 87.93%.

Table 3

One-to-one Elementary Schools in District S 2014-2015

School	Enrollment	% Free/Reduced Lunch
School 1	442	54.00
School 2	371	7.82
School 3	513	85.58
School 4	332	63.25
School 5	290	87.93
School 6	449	54.34
School 7	511	30.33
School 8	290	51.38
School 9	372	17.20
School 10	285	8.77

Note: 1:1 Elementary Schools, February 2014, retrieved from http://www.[redacted].org/news.aspx?id=1817

Table 4 includes the enrollment and percent of free and reduced lunch students attending the 23 schools that did not have a one-to-one iPad implementation. The students at these schools had access to iPads in a one-to-many format, where iPads were available at the school, but students did not have individual, full-time access to them. Students used the iPads when teachers reserved them for specific times for individual classrooms, and they often worked on one iPad with another student or with a group of students.

Table 4

1:Many Elementary Schools in District S 2014-2015

School	Enrollment	% Free/Reduced Lunch
School 11	587	70.00
School 12	493	11.97
School 13	494	57.29
School 14	571	22.42
School 15	527	46.49
School 16	427	15.22
School 17	543	5.52
School 18	379	53.03
School 19	371	38.54
School 20	494	60.32
School 21	363	10.74
School 22	577	72.10
School 23	520	24.23
School 24	391	56.01
School 25	420	8.57
School 26	648	33.95
School 27	602	57.48
School 28	387	51.68
School 29	585	63.42
School 30	332	50.60
School 31	400	83.00
School 32	591	33.33
School 33	279	34.05

Note: Kansas State Department of Education K-12 Reports Retrieved from

http://uapps.ksde.org/k12/organization.aspx?org_no=D0[redacted]#schools

In fall 2015, to implement the technology initiative fully, the school district bought more iPads to make all the elementary one-to-one schools. The students at the ten elementary schools that began the initiative in 2014 received their iPads for the second year, and students at the remaining schools transitioned from one-to-many schools to one-to-one schools. This study sought to determine the impact of the one-to-one initiative after on year of implementation. Additionally, this study sought to determine whether there was a difference in student achievement at the one-to-one schools compared to the one-to-many schools.

Statement of the Problem

New technology is permeating our society in a variety of ways, and school districts are investing a great amount of time, money, and effort to provide technological access in schools. District S has invested approximately $20 million in new technology for the 2014 initiative (Haake, 2014). As District S and other districts continue to provide funds for new technology and the upkeep of technology initiatives, they need to know the academic impact that the new technology has on student learning. Exploring the relationship between iPads in school and math success could provide justification for spending time and money on these tools in elementary schools.

Purpose of the Study

The first year of the one-to-one iPad initiative that District S implemented at 10 schools provided the opportunity to compare test data and identify any differences in math achievement between students who attended one-to-one schools and students who attended one-to-many schools. The purpose of this study was to determine whether there were differences in third through sixth grade student achievement, as measured by the change in Measures of Academic Progress (MAP) mathematics assessment scores, between students who participated in the one-to-one iPad initiative and students who did not participate in the initiative during the 2014-2015 school year but participated in the one-to-many initiative. The second purpose of this study was to determine whether the difference in third through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative and students who did not participate in the initiative but participated in the one-to-many initiative during the 2014 – 2015 school year was affected by one if the following variables: student gender, race, or SES. The third purpose of this study was to determine whether there were differences in fourth through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative their second year and students who participated in the one-to-one initiative their first year during the 2015-2016 school year. The fourth purpose of this study was to determine whether the difference in fourth through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative for their second year and students who participated in the one-to-one initiative for their first year during the 2015-2016 school year was affected by one if the following variables: student gender, race, or SES.

Significance of the Study

Researchers have had a difficult time showing the academic benefits of technology with the rapid implementation of technology in schools. Many researchers recommend further studies on the impact that one-to-one initiatives have on student achievement (Bebell, 2005; Dunleavy & Heinecke, 2007; Penuel, 2006; Russell, Bebell, & Higgins, 2004). While there is limited research on the effects of technology on student achievement, most studies focused on high school and middle school students leaving a lack of research that focused on the impact of technology in elementary schools (Bebell & Kay, 2010; Burgad, 2008; Cottone, 2013; Lowther, Strahl, Inan, & Bates, 2007; Ramsdell, 2014; Silvernail & Gritter, 2007; Sprenger, 2010). Specifically, Carr (2012) noted that there is little research on the use of iPads in elementary schools and the effects on math performance. This study is important to the field of education because it contributes valuable insight into the effect that iPads have on student achievement in elementary schools. School districts could use the results of the study to determine if the implementation of a one-to-one iPad initiative could improve math skills in elementary students.

Delimitations

Per Lunenburg and Irby (2008), delimitations are “self-imposed boundaries set by the researcher on the purpose and scope of the study” (p.134). The study was limited to third, fourth, fifth, and sixth grade students enrolled in District S during the 2014-2015 school year, and fourth, fifth, and sixth grade students enrolled in District S during the 2015-2016 school year. Student achievement was measured using the difference in MAP mathematics assessment gains from fall to spring. The scores for students who participated in both the fall and spring test administration each year were used.

Assumptions

Lunenburg and Irby (2008) define assumptions as, “postulates, premises, and propositions that are accepted as operational for purposes of the research” (p. 135). This study includes the following assumptions:

1. The MAP is a valid measure of mathematics achievement.
2. Students gave their best efforts during each MAP Math assessment session.
3. Teachers in the ten one-to-one schools received the same amount of training and support.
4. Teachers in the ten one-to-one schools implemented iPads during math instruction in the same way.
5. Teachers in the one-to-many schools received the same amount of training and support.
6. Teachers in the one-to-many schools implemented iPads during math instruction in the same way.

Research Questions

Lunenburg and Irby (2008) recognize research questions as “a directional beam for the study” (p. 126). The first eight research questions for this study compare the difference in math achievement between students in one-to-one schools and students in one-to-many schools and whether student gender, student race, or student SES affected these differences. Research questions nine through fourteen compare the difference in math achievement between students participating in a one-to-one school for the first year and students participating in a one-to-one school for the second year and whether student gender, student race, or student SES affected these differences. The students who did not participate in the one-to-one initiative during the 2014-2015 school year were considered as the group who were in the one-to-many schools. The following research questions were used to guide this study:

RQ1. To what extent is there a difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative?

RQ2. To what extent is the difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative affected by one if the following variables: student gender, student race, or student SES?

RQ3. To what extent is there a difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative?

RQ4. To what extent is the difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative affected by one if the following variables: student gender, student race, or student SES?

RQ5. To what extent is there a difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative?

RQ6. To what extent is the difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative affected by one if the following variables: student gender, student race, or student SES?

RQ7. To what extent is there a difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative?

RQ8. To what extent is the difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative affected by one if the following variables: student gender, student race, or student SES?

RQ9. To what extent is there a difference in fourth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year?

RQ10. To what extent is the difference in fourth grade student achievement, as measured by the change in MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year affected by one if the following variables: student gender, race, or SES?

RQ11. To what extent is there a difference in fifth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year?

RQ12. To what extent is the difference in fifth grade student achievement, as measured by the change in MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year affected by one if the following variables: student gender, race, or SES?

RQ13. To what extent is there a difference in sixth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year?

RQ14. To what extent is the difference in sixth grade student achievement, as measured by the change in MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year affected by one if the following variables: student gender, race, or SES?

Definition of Terms

Lunenburg and Irby (2008) stated that key terms in a study should be defined to provide a common understanding of ideas central to a study. The following terms are defined for this study:

One-to-one initiative. A one-to-one initiative is a term that is applied to programs that all the students in a classroom, grade, school or district are provided laptop computers for use throughout the school day, and often at home, in different school districts across the United States (Zheng & Warschauer, 2016).

One-to-many. There was a classroom set of devices at each grade level. The ratio of devices to students depended on the number of grade level classroom sections in the building, so the ratio of devices was 1:2, 1:3, or 1:4. Students did not take devices home in one-to-many schools (Assessment and Research Director, personal communication, December 17, 2016). For this study, the students who did not participate in the one-to-one initiative were considered as participating in the one-to-many initiative.

Measure of Academic Progress (MAP). The MAP assessment is a computer-adaptive test that measures student progress and growth over time. The assessment can be given in reading, language usage, and mathematics (Northwest Evaluation Association [NWEA] 2016b). For this study, only the mathematics assessment gains were used for one year from fall to spring.

Rasch Unit (RIT) score. The RIT score indicates the level of question difficulty a given student is capable of answering correctly about 50% of the time. The RIT score is a stable equal-interval vertical scale established by the NWEA to help educators understand every student's current achievement level (NWEA, 2016c).

Organization of the Study

This study is presented in five chapters. Chapter one included the background of the district used for the study and the purpose and significance of the study. Delimitations of the study, assumptions, research questions, and definition of terms were also provided. Chapter two provides a summary of the history of educational technology, current research about the technology impact on student achievement, and research about one-to-one technology initiatives. In chapter three, the research design, selection of participants, and the measurement are described. Chapter three also includes the data collection procedures, data analysis and hypothesis testing, and the limitations of the study. Chapter four contains results of the data analysis. Finally, chapter five includes a study summary, findings related to the literature, and the conclusions.

Chapter Two

Review of the Literature

As digital capabilities increase, education is being transformed by changing the tools that students use to learn. Regarding literacy, reading and writing are still the foundation, but the term has expanded to include digital literacy. Boss (2011) believes that students must have digital literacy to be successful in our increasingly digital world. She stated, "Becoming literate in the 21st century puts new demands on learners to be able to use technology to access, analyze, and organize information" (Boss, 2011, para. 1). In the areas of math and science, Desilver (2015) stated that American educators struggle to raise student achievement in STEM to match international peers and may need to turn to technology to make the difference. According to Desilver (2015), research conducted by The Pew Research Center concluded US students are gaining in mathematics and science standardized scores, but "they still rank around the middle of the pack in international comparisons" (para. 3). Many US schools are implementing new technology initiatives to provide personalized, challenging, and engaging learning opportunities for students (Smith, 2015). This chapter includes a review of the history of educational technology in schools, technology's impact on student achievement, and one-to-one technology initiatives.

The History of Educational Technology

Educational technology has grown increasingly important to achieve the goals of education. According to Molnar (1997), the two main goals for education are to transmit a culture's history and values and prepare children for their future. The basic modes of communication (oral, reading, and writing) make technology essential in connection with learning (Bates, 2014). Technology use in schools can provide students with tools to help them learn new information and skills. Educational technology can also help prepare students for their future, as they learn how to utilize the tools that are prevalent in the modern world.

In 18th century America, Puritans began pushing for education for children outside of the home. Their original classroom technology consisted of Horn-books, which had lessons carved onto pieces of wood and were covered with thin slices of a cow's horn (Purdue University, 2016). Students wrote using birch bark, quills, and ink. As technology progressed and new inventions were created, schools in the 1800s began using the first slide projector called "The Magic Lantern" (Purdue University, 2016), which used plates made of glass to show images to students.

Technology continued to advance, making tools such as the chalkboard, pencil, and ballpoint pen ubiquitous in American schools in the 1800s (Purdue University, 2016). Students used individual slateboards until the first teacher hung up a large blackboard in a classroom in 1901 (Concordia University, 2016). These early forms of technology were used as a more efficient way to teach students the basics of reading, writing, and arithmetic.

Eventually, events outside of schools influenced the increase of more types of educational technology. American schools have long felt pressure to keep up with the competing nations regarding technology, innovation, and gaining information. When the Soviet Union launched the first satellite into space in 1957, Americans no longer felt like the world's leader in science and technology (Watters, 2015a). Immediate educational reform was called for with The National Defense Education Act of 1958, which spurred the urgency for technology improvement in American schools (Watters, 2015a). Providing students with access to technology seemed imperative to keep America at the forefront of global science and technological advances.

In 1960, Papert worked with renowned child psychologist Piaget on a "Logo Programming Language" to create a technological tool that would directly affect student learning (Boss, 2011). With this device, a student used a computer-based coding system for controlling a turtle robot. Boss (2011) said that this groundbreaking work helped students gain mathematical and programming skills, along with high motivation and interest in learning. Technology could be used to improve student achievement, and it opened the door for continued research in instructional technology.

Twentieth century inventions that were quickly gaining popularity outside of schools for personal use were also seen by educators as ways to enhance student learning. In the 1960s, televisions began being used in classrooms, and it "quickly spread around the world, being seen in the 1970s….as a panacea for education in developing worlds" (Bates, 2014, para. 3). Videos in schools became even more commonplace as it became cost effective to create and dispense them in classrooms in the 1990s (Bates, 2014). The tools used in schools quickly continued to expand as handheld calculators, headphones, and the Scantron system of testing proved to be cost effective and easy to use (Molnar, 1997).

In the middle of the 20th century, educational technology also began to include early computers. According to Dunn (2011), "Public schools in the US averaged one computer for every 92 students by 1984" (para. 28). At first, the reasons for computer access in classrooms were to provide students access to real-world problems in classroom mathematics and scientific studies (Molnar, 1997). Computers, however, were expensive, which limited the number of computers available to students. Soon "the economics that once favored large, time-shared systems shifted to low-cost microcomputers and the personal computer revolution began" (Molnar, 1997, p. 4). Computers became common in almost every school in the country, and while many schools had computer lab rooms, which provided students with limited access to a computer in a whole group setting, computers began to be placed directly in student classrooms.

Along with desktop computers, a variety of devices began being used for education, including interactive whiteboards and iClickers (Dunn, 2011). The interactive whiteboard, which relies on a projector and a computer to work, made the traditional chalkboard more versatile and more meaningful to students. Student response systems, such as iClickers, provide a way for teachers to poll, quiz, and test students with immediate feedback. The interactive nature of these tools and their accessibility gave students and teachers reasons to value technology in education.

Advances in computer technology, such as the advent of the World Wide Web in 1991 and search engines such as Google in 1999 (Bates, 2014), continued to expand the way technology was used for learning. These inventions allowed students to have access to a greater wealth of knowledge, which greatly passed the limitations of informational texts available in classrooms and school libraries. Internet access also allowed the creation of learning management systems, providing a way for students and teachers to organize learning materials and student documents as well as providing online discussion forums for sharing information quickly (Bates, 2014). The effect of the Internet on the quickly changing scene of educational technology was a "paradigm shift" in how schools utilize technology to increase learning (Bates, 2014).

In 2011, Boss reported that students had access to a variety of tools that ranged "from inexpensive personal computers and handheld devices to interactive whiteboards, digital video cameras, and a constantly expanding suite of Web 2.0 tools" (para. 5). Technology companies began to market its products to the education sector (Dawson, 2016). With its products such as laptops, iPad, and Apple TV, Apple Inc. claims to provide a variety of tools that can enhance education (Apple, 2017). Since its beginning, Apple has looked for ways to provide schools at all levels with technological tools, starting in 1978 just two years after its founding (Watters, 2015b). The company, together with the Minnesota Educational Computing Consortium, provided 500 schools in Minnesota with a desktop computer. In efforts to increase student literacy, the company became involved in lobbying for legislation that would offer tax credits for companies that would donate technology to American schools (Watters, 2015b). Apple remains a top competitor providing technology in the education market today (Dawson, 2016).

When Apple first launched the iPad device in 2010 (*Apple Launches iPad*, 2010), the company claimed that it was a "magical and revolutionary device at an unbelievable price" (para. 2). The device is small enough to be handheld, yet has a screen large enough to boast a variety of user-friendly features. With the seemingly endless amount of educational applications available on the iPad, school districts were immediately interested in finding ways to use the technological tool to enhance student learning, making the iPad one of the most popular digital devices in schools (Hu, 2011).

In 1996, the United States Department of Education created the first national education technology plan. The plan stated that while technological literacy could improve student learning, “these new technologies are not to be found in the nation’s schools” (United States Department of Education, 1996, p. 7). The plan sought to provide quality teacher training with technology, increase technology usage in classrooms, connect every classroom to the Internet, and embed technology into school curricula. While this initial plan sought to make the presence of technology in schools a national priority, the 2016 plan called for dynamic shifts in learning and teaching with technology (United States Department of Education, 2016). The plan emphasized an increase in research on educational technology, stronger teacher professional development, and strove to end the “digital use divide” (United States Department of Education, 2016, p. 5) between students who used digital tools for meaningful learning and students who used digital tools passively.

The 2016 technology plan provides a rationale for increasing technology across all schools in America:

> Technology can be a powerful tool for transforming learning. It can help arm and advance relationships between educators and students, reinvent our approaches to learning and collaboration, shrink long-standing equity and accessibility gaps, and adapt learning experiences to meet the needs of all learners. (United States Department of Education, 2016, p. 1)

With the variety of technological tools available and a nationwide emphasis on increasing technology in schools, students and educators have the opportunity to change traditional methods of teaching and learning.

Technology's Impact on Student Achievement

Technology has become ubiquitous in schools across America as "public schools in the United States now provide at least one computer for every five students" (Herold, 2016b, para. 1). The importance of understanding its effects on student achievement was apparent. Roschelle, Pea, Hoadley, Gordin, and Means (2000) contended there were varied research results on this topic, due to differences in the type and way in which technology is used in classrooms. However, educators were finding benefits in increasing the use of various tools to improve student learning. According to cognitive learning theories, optimal learning takes place when four elements take place: active engagement, group participation, frequent interaction and feedback, and connections to real-world contexts (Roschelle et al., 2000). Technology could maximize the impact of each of these areas on student learning.

Roschelle et al. (2000) stated that active engagement in learning was improved as technology allowed students to have hands-on experiences, because "new technologies make content construction much more accessible to students" (p. 80). Through various tools and applications, students moved from passive learning to actively being involved in discovering and understanding new ideas. For example, tools with touch screen applications allowed students to create their own examples of learning the material rather than simply watching a teacher present the information. A variety of learning styles can be addressed as technology can easily incorporate musical and kinesthetic elements into learning activities. Roschelle et al. (2000) also noted that technology used in this way promotes higher levels of problem solving and individual student design.

Educational psychologist Vygotsky long established the idea that children could learn more by working in groups. He argued, "Human learning presupposes a specific social nature and a process by which children grow into the intellectual life of those around them" (Vygotsky, 1978, p. 39). Thus, when children have social interactions with others, they were able to increase their learning. Technology helps educators achieve this goal by providing multiple ways for students to think, work, and talk together as they learn new ideas and skills. Roschelle et al. (2000) found that technology use could promote communication because "networking technologies such as the Internet and digital video permit a broad new range of collaborative activities in schools" (p. 80). Emails, Google Docs, wikis, and interactive whiteboards were just some of the tools that students used to collaborate effectively using technology (Pilgrim, Bledsoe, & Reily, 2012).

Students can better monitor their learning and make improvements when they have frequent feedback on their work, and technology provides instantaneous feedback. The automatic feedback that technology provides can drastically shorten the time that teachers need to score, return, and comment on the quiz, test, and daily work performance (Roschelle et al., 2009). Computers and other tools also help students accomplish tasks more efficiently than by hand (Roschelle et al., 2000). Time is also saved as a mobile device "allows students to engage in academic activities during times that might otherwise be wasted" (Pilgrim et al., 2012, p. 17).

Finally, Roschelle et al. (2000) found that technology could improve achievement by providing more ways for students to connect to the real world and apply learning to real-world contexts. Blogs, video chats, email, and the Internet allowed for communication with others anywhere in the word and gave students access to information that goes far beyond the realm of classroom textbooks. Students could also contact professionals and experts to expand on classroom learning and research issues in the real world to practice problem solving. According to the United States Department of Education (2016), technology "can help organize learning around real world challenges and problem-based learning using a wide variety of digital learning devices" (p. 11).

Kulik and Kulik (1991) conducted one of the first studies regarding the effect of technology on academic achievement. They conducted a meta-analysis across all levels of education and determined that computer usage could raise achievement and in less time than without this technology (Kulik & Kulik, 1991). Their meta-analysis included 254 studies with participants from Kindergarten to adult students. Kulik and Kulik (1991) found that computer-based instruction (CBI) had a positive effect on student achievement when used for short periods of time. The study results showed "CBI was especially effective when the duration of treatment was limited to four weeks or less" (Kulik & Kulik, 1991, p. 88), but findings were ambiguous when CBI was used for longer periods of time (Kulik &Kulik, 1991). Other research in the 1990s (Bialo & Sivin-Kachala, 1996; Middleton & Murray, 1999) showed that student achievement could be enhanced when students interact with computer-based technologies.

Bialo and Sivin-Kachala (1996) conducted a meta-analysis on the effectiveness of technology using 176 research reviews. The research included studies on preschool, grade school, high school, and higher education students in both regular and special education classes. Analysis of the data showed that technology had a positive effect on achievement at all levels of education. Additionally, the data indicated that technology used improved learning in language arts, mathematics, and science. Bialo and Sivin-Kachala (1996) concluded that technology in schools "has been shown to make learning more student-centered, to encourage cooperative learning, and to stimulate increased teacher/student interaction" (p. 9).

Middleton and Murray (1999) studied fourth and fifth grade students in South Carolina to compare the effect of technology on student performance on state assessments. A survey was used to determine the level of technology use that teachers employed for mathematics and reading instruction. Mathematics and reading test scores were compared with the teacher level of technology implementation. The results of the study showed a higher level of teacher technology use in the fifth grade than among fourth grade teachers. Accordingly, the fifth grade students had higher scores in both mathematics and reading than the fourth grade students. Middleton and Murray (1999) concluded that technology use in instruction had a statistically significant effect on student learning in mathematics and reading.

Gulek and Demirtas (2005) conducted a study at a middle school in California to evaluate the effect laptops had on student achievement. Data from grade point averages, writing test scores, and standardized state test scores were used. The students in the laptop program were not randomly chosen; rather, taking part in the program was optional. However, the baseline data showed no statistically significant difference between the grade point averages of students in the laptop program and students not in the laptop program before the start of the study. The students in the laptop program had access to a personal laptop at school every day. The laptops were mostly used for online research, online grading tools, note taking, and creating PowerPoint and video presentations. The results of the study indicated a statistically significant difference in the grades and test scores between the two groups of students, with the students enrolled in the laptop program achieving higher scores in all areas. The researchers determined that providing laptops to students could improve learning in mathematics, reading, and writing.

White and Martin (2012) believe that educators should capitalize on students' wide knowledge of technology and incorporate them into classroom practice. By using the technological devices that students already owned and had expertise with, they argued, educators could enhance learning opportunities. They conducted an informal two-week study with high school students. Students used iPod Touch devices to work on a variety of STEM activities, utilizing a variety of applications on the devices including video, visuals, and spreadsheets. White and Martin (2012) purported that rather than seeing technology as a distraction to learning, it could actually support student achievement as the "mobile device turned idle moments into opportunities for academic work" (p. 25). Through data collected from student interviews and surveys, the results of the study showed that the students learned new mathematics and found the activities "novel and exciting" (White & Martin, 2012, p. 25), and gave the students confidence in their mathematics ability. White and Martin (2012) concluded that the use of mobile devices in school could improve student achievement.

Carr (2012) conducted a study to determine if the use of iPads and game-based-learning affected mathematics achievement for fifth grade students. The participants in the study were 104 fifth grade students from two rural schools in Virginia. The instrument used was a 50-question multiple-choice test that measured change over time.

Carr's (2012) results, analyzed through descriptive statistics and a one-way ANOVA, did not show any significant mathematics achievement growth for the students with iPad experiences. Carr (2012) concluded that these results "do not dismiss the usage of iPads in the classroom, but rather encourages educators, principals, and school officials to further investigate the uses of the device in the classroom" (p. 280).

A 2013 study by scientists at the Harvard-Smithsonian Center for Astrophysics showed that iPads could help students understand scientific concepts better than traditional methods. The participants in the study were high school students in Massachusetts. The results of the study indicated that "Students grasp the unimaginable emptiness of space more effectively when they use iPads to explore 3-D simulations of the universe, compared to traditional classroom instruction" (Harvard-Smithsonian, 2013, para. 2). Concepts such as time spans, the solar system, and atoms have long been difficult for teachers to convey correctly to students, which often caused misconceptions. Using technology such as iPads provided accurate visuals and interactive simulations that allowed students a deeper understanding of the solar system. Harvard-Smithsonian's (2013) study results indicated that iPads also improved student learning in fields that are more scientific such as physics and chemistry.

The Springford Area School District in Pennsylvania saw first-hand the benefits that technology could bring in education (Boccella, 2015). The district decided to invest financially and provide a variety of technological tools for one of its struggling elementary schools, Spring City Elementary. The school used iPads, Apple TVs, and smartboards to provide personalized learning opportunities for students. While the district did not see academic growth until the second year after implementation, their hybrid learning system showed a 24-percentile growth in mathematics, 20-percentile growth in reading, and a 27-percentile growth in science. The school credited its success to the use of digital tools that provided individual learning opportunities for students. They implemented a hybrid-learning model to allow for small groups in every subject, all day long. The technology allowed for individualized learning as well as opportunities for teachers to meet with guided small groups throughout the day (Boccella, 2015).

In a 2015 study conducted in Texas, Kuyatt, Holland, and Jones looked at technology use in middle school English/Language Arts and social studies classrooms and how it affected student performance on the Texas state assessment. Specifically, Kuyatt et al. (2015) looked at the instructional practices that the teachers used when incorporating technology. The results of the study indicated that teachers who used technology in the classroom, either teacher or student directed, had lower scores on the state assessment than students who were in non-technological classrooms. Furthermore, the mean scores between the two groups were analyzed. On both teacher use and student use of technology, the non-proficient students had a higher mean score. The researchers concluded, “It is not enough to use technology by teachers or students but to understand and identify factors that would be able to contribute to student learning” (Kuyatt et al., 2015, p. 68).

Multiple studies point to differences in the implementation of technology, teacher training, and time that students spend on technology, as reasons for differences in the effect of technology on student achievement (Kuyatt et al., 2015; Means, 2010; Norris & Soloway, 2012). Means (2010) conducted a study to identify specific classroom and school technology practices that increase student achievement. Means identified schools using mathematics and reading software products at schools with above average achievement gains and schools that had below average achievement gains. Interviews and observations were conducted and how teachers and schools implemented the software was compared. Two teacher practices were identified to be essential for student achievement: classroom management and review of student data. Regarding school practices, the data indicated that principal vision and support, collaboration among colleagues, and on-site technology support were present in the high achieving schools, as compared with the low achieving schools. Means (2010) concluded that teacher and school practices were imperative for using technology to impact student achievement positively.

Technology could greatly affect student achievement. Essentially, educators need to identify and implement the teaching practices and create a school culture that supports student learning with the use of technology. Technology used with a purpose has the "potential to transform education when used with emerging models of teaching and learning" (Protheroe, 2005, p. 46).

One-to-One Technology Initiatives

A growing number of school districts are seeking opportunities for one-to-one iPad initiatives, which provide every student with a technological device for personal use throughout the school day. Researchers have cited a variety of goals for one-to-one initiatives: improved student engagement in learning, more student-centered learning opportunities, and higher student achievement (Herold, 2016a; Jackson 2016). Supporters of one-to-one initiatives also believe that they better prepare students for their future work environment (Jackson, 2016). While some believe that these initiatives can greatly benefit students, Goodwin (2011) pointed out that "most large-scale evaluations have found mixed or no results for one-to-one initiatives" (Goodwin, 2011, para. 8). In fact, Goodwin (2011) noted that some schools are questioning the benefits of one-to-one programs due to the high cost of obtaining and maintaining the technology and issues with student usage of technology.

District-wide one-to-one technology initiatives were new, so the research that exists was varied and limited. Many factors could affect the success of a one-to-one initiative. According to Foote (2012), factors that could affect the impact of an iPad initiative include "the pedagogy accompanying its use; training afforded to teachers; the methods for implementing the new technology; and the tech support provided" (para. 2).

During the 2002-2003 school year, Russell et al. (2004) studied the effect that one-to-one laptops had on teaching and learning. The study was conducted with 209 fourth and fifth grade students at an elementary school in suburban Massachusetts. A one-to-one initiative was carried out as part of a parent purchase program in four classrooms, while five classrooms used a shared technology approach. In the shared classrooms, a cart of laptops was rotated weekly between the classrooms, providing each student with a personal laptop every five weeks. The study utilized classroom observations, teacher interviews, student surveys, and student drawings to collect data. The results of the study concluded that the one-to-one students used technology much more often and in a greater variety of ways than the shared classroom students did. Student motivation and time on task was also higher among students in the one-to-one classrooms. One-to-one students also reported writing more often and writing a higher quality text. The researchers found evidence that there was also a difference in the classroom structure and relationships between teacher and students in both types of classrooms. The one-to-one classroom students were more often working independently, with frequent teacher and peer-to- peer conferences, while the shared classroom students were more often working as a whole group with the teacher addressing the class. Finally, the study concluded that students in the one-to-one classrooms utilized technology for school-related work at home more often than did the students in the shared laptop classrooms.

Bebell (2005) conducted research on the effect that a one-to-one laptop program had on six New Hampshire middle schools. The study utilized teacher and student pre- and post-surveys to collect data. The surveys were administered before the start of the initiative, and again six months after the initiative was implemented. The surveys included questions to determine the amount of technology use in the classroom, frequency of student assignments that required technology to create products, and teacher perceptions of the impact that the laptop program had on students. The results of the data showed that teachers and students greatly increased technology usage and used computers in new ways (Bebell, 2005). Data analysis also showed a perceived increase in student motivation, engagement, and participation because of the laptop initiative. Regarding student achievement, Bebell (2005) found that teachers "indicated increases in students' ability to retain content material and the quality of students' writing" (p. 33).

Dunleavy and Heinecke (2007) conducted a study in an urban middle school in the mid-Atlantic area. The school was identified as at-risk and had a history of low standardized test scores. Mathematics and science achievement between students who participated in a one to one laptop initiative and students who did not participate were compared. The students were randomly selected to participate in either group. Longitudinal data over the course of two school years was used to compare pre-and post-test results on state standardized tests. The results of the data analysis showed a significant difference in the science scores, with the students in the one to one initiative outperforming the control group. The results of the data analysis also showed a gender difference, with male students scoring higher than female students did in the one to one science classroom. There was no statistically significant difference shown in the mathematics data. Dunleavy and Heinecke concluded that technology "can increase student achievement under certain conditions" (p. 1) and recommends further research on one-to-one initiatives.

Lowther et al. (2007) conducted a study to analyze the effect that a one-to-one technology initiative had on teacher practices and student achievement in Michigan. The Michigan Freedom to Learn (FTL) program provided personal laptops to teachers and students. Observations and surveys were used to analyze teacher and student usage of technology. The results of the data analysis showed that teachers in FTL classrooms utilized a greater amount of "independent inquiry, project-based learning, meaningful laptop lessons, and higher quality hands-on activities" (Lowther et al., 2007, p. 2). FTL teachers were also more likely to perceive that technology had a positive effect on student learning. The Michigan Educational Assessment of Program (MEAP) was used as a standardized assessment to measure student achievement in English, mathematics, reading, and writing. The scores of seventh grade students enrolled in FTL and seventh grade students enrolled in similar schools were compared. The schools in the study were grouped into eight pairs, and two FTL schools were paired with two comparison schools.

The results of the data analysis for student achievement were mixed. For one pair of schools, there was no statistically significant difference in student MEAP scores. Two pairs of FTS schools outperformed comparison schools in mathematics, and two pairs of FTS schools outperformed comparison schools in reading. Two pairs of comparison schools outperformed FTS schools in mathematics, and one pair of comparison schools outperformed FTS schools in both English and writing.

Silvernail and Gritter (2007) conducted a study in Maine to examine the effect that a statewide one-to-one initiative had on eighth grade writing achievement. Silvernail and Gritter (2007) collected data from student scores from the Maine Educational Assessment (MEA) in 2000, prior to the laptop initiative, and compared them with student scores from the MEA in 2005. The results of the study showed the average writing score increased by 3.44, displaying a statistically significant improvement in student writing achievement. Data analysis also provided evidence that when students utilized laptops throughout the writing process, there was a statistically significant increase in writing scores. Silvernail and Gritter (2007) stated, "Policy makers and others should reasonably expect to see improvements in students' writing achievement over a period of time with the implementation of laptop programs" (p. 9).

Burgad (2008) studied the impact of a one-to-one laptop initiative on junior and senior student achievement in a rural North Dakota high school. Using data from the 2006-2007 school year, Burgad looked at NWEA MAP scores from 70 junior and senior students after their first year with a one-to-one laptop initiative and compared them with the average state scores in language arts, reading, and mathematics. The results of the study indicated that in language arts, the laptop initiative had no impact on junior achievement and a negative impact on senior student achievement. In reading, the junior students showed a negative impact and the senior students had a positive impact. Both junior and senior students' mathematics achievements were positively impacted because of the laptop initiative. Burgad concluded that differences in the study results implied that schools must have an aligned curriculum with state standards and assessments and that strong instructional practices must be implemented to receive the full impact of technological initiatives.

Danielsen (2009) conducted research to identify leadership practices surrounding the implementation of a one-to-one laptop initiative in three Midwest high schools. Danielsen (2009) utilized a variety of instruments to gather data including school documents, observations, and interviews. The results of the study revealed common themes among the implementation of the technology initiative. The districts all established a clear vision for the initiative prior to its beginning. Acceptable use policies were adjusted to include technology use. All three schools provided teachers with intensive initial training on using the new technology for instruction, and they continued to maintain technology support as an ongoing effort. Danielsen (2009) concluded that these actions were necessary for ensuring the success of a one-to-one initiative.

In 2004, Texas began a technology immersion program that sought to provide every middle school educator and student with a technological device. Shapley et al. (2009) conducted a study that evaluated the effects of the program after four years of implementation. The study utilized a quasi-experimental design with 42 middle schools across Texas. There were 21 treatment schools and 21 control schools. In comparison to teachers at control schools, teachers at treatment schools had higher technological skills, required their students to use technology more often, and taught more intellectually challenging lessons. Student achievement was compared using student growth on the Texas Assessment of Knowledge and Skills (TAKS). Students were placed into cohorts based on the number of years they participated in the program, Cohort 1 (ninth graders who participated for three years), Cohort 2 (eighth graders in their third year of participation), and Cohort 3 (seventh graders in their second year of participation). There was no statistically significant difference in reading achievement growth between students attending treatment schools and students attending control schools for Cohort 2 and 3. Cohort 1 students in the treatment schools showed a statistically significant higher growth rate in reading. Mathematics achievement, as measured by growth rate on the TAKS, was slightly higher for Cohort 2 and Cohort 3 students at the treatment schools, but not for Cohort 1. Shapley et al. (2009) determined that student access and use of their laptops outside of school was the greatest determiner of student success on the TAKS. The researchers concluded that "individual student laptops, in contrast to laptops on carts or computers available in libraries, labs, and classrooms, expand where and how student learning occurs" (Shapley et al., 2009, p. 84).

In 2006, Pennsylvania launched a statewide laptop initiative, "Classroom for the Future," which provided high school students with a personal laptop at school. Sprenger (2010) studied the effect that the one-to-one initiative had on teaching pedagogy and practices. Student and teacher surveys and classroom observations were used to collect data for the first and second year of the initiative. Pre- and post- student and teacher surveys were administered to identify perceived changes in teacher practices. Administrators used a Classroom for the Future technology observation form and completed pre- and post-observations. Analysis of the data showed statistically significant changes in teaching styles. Classroom layout changed to allow for more student collaboration. Teachers were perceived to spend less time lecturing and engaged more with the students in a small group format. Students increased the time they were engaged in constructivist learning activities as opposed to listening to teacher lectures. The types of assessments used for student grades also changed. Oral reports, class participation, and group projects increased in amount, and fewer tests, quizzes, and paper reports were required.

Bebell and Kay (2010) studied the impact that a one-to-one technology initiative in five middle schools in Massachusetts had on teacher practices, student achievement, student engagement, and student research skills. Teacher surveys and interviews, student surveys, student drawings, school records, classroom observations, and test scores were used to collect data. The results were varied across the five schools and over the three years of the program, but overall results showed a change in teacher behavior and growth in student achievement. Teachers changed their instructional practices to incorporate technology and students dramatically increased the amount of technology use throughout the school day. Teachers, students, and principals perceived an increase in student engagement and improvement in student research skills and abilities to collaborate. Bebell and Kay (2010) also compared state assessment scores between students who participated in the technology initiative and students who did not. The results showed that students in the laptop initiative had a statistically higher increase in ELA scores, but not in mathematics. Bebell and Kay (2010) stated that “1:1 computing holds major promise for impacting the lives of teachers and students in meaningful ways” (p. 47).

Lambert (2014) conducted a study to identify the impact of a laptop initiative on South Carolina middle school student achievement. Student performance on the South Carolina Palmetto Achievement Challenge Test (PACT) in mathematics was analyzed. Pretest and posttest scores were used to provide a baseline reference to compare the difference of change in scores. The results of the study showed a statistically significant difference in achievement between sixth grade students participating in the laptop initiative and students in a typical sixth grade classroom, with students in the laptop initiative displaying a greater change in test scores. Lambert (2014) concluded, "Dedicated technology access would be beneficial to the educational achievement of students" (p. 84).

In North Carolina, Cottone (2013) conducted a study to investigate if a one-to-one laptop initiative in intermediate mathematic classes affected mathematics scores. Cottone utilized *t* tests and Chi-square tests to analyze his test data, which was collected from 2006 to 2011. Two school years of test scores were analyzed before the one-to-one laptop initiative and then two years after the initiative had been in place. The test scores were collected from the State of North Carolina End-of-Grade assessments. The study participants included 5,500 students who attended the North Carolina School District. The results of Cottone's (2013) study were mixed. While there was no significant increase in reading achievement, there was a statistically significant increase in mathematics achievement, showing that the one-to-one laptop initiative had a positive influence on mathematics achievement. Furthermore, the qualitative results of the study showed that educators and students reported that the laptop initiative "increased student participation, motivation, and engagement to learn" (Cottone, 2013, p. 98). Cottone's study provided valuable data for promoting laptop technology in intermediate schools.

Charleston County Schools began a one-to-one initiative at three district schools, two elementary and one middle school, at the beginning of the 2012 school year (Casey, 2014). The district hired Metis Associates to analyze the impact of the iPads. Metis Associates used classroom observations, teacher, parent, and student surveys, student test scores, and administrative interviews to evaluate the initiative. The research results showed many positive outcomes. All groups (teachers, students, parents, and school administrators) had highly positive feelings towards the use of iPads in the schools. Teachers reported an increase in their abilities to differentiate instruction to address a variety of learning needs in the classroom. Teachers also saw an increase in student engagement and motivation in learning, and students and parents reported that children had more positive feelings about school. Results of the study showed a decrease in student disciplinary measures with the implementation of iPads. The one area that did not show improvement was student achievement, as shown by a comparison of test scores both before and after the initiative. While there was no overall student achievement gain, some subgroups showed slight academic increases. Reading scores improved for fifth and eighth grade Hispanic students and students who speak English as a second language. Mathematics scores improved for eighth grade students, Black and Hispanic students, and English language learners. In response, many district officials felt that over more time, the positive outcomes would begin to affect student achievement more.

Metis Associates provided Charleston Schools recommendations for future action to ensure continued success with the initiative, mostly related to teacher support (Casey, 2014). The firm called for more professional development so teachers could learn to differentiate instruction more effectively in the classroom with the iPads. Teachers should be provided with more technology support for the variety of complications that arise with the devices. Finally, the firm recommended that the district keep a close eye on student achievement and conduct further research to look for academic growth related to the iPad use.

In 2014, Ramsdell conducted a study to identify the impact of a laptop initiative on high school students in rural Missouri. Ramsdell used ANOVAs used to look at the differences of End of Course (EOC) Missouri state exams before, during, and after the implementation of one-to-one laptops from 2012 to 2014. Eight academic areas were analyzed for the study as a part of the EOC exams: English Language Arts I and II, Algebra I and II, Geometry, Biology, American History, and American Government. In all eight areas of study, the overall proficient and advanced scores increased after the laptop initiative. However, raw scores declined on Algebra I state EOC scores. Overall, Ramsdell (2014) concluded that this laptop initiative was shown to have a positive impact on student achievement.

Lopez-Boren (2016) conducted qualitative research on a one-to-one laptop initiative impact on teacher positioning and pedagogy in English Language Arts classrooms. Lopez-Boren (2016) focused on the changes in teachers' roles when technological tools are integrated into classroom instruction. Data was collected from interviews, artifacts, and classroom observations from five high school teachers. The data results displayed a shift in how classroom teachers viewed their role in the classroom after the technology initiative was implemented, changing from "facilitator and companion in the learning process to a policing/authoritative position" (p. 96). Most of the participants perceived technology as a hindrance to student learning. Lopez-Boren (2016) concluded that because technology use does impact teacher positioning and teacher learning and beliefs, either positively or negatively, "decision makers should use consideration and care throughout the adoption and implementation process" (p. 3).

Researchers from Michigan State University studied the impact of one-to-one laptop initiatives on student test scores (Herold, 2016a). Using studies previously completed, the researchers conducted a meta-analysis and found student achievement increased in mathematics, science, and English-Language Arts when students were each provided with their own laptop. The results showed a distinction between the purposeful use of the laptops, compared with districts and schools that simply provided the computers without any real plan for their implementation. Like Cottone's (2013) study, the Michigan State researchers found benefits other than academic with individual laptop use. These benefits included "more student-centered and project-based instruction, greater student engagement, and better relationships between teachers and students" (Herold, 2016a). These 21st Century skills are needed for students to be successful when they graduate outside the classroom.

Summary

Chapter two provided literature about the history of technology in schools. Current studies about technology's impact on student achievement were discussed, as well as one-to-one initiatives and their effect on teaching and learning. Chapter three includes a description of the methodology used for the study, the research design, selection of participants, measurement, and the data collection procedures. The data analysis and hypothesis testing for the study are described as well as the limitations of the study.

Chapter Three

Methods

The purpose of this study was to determine whether there were differences in third through sixth grade student achievement, as measured by the change in MAP mathematics RIT assessment scores, between students who participated in the one-to-one iPad initiative and students who did not participate in the initiative during the 2014-2015 school year and whether these differences were affected by student gender, race, or SES. Another purpose of this study was to determine whether there were differences in fourth through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year and whether these differences were affected by student gender, race, or SES.

As technology continues to play a prominent role in all areas of society, schools must determine how to spend their limited funds on electronic devices and other technological tools. This chapter describes the research design, selection of participants, and the measurement used. The data collection procedures, data analysis and hypothesis testing, and the limitations of the study are also included.

Research Design

This research was designed as a quantitative research study using a quasi-experimental design. Creswell (2014) states that quantitative research "is an approach for testing objective theories by examining the relationship among variables" (p. 4). A quasi-experiment uses naturally formed groups as participants, as opposed to randomly assigning participants (Creswell, 2014). The independent variables were 1:1 iPad implementation, student gender, race, and SES. The dependent variable was the student mathematics gains on the MAP for third, fourth, fifth, and sixth grade students. The MAP test was used as the instrument to measure the variables.

In RQ1, RQ3, RQ5, and RQ7 (differences in MAP mathematics score gains in student achievement from fall 2014 to spring 2015), the independent variable was student participation in the one-to-one initiative during the 2014-2015 school year. In RQ9, RQ11, and RQ13 (differences in MAP mathematics score gains in student achievement from fall 2015 to spring 2016), the independent variable was student participation in a one-to-one initiative for either their first year or their second year during the 2015-2016 school year. In RQ2, RQ4, RQ6, RQ8, RQ10, RQ12, and RQ14 (differences in MAP mathematics score gains were affected by gender, race, and SES), there were three independent variables: student gender, student race, and student SES. Student gender was assigned an M (male) or F (female). Student race was identified as A (Asian), B (Black), H (Hispanic), M (Multi), O (Other), or W (White). Hawaiian/Pacific Island and American Indian students were categorized together as “Other” due to a low participation number. Student SES was identified as either free/reduced or full pay. Students who participated one year attended a one-to-many school during the 2014-2015 school year and then attended a one-to-one school during the 2015-2016 school year. Students who participated two years attended a one-to-one school during the 2014-2015 and 2015-2016 school years.

Selection of Participants

The population for this study included all third through sixth grade students in thirty-three elementary schools in District S. The schools and their demographics were presented in Tables 1 and 2 in chapter one. Lunenburg and Irby (2008) state, "purposive sampling involves setting a sample based on the researcher's experience or knowledge of the group to be sampled" (p. 175). For this study, a purposive sampling was utilized based on the researcher's knowledge of schools that were one-to-one with iPad devices and schools that were one-to-many with iPad devices. The participants were students in the third, fourth, fifth, and sixth grades enrolled in District S during the 2014-2015 school year and students in the fourth, fifth, and sixth grades enrolled in District S during the 2015-2016 school year. The participants had a fall and spring MAP mathematics score. Any students who did not have a fall and spring MAP mathematics assessment score were eliminated from the study.

Measurement

The instrument used to measure mathematics growth in grades three through six was the MAP mathematics assessment. The MAP assessment creates a "personalized assessment experience by adapting to each student's learning level" (NWEA, 2016b). The purpose of the test is threefold: (a) To provide information on what a student already knows, (b) To provide information about what a student still needs to learn, and (c) To provide information about how much a student has learned throughout the year (NWEA, 2016b). Instructors use the data from the MAP to make decisions about how to enrich or provide extra support for students in mathematics.

The MAP math assessment is described as “computer adaptive” (NWEA 2016b), which means that the test adjusts itself for each student as they progress through the questions. The test measures growth over the period of a year and helps instructors identify areas of need for students. The MAP assessment is aligned with the Kansas State Assessment and provides information about how well a student will perform on state objectives because it can “accurately predict whether a student could be proficient or above on the basis of his/her MAP scores” (NWEA, 2016a, p. 22).

The test has a multiple-choice format. All students begin with grade-level questions and as student correctly or incorrectly answer questions; the test adjusts itself to reflect the needs of each student. If a student answers a question wrong, the questions get progressively easier; however, if a student answers a question correctly, the test automatically adjusts to present the student with more difficult questions. In this way, it identifies a student’s zone of proximal development (NWEA, 2016c). Vygotsky (1978) defines the zone of proximal development as the difference between a child’s actual development and the level of potential development under adult guidance or peer interaction.

Lunenburg and Irby (2008) state that validity is “the degree to which an instrument measures what it purports to measure” (p. 181). Test reliability is “the degree to which an instrument consistently measures whatever it is measuring (Lunenburg & Irby, 2008, p. 182). The MAP test has been tested for validity and reliability in three ways: concurrent, test-retest, and marginal. All three tests produce a Pearson correlation coefficient where the closer the coefficient is to 1.00, the greater the correlation. A strong correlation is recognized when the coefficient is at least .80, with 1 being a perfect correlation (NWEA, 2004).

Test validity was measured using concurrent validity, which is “the degree to which scores on one test correlate to scores on another test when both are administered at about the same time” (Lunenburg & Irby, 2008, p. 181). Concurrent validity reports show coefficients that range from 0.72 to 0.90. Reliability through test-retest is measured by administering two equivalent tests (different individual tests, but with the same number and type of items) tests to students over a period of time. MAP test reports most coefficients to be in the mid .80s to the low .90s (NWEA, 2004). Reliability is also measured using a marginal reliability coefficient, which is “the result of combining measurement error estimated at different points on the achievement scale into a single index” (NWEA, 2004). This method of reliability testing found results “nearly identical to coefficient alpha” (NWEA, 2004). The data shows that the NWEA MAP test is a valid and reliable instrument for measuring student achievement.

Data Collection Procedures

The researcher submitted the IRB form to Baker University on December 26, 2016 (see Appendix A). The researcher submitted the Regulations and Procedures for Research Projects form to District S on December 29, 2016 (see Appendix B). The IRB was approved on January 4, 2017 (see Appendix C). After permission to receive the data had been granted, the researcher requested the data from District S’s assessment and research department. The data was collected and given to the researcher on February 5, 2017. The researcher uploaded the Excel file to JASP 0.8.0.1 for Windows to complete the statistical analysis.

Data Analysis and Hypothesis Testing

This study employed a quantitative method for collecting data and completing data analysis. This section describes the statistical tests that were used to address each research question.

RQ1. To what extent is there a difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative?

H1. There is a mean difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative.

A two-sample *t* test of independence was conducted to test H1. The two sample means (participation in the one-to-one initiative, non-participation in the one-to-one initiative) were compared. The level of significance was set at .05.

RQ2. To what extent is the difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative affected by one if the following variables: student gender, student race, or student SES?

H2. The difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student gender.

A two-factor ANOVA was conducted to test H2. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student gender (male, female). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for gender, and the two-way interaction effect (participation in the one-to-one initiative X gender). The two-way interaction effect was used to test H2. The level of significance was set at .05

H3. The difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student race.

A two-factor ANOVA was conducted to test H3. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for race, and the two-way interaction effect (participation in the one-to-one initiative X student race). The two-way interaction effect was used to test H3. The level of significance was set at .05.

H4. The difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student SES.

A two-factor ANOVA was conducted to test H4. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect was used to test H4. The level of significance was set at .05.

RQ3. To what extent is there a difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative?

H5. There is a mean difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative.

A two-sample *t* test of independence was conducted to test H5. The two sample means (participation in the one-to-one initiative, non-participation in the one-to-one initiative) were compared. The level of significance was set at .05.

RQ4. To what extent is the difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative affected by one if the following variables: student gender, student race, or student SES?

H6. The difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student gender.

A two-factor ANOVA was conducted to test H6. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student gender (male, female). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for gender, and the two-way interaction effect (participation in the one-to-one initiative X gender). The two-way interaction effect was used to test H6. The level of significance was set at .05.

H7. The difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student race.

A two-factor ANOVA was conducted to test H7. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for race, and the two-way interaction effect (participation in the one-to-one initiative X race). The two-way interaction effect was used to test H7. The level of significance was set at .05.

H8. The difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student SES.

A two-factor ANOVA was conducted to test H8. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect was used to test to test H8. The level of significance was set at .05.

RQ5. To what extent is there a difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative?

H9. There is a mean difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative.

A two-sample *t* test of independence was conducted to test H9. The two sample means (participation in the one-to-one initiative, non-participation in the one-to-one initiative) were compared. The level of significance was set at .05.

RQ6. To what extent is the difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative affected by one if the following variables: student gender, student race, or student SES?

H10. The difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student gender.

A two-factor ANOVA was conducted to test H10. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student gender (male, female). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for gender, and the two-way interaction effect (participation in the one-to-one initiative X gender). The two-way interaction effect was used to test H10. The level of significance was set at .05.

H11. The difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student race.

A two-factor ANOVA was conducted to test H11. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for race, and the two-way interaction effect (participation in the one-to-one initiative X race). The two-way interaction was used to test H11. The level of significance was set at .05.

H12. The difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student SES.

A two-factor ANOVA was conducted to test H12. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect was used to test H12. The level of significance was set at .05.

RQ7. To what extent is there a difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative?

H13. There is a mean difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative.

A two-sample *t* test of independence was conducted to test H13. The two sample means (participation in the one-to-one initiative, non-participation in the one-to-one initiative) were compared. The level of significance was set at .05.

RQ8. To what extent is the difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative affected by one if the following variables: student gender, student race, or student SES?

H14. The difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student gender.

A two-factor ANOVA was conducted to test H14. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student gender (male, female). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for gender, and the two-way interaction effect (participation in the one-to-one initiative X gender). The two-way interaction effect was used to test H14. The level of significance was set at .05.

H15. The difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student race.

A two-factor ANOVA was conducted to test H15. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for race, and the two-way interaction effect (participation in the one-to-one initiative X race). The two-way interaction was used to test H15. The level of significance was set at .05.

H16. The difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student SES.

A two-factor ANOVA was conducted to test H16. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect was used to test H16. The level of significance was set at .05.

RQ9. To what extent is there a difference in fourth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year?

H17. There is a mean difference in fourth grade student achievement, as measured by the change in MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year.

A two-sample *t* test of independence was conducted to test H17. The average MAP mathematics score gains of students who participated in the one-to-one initiative during the 2014-2015 and 2015-2016 school years was compared with the average MAP mathematics scores of students who did not participate in the initiative during the 2014-

2015 school year but did participate during the 2015-2016 school year. The level of significance was set at .05.

RQ10. To what extent is the difference in fourth grade student achievement, as measured by the change in MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year affected by one if the following variables: student gender, race, or SES?

H18. The difference in fourth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student gender.

A two-factor ANOVA was conducted to test H18. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student gender (male, female). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student gender, and the two-way interaction effect (participation in the one-to-one initiative X student gender). The two-way interaction effect was used to test H18. The level of significance was set at .05.

H19. The difference in fourth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student race.

A two-factor ANOVA was conducted to test H19. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student race, and the two-way interaction effect (participation in the one-to-one initiative X race). The two-way interaction effect was used to test H19. The level of significance was set at .05.

H20. The difference in fourth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student SES.

A two-factor ANOVA was conducted to test H20. The two categorical factors used to group the dependent variable, MAP mathematics score gains, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect was used to test H20. The level of significance was set at .05.

RQ11. To what extent is there a difference in fifth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year?

H21. There is a mean difference in fifth grade student achievement, as measured by the change in MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year.

A two-sample *t* test of independence was conducted to test H21. The average MAP mathematics score gains of students who participated in the one-to-one initiative during the 2014-2015 and 2015-2016 school years was compared with the average MAP mathematics scores of students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year. The level of significance was set at .05.

RQ12. To what extent is the difference in fifth grade student achievement, as measured by the change in MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year affected by one if the following variables: student gender, race, or SES?

H22. The difference in fifth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student gender.

A two-factor ANOVA was conducted to test H22. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student gender (male, female). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student gender, and the two-way interaction effect (participation in the one-to-one initiative X student gender). The two-way interaction effect was used to test H22. The level of significance was set at .05.

H23. The difference in fifth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student race.

A two-factor ANOVA was conducted to test H23. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years,

participated 1 year) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student gender, and the two-way interaction effect (participation in the one-to-one initiative X race). The two-way interaction effect was used to test H23. The level of significance was set at .05.

H24. The difference in fifth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student SES.

A two-factor ANOVA was conducted to test H24. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect was used to test H24. The level of significance was set at .05.

RQ13. To what extent is there a difference in sixth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year?

H25. There is a mean difference in sixth grade student achievement, as measured by the MAP mathematics score gains, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year.

A two-sample *t* test of independence was conducted to test H25. The average MAP mathematics score gains of students who participated in the one-to-one initiative during the 2014-2015 and 2015-2016 school years was compared with the average MAP mathematics scores of students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year. The level of significance was set at .05

RQ14. To what extent is the difference in sixth grade student achievement, as measured by the change in MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year affected by one if the following variables: student gender, race, or SES?

H26. The difference in sixth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student gender.

A two-factor ANOVA was conducted to test H26. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student gender (male, female). The two-factor ANOVA was used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student gender, and the two-way interaction effect (participation in the one-to-one initiative X student gender). The two-way interaction effect was used to test H26. The level of significance was set at .05.

H27. The difference in sixth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student race.

A two-factor ANOVA was conducted to test H27. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student gender, and the two-way interaction effect (participation in the one-to-one initiative X race). The two-way interaction effect was used to test H27. The level of significance was set at .05.

H28. The difference in sixth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, by student SES.

A two-factor ANOVA was conducted to test H28. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect was used to test H28. The level of significance was set at .05.

Limitations

Lunenburg and Irby (2008) define limitations as "factors that may have an effect on the interpretation of the findings or on the generalizability of the results" (p. 133). The researcher could not control the schools the district chose for one-to-one implementation. The amount of time students had access to their iPads, and the way that iPads were used for mathematics instruction were also outside of the researcher's control for both one-to-one schools and one-to-many schools. The type and amount of professional development provided to teachers at one-to-one schools and one-to-many schools were also outside of the researcher's control.

Summary

This study was conducted to determine if there was a difference between the gains in MAP mathematics RIT scores from students who participated in the one-to-one iPad initiative and those who did not participate in the initiative and whether the differences between the gains in MAP math RIT scores was affected by student gender, race, or SES. This chapter included the validity and reliability of the MAP mathematics test, data collection procedures, an analysis of the data and a description of the hypothesis testing, and limitations of the study. Chapter four contains an analysis of the data collected that address the research questions of this study.

Chapter Four

Results

The purpose of this study was to determine whether there were differences in third through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative and students who did not participate in the initiative during the 2014-2015 school year and participated in the one-to-many initiative, and whether these differences was affected by one of the following variables: student gender, race, or SES. An additional purpose of this study was to determine whether there were differences in third through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative for their second year and students who participated in the one-to-one initiative for their first year during the 2015-2016 school year, and whether these differences were affected by one if the following variables: student gender, race, or SES. The results of hypothesis testing that addressed each of the fourteen research questions are presented in this chapter.

Hypothesis Testing

Each research question is presented followed by the associated hypothesis, type of analysis used, a table with the descriptive analysis, and the results of the hypothesis testing.

RQ1. To what extent is there a difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative?

H1. There is a mean difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative.

A two-sample *t* test of independence was conducted to test H1. The two sample means (participation in the one-to-one initiative, non-participation in the one-to-one initiative) were compared. The level of significance was set at .05. The results of the two-sample *t* test of independence indicated no difference between the two values, $t = 1.632$, $df = 2039$, $p = 0.103$. The sample mean for participation in the one-to-one initiative ($M = 13.11$, $SD = 7.801$) was not significantly different from the sample mean for non-participation in the one-to-one initiative ($M = 13.72$, $SD = 7.224$). The hypothesis was not supported by the data.

Table 5

Descriptive Statistics for the Results of the Test for H1

Participation	*M*	*SD*	*N*
Yes	13.11	7.801	537
No	13.72	7.227	1,504

RQ2. To what extent is the difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the

one-to-one initiative affected by one if the following variables: student gender, student race, or student SES?

H2. The difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student gender.

A two-factor ANOVA was conducted to test H2. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student gender (male, female). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for gender, and the two-way interaction effect (participation in the one-to-one initiative X gender). The two-way interaction effect 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 in the interaction, $F = 0.213$, $df = 1, 2037$, $p = .644$. See Table 6 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The hypothesis that the difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one initiative and students who did not participate in the one-to-one initiative is affected by student gender was not supported.

Table 6

Descriptive Statistics for the Results of the Test for H2

Participation	Gender	*M*	*SD*	*N*
Yes	Males	13.03	8.542	243
	Females	13.17	7.145	294
No	Males	13.82	7.556	764
	Females	13.61	6.869	740

H3. The difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student race.

A two-factor ANOVA was conducted to test H3. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for race, and the two-way interaction effect (participation in the one-to-one initiative X student race). The two-way interaction effect was used to test H3. 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 in the interaction, $F = 0.161$, $df = 5, 2029$, $p = .977$. See Table 7 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The hypothesis that the difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one initiative and students who did not participate in the one-to-one initiative is affected by student race was not supported by the data.

Table 7

Descriptive Statistics for the Results of the Test for H3

Participation	Race	*M*	*SD*	*N*
Yes	Asian	13.30	7.543	10
	Black	12.82	7.646	51
	Hispanic	13.00	7.078	81
	Multi	13.24	8.697	41
	Other	13.33	2.309	3
	White	13.15	7.952	351
No	Asian	13.88	5.342	48
	Black	12.68	6.997	135
	Hispanic	13.55	6.877	312
	Multi	13.21	8.027	77
	Other	15.25	1.500	4
	White	13.95	7.395	928

H4. The difference in MAP mathematics score gains in third grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student SES.

A two-factor ANOVA was conducted to test H4. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect 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 in the interaction, $F = 2.104$, $df = 1, 2037$, $p = .147$. See Table 8 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. Although the hypothesis related to the interaction effect between participation in the one-to-one iPad initiative and student SES was not supported, the mean for full pay students ($M = 13.95$, $SD = 7.465$) was marginally higher than the mean for free/reduced pay students ($M = 12.99$, $SD = 7.232$) regardless of participation in the one-to-one initiative, $F = 3.521$, $df = 1, 2037$, $p = .061$.

Table 8

Descriptive Statistics for the Results of the Test for H4

Participation	SES	*M*	*SD*	*N*
Yes	Free/reduced	13.01	7.356	216
	Full pay	13.17	8.097	321
No	Free/reduced	12.98	7.195	625
	Full Pay	14.24	7.204	879

RQ3. To what extent is there a difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative?

H5. There is a mean difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative.

A two-sample *t* test of independence was conducted to test H5. The two sample means (participation in the one-to-one initiative, non-participation in the one-to-one initiative) were compared. The level of significance was set at .05. The results of the two-sample *t* test indicated no difference between the two values, $t = .099$, $df = 1963$, $p = .921$. The sample mean for participation in the one-to-one initiative ($M = 12.16$, $SD = 7.741$) was not significantly different from the sample mean for non-participation in the one-to-one initiative ($M = 12.2$, $SD = 7.901$). The hypothesis was not supported by the data.

Table 9

Descriptive Statistics for the Results of the Test for H5

Participation	*M*	*SD*	*N*
Yes	12.16	7.741	508
No	12.20	7.901	1,457

RQ4. To what extent is the difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who

participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative affected by one if the following variables: student gender, student race, or student SES?

H6. The difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student gender.

A two-factor ANOVA was conducted to test H6. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student gender (male, female). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for gender, and the two-way interaction effect (participation in the one-to-one initiative X gender). The two-way interaction effect 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 in the interaction, $F = .075$, $df = 1, 1961$, $p = .784$. See Table 10 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The hypothesis that the difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one initiative and students who did not participate in the one-to-one initiative is affected by student gender was not supported by the data.

Table 10

Descriptive Statistics for the Results of the Test for H6

Participation	Gender	*M*	*SD*	*N*
Yes	Male	12.08	8.143	265
	Female	12.25	7.293	243
No	Male	12.01	8.599	760
	Female	12.40	7.062	697

H7. The difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student race.

A two-factor ANOVA was conducted to test H7. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for race, and the two-way interaction effect (participation in the one-to-one initiative X race). The two-way interaction effect 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 in the interaction, $F = 1.829$, $df = 5, 1953$, $p = .104$. See Table 11 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. Although the hypothesis related to the interaction effect between participation in the one-to-one iPad initiative and student race was not supported, the mean for Asian (*M* = 13.56, *SD* = 6.451) and White students (*M* = 12.45, *SD* = 8.059) was higher than the mean for Black students (*M* = 11.38, *SD* = 7.400) regardless of participation in the one-to-one initiative *F* = 2.380, *df* = 5, 1953, *p* = .037.

Table 11

Descriptive Statistics for the Results of the Test for H7

Participation	Race	*M*	*SD*	*N*
Yes	Asian	15.071	6.510	14
	Black	8.682	7.826	44
	Hispanic	11.535	7.056	86
	Multi	13.400	8.786	20
	Other	9.333	4.163	3
	White	12.598	7.796	341
No	Asian	13.049	6.430	41
	Black	12.290	7.053	131
	Hispanic	11.599	7.896	294
	Multi	11.573	7.000	75
	Other	13.500	3.786	4
	White	12.388	8.158	912

H8. The difference in MAP mathematics score gains in fourth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student SES.

A two-factor ANOVA was conducted to test H8. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect 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 in the interaction, $F = 0.522$, $df = 1, 1961$, $p = .470$. See Table 12 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. Although the hypothesis related to the interaction effect between participation in the one-to-one iPad initiative and student SES was not supported, the mean for full pay students ($M = 12.52$, $SD = 7.718$) was higher than the mean for free/reduced pay students ($M = 11.70$, $SD = 8.044$) regardless of participation in the one-to-one initiative, $F = 5.418$, $df = 1, 1961$, $p = .020$.

Table 12

Descriptive Statistics for the Results of the Test for H8

Participation	SES	*M*	*SD*	*N*
Yes	Free/reduced	11.38	7.731	195
	Full pay	12.65	7.721	313
No	Free/reduced	11.80	8.148	590
	Full pay	12.47	7.722	867

RQ5. To what extent is there a difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative?

H9**.** There is a mean difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative.

A two-sample *t* test of independence was conducted to test H9. The two sample means (participation in the one-to-one initiative, non-participation in the one-to-one initiative) were compared. The level of significance was set at .05. The results of the two-sample *t* test indicated no difference between the two values, $t = 1.742$, $df = 1929$, $p = .082$. The sample mean for participation in the one-to-one initiative ($M = 12.57$, $SD = 7.95$) was not significantly different from the sample mean for non-participation in the one-to-one initiative ($M = 13.32$, $SD = 8.233$). The hypothesis was not supported by the data.

Table 13

Descriptive Statistics for the Results of the Test for H9

Participation	*M*	*SD*	*N*
Yes	12.57	7.950	491
No	13.32	8.233	1440

RQ6. To what extent is the difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who

participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative affected by one if the following variables: student gender, student race, or student SES?

H10. The difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student gender.

A two-factor ANOVA was conducted to test H10. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student gender (male, female). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for gender, and the two-way interaction effect (participation in the one-to-one initiative X gender). The two-way interaction effect 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 in the interaction, $F = 0.107$, $df = 1, 1927$, $p = .743$. See Table 14 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The hypothesis that the difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one initiative and students who did not participate in the one-to-one initiative is affected by student gender was not supported by the data.

Table 14

Descriptive Statistics for the Results of the Test for H10

Participation	Gender	*M*	*SD*	*N*
Yes	Male	12.73	8.219	256
	Female	12.40	7.661	235
No	Male	13.34	8.549	745
	Female	13.29	7.888	695

H11. The difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student race.

A two-factor ANOVA was conducted to test H11. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for race, and the two-way interaction effect (participation in the one-to-one initiative X race). The two-way interaction 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 in the interaction, $F = 0.805$, $df = 5, 1919$, $p = .546$. See Table 15 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. Although the hypothesis related to the interaction effect between participation in the one-to-one iPad initiative and student race was not supported, the mean for White students (*M* = 13.95, *SD* = 8.006) was higher than the mean for Black (*M* = 11.16, *SD* = 8.594) and Hispanic students (*M* = 11.43, *SD* = 8.067) regardless of participation in the one-to-one initiative, $F = 7.835$, $df = 5, 1919$, $p < .001$.

Table 15

Descriptive Statistics for the Results of the Test for H11

Participation	Race	*M*	*SD*	*N*
Yes	Asian	10.833	8.886	6
	Black	9.978	7.448	45
	Hispanic	9.989	8.136	88
	Multi	11.706	8.383	34
	Other	15.000	14.142	2
	White	13.775	7.654	316
No	Asian	12.632	8.812	38
	Black	11.600	8.975	120
	Hispanic	11.891	8.005	275
	Multi	13.481	8.005	79
	Other	9.667	6.154	6
	White	14.004	8.126	922

H12. The difference in MAP mathematics score gains in fifth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student SES.

A two-factor ANOVA was conducted to test H12. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect was used to test H12. 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 in the interaction, $F = 2.828$, $df = 1, 1927$, $p = .093$. See Table 16 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. Although the hypothesis related to the interaction effect between participation in the one-to-one iPad initiative and student SES was not supported, the mean for full pay students ($M = 14.24$, $SD = 8.009$) was higher than the mean for free/reduced pay students ($M = 11.38$, $SD = 8.109$) regardless of participation in the one-to-one initiative, $F = 55.935$, $df = 1, 1927$, $p < .001$.

Table 16

Descriptive Statistics for the Results of the Test for H12

Participation	SES	*M*	*SD*	*N*
Yes	Free/reduced	10.19	7.858	194
	Full pay	14.13	7.630	297
No	Free/reduced	11.79	8.162	557
	Full pay	14.28	8.136	883

RQ7. To what extent is there a difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative?

H13. There is a mean difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative.

A two-sample *t* test of independence was conducted to test H13. The two sample means (participation in the one-to-one initiative, non-participation in the one-to-one initiative) were compared. The level of significance was set at .05. The results of the two-sample *t* test indicated no difference between the two values, $t = .934$, $df = 1794$, $p = .350$. The sample mean for participation in the one-to-one initiative ($M = 8.663$, $SD = 7.712$) was not significantly different from the sample mean for non-participation in the one-to-one initiative ($M = 9.041$, $SD = 7.343$). The hypothesis was not supported by the data.

Table 17

Descriptive Statistics for the Results of the Test for H13

Participation	*M*	*SD*	*N*
Yes	8.663	7.712	451
No	9.041	7.343	1,345

RQ8. To what extent is the difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who

participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative affected by one if the following variables: student gender, student race, or student SES?

H14. The difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student gender.

A two-factor ANOVA was conducted to test H14. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student gender (male, female). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for gender, and the two-way interaction effect (participation in the one-to-one initiative X gender). The two-way interaction effect 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 in the interaction, $F = 0.213$, $df = 1, 1792$, $p = .645$. See Table 18 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. Although the hypothesis related to the interaction effect between participation in the one-to-one iPad initiative and student gender was not supported, the mean for female students ($M = 9.35$, $SD = 6.860$) was higher than the mean for male students ($M = 8.55$, $SD = 7.948$) regardless of participation in the one-to-one initiative, $F = 4.861$, $df = 1, 1792$, $p = .028$.

Table 18

Descriptive Statistics for the Results of the Test for H14

Participation	Gender	*M*	*SD*	*N*
Yes	Male	8.113	8.481	221
	Female	9.191	6.871	230
No	Male	8.694	7.769	684
	Female	9.399	6.861	661

H15. The difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student race.

A two-factor ANOVA was conducted to test H15. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for race, and the two-way interaction effect (participation in the one-to-one initiative X race). The two-way interaction 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 in the interaction, $F = 0.426$, $df = 5, 1784$, $p = .831$. See Table 19 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. Although the hypothesis related to the interaction effect between participation in the one-to-one iPad initiative and student race was not supported, the mean for White students (*M* = 9.33, *SD* = 7.232) was higher than the mean for Black (*M* = 7.70, *SD* = 8.477) and Multi students (*M* = 7.30, *SD* = 6.949) regardless of participation in the one-to-one initiative, *F* = 2.878, *df* = 5, 1784, *p* = .014.

Table 19

Descriptive Statistics for the Results of the Test for H15

Participation	Race	*M*	*SD*	*N*
Yes	Asian	9.083	8.857	12
	Black	7.294	10.394	34
	Hispanic	7.098	7.405	41
	Multi	6.567	6.652	30
	Other	6.667	0.577	3
	White	9.190	7.479	331
No	Asian	10.250	7.153	40
	Black	7.800	7.944	130
	Hispanic	8.657	7.746	245
	Multi	7.600	7.086	75
	Other	11.750	6.228	8
	White	9.387	7.137	847

H16. The difference in MAP mathematics score gains in sixth grade student achievement from fall 2014 to spring 2015 between students who participated in the one-to-one iPad initiative and students who did not participate in the one-to-one initiative is affected by student SES.

A two-factor ANOVA was conducted to test H16. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2014 to spring 2015, were participation in the one-to-one iPad initiative (yes, no) and student SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect was used to test H16. 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 in the interaction, $F = 3.297$, $df = 1, 1792$, $p = .070$. See Table 20 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. Although the hypothesis related to the interaction effect between participation in the one-to-one iPad initiative and student SES was not supported, the mean for full pay students ($M = 9.54$, $SD = 7.076$) was higher than the mean for free/reduced pay students ($M = 7.87$, $SD = 7.944$) regardless of participation in the one-to-one initiative, $F = 24.15$, $df = 1, 1792$, $p < .001$.

Table 20

Descriptive Statistics for the Results of the Test for H16

Participation	SES	*M*	*SD*	*N*
Yes	Free/reduced	6.591	8.749	132
	Full pay	9.520	7.079	319
No	Free/reduced	8.200	7.695	506
	Full pay	9.548	7.078	839

RQ9. To what extent is there a difference in fourth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year?

H17. There is a difference in fourth grade student achievement, as measured by the change in MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year.

A two-sample *t* test of independence was conducted to test H17. The average MAP mathematics score gains of students who participated in the one-to-one initiative during the 2014-2015 and 2015-2016 school years was compared with the average MAP mathematics scores of students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year. The level of significance was set at .05. The results of the two-sample *t* test indicated a statistically significant difference between the two values, t = -3.264, df = 1991, p = .001. The sample mean for participation in the one-to-one initiative for two years (M = 12.29, SD = 6.848) was higher than the sample mean for non-participation in the one-to-one initiative for one year (M = 11.12, SD = 7.29). The hypothesis was supported by the data. Fourth grade students who participated in the one-to-one initiative for two years had a greater gain in mathematics achievement than fourth grade students who participated in the one-to-one initiative for one year.

Table 21

Descriptive Statistics for the Results of the Test for H17

Participation Two Years	*M*	*SD*	*N*
Yes	12.29	6.848	545
No	11.12	7.29	1,448

RQ10. To what extent is the difference in fourth grade student achievement, as measured by the change in MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year affected by one if the following variables: student gender, race, or SES?

H18. The difference in fourth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student gender.

A two-factor ANOVA was conducted to test H18. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student gender (male, female). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student gender, and the two-way interaction effect (participation in the one-to-one initiative X student gender). The two-way interaction effect was used to test H18. 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 in the interaction, $F = 0.582$, $df = 1, 1989$, $p = .446$. See Table 22 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The hypothesis that the difference in fourth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student gender was not supported by the data.

Table 22

Descriptive Statistics for the Results of the Test for H18

Participation	Gender	*M*	*SD*	*N*
Two years	Male	12.12	7.197	263
	Female	12.45	6.515	282
One year	Male	11.23	7.501	726
	Female	11.00	7.075	722

H19. The difference in fourth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student race.

A two-factor ANOVA was conducted to test H19. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student race, and the two-way interaction effect (participation in the one-to-one initiative X race). The two-way interaction effect was used to test H19. 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 in the interaction, *F* = .858, *df* = 5, 1981, *p* = .508. See Table 23 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. Although the hypothesis related to the interaction effect between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year and student race was not supported, the means for Asian (*M* =13.66, *SD* = 7.807), Hispanic, (*M* = 11.76, *SD* = 7.774) and White students (*M* = 11.55, *SD* = 6.724) were higher than the mean for Black students (*M* = 9.56, *SD* = 8.067) regardless of participation in the one-to-one initiative, *F* = 3.141, *df* = 5, 1981, *p* = .008.

Table 23

Descriptive Statistics for the Results of the Test for H19

Participation	Race	*M*	*SD*	*N*
Two Years	Asian	12.899	10.337	9
	Black	9.725	8.217	51
	Hispanic	12.640	7.802	89
	Multi	13.220	6.428	41
	Other	11.333	11.504	3
	White	12.460	6.227	352
One Year	Asian	13.800	7.387	50
	Black	9.500	8.038	126
	Hispanic	11.498	7.759	305
	Multi	9.707	8.094	75
	Other	7.667	3.786	3
	White	11.192	6.881	889

H20. The difference in fourth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student SES.

A two-factor ANOVA was conducted to test H20. The two categorical factors used to group the dependent variable, MAP mathematics score gains, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student

SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect was used to test H20. 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 in the interaction, $F = 0.020$, $df = 1, 1989$, $p = .888$. See Table 24 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The hypothesis that the difference in fourth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student SES was not supported by the data.

Table 24

Descriptive Statistics for the Results of the Test for H20

Participation	SES	*M*	*SD*	*N*
Two years	Free/reduced	11.91	7.751	215
	Full pay	12.54	6.190	330
One year	Free/reduced	10.81	7.581	598
	Full pay	11.33	7.074	850

RQ11. To what extent is there a difference in fifth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and

2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year?

H21. There is a difference in fifth grade student achievement, as measured by the change in MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year.

A two-sample *t* test of independence was conducted to test H21. The average MAP mathematics score gains of students who participated in the one-to-one initiative during the 2014-2015 and 2015-2016 school years was compared with the average MAP mathematics scores of students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year. The level of significance was set at .05. The results of the two-sample *t* test indicated no difference between the two values, t = .275, df = 1952, p = .783. The sample mean for participation in the one-to-one initiative for one year (M = 11.88, SD = 7.503) was not different from the sample mean for participation in the one-to-one initiative for two years (M = 11.99, SD = 8.4). The hypothesis was not supported by the data.

Table 25

Descriptive Statistics for the Results of the Test for H21

Participation	*M*	*SD*	*N*
Two years	11.88	7.503	511
One year	11.99	8.4	1,443

RQ12. To what extent is the difference in fifth grade student achievement, as measured by the change in MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year affected by one if the following variables: student gender, race, or SES?

H22. The difference in fifth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student gender.

A two-factor ANOVA was conducted to test H22. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student gender (male, female). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student gender, and the two-way interaction effect (participation in the one-to-one initiative X student gender). The two-way interaction effect was used to test H22. 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 in the interaction, $F = 1.996$, $df = 1, 1950$, $p = .158$. See Table 26 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The hypothesis that the difference in fifth grade student achievement, as measured by the

MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student gender was not supported by the data.

Table 26

Descriptive Statistics for the Results of the Test for H22

Participation	Gender	*M*	*SD*	*N*
Two years	Male	12.20	7.736	275
	Female	11.50	7.220	236
One year	Male	11.76	8.942	743
	Female	12.25	7.782	700

H23. The difference in fifth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student race.

A two-factor ANOVA was conducted to test H23. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student gender, and the two-way interaction effect (participation in the one-to-one initiative X race). The two-way interaction effect was used to test H23. 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 in the interaction, $F = 1.084$, $df = 5, 1942$, $p = .367$. See Table 27 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. Although the hypothesis related to the interaction effect between participation in the one-to-one iPad initiative and student race was not supported, the main effect for race was supported, $F = 10.306$, $df = 5, 1942$, $p < .001$. The means for Asian ($M = 12.73$, $SD = 7.807$), Hispanic ($M = 10.79$, $SD = 7.473$), Multi ($M = 11.52$, $SD = 8.346$), and White students ($M = 12.87$, $SD = 7.958$) were higher than the Black students ($M = 7.95$, $SD = 9.548$) regardless of participation in the one-to-one initiative. Additionally, the mean for White students ($M = 12.87$, $SD = 7.958$) was higher than the mean for Hispanic students ($M = 10.79$, $SD = 7.473$) regardless of participation in the one-to-one initiative.

Table 27

Descriptive Statistics for the Results of the Test for H23

Participation	Race	*M*	*SD*	*N*
Two Years	Asian	13.286	7.205	14
	Black	8.447	7.225	38
	Hispanic	10.978	6.794	91
	Multi	9.174	7.797	23
	Other	-6.000	0.000	1
	White	12.672	7.513	344
One Year	Asian	12.563	8.040	48
	Black	7.806	10.151	129
	Hispanic	10.730	7.690	282
	Multi	12.282	8.428	71
	Other	8.000	10.464	5
	White	12.952	8.123	908

H24. The difference in fifth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student SES.

A two-factor ANOVA was conducted to test H24. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years,

participated 1 year) and student SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect was used to test H24. 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 in the interaction, $F = .027$, $df = 1, 1950$, $p = .870$. See Table 28 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. Although the hypothesis related to the interaction effect between participation in the one-to-one iPad initiative and student SES was not supported, the mean for full pay students ($M = 13.16$, $SD = 7.866$) was higher than the mean for free/reduced pay students ($M = 10.08$, $SD = 8.295$) regardless of participation in the one-to-one initiative, $F = 60.430$, $df = 1, 1950$, $p < .001$.

Table 28

Descriptive Statistics for the Results of the Test for H24

Participation	SES	*M*	*SD*	*N*
Two years	Free/reduced	10.02	6.930	193
	Full pay	13.01	7.622	318
One year	Free/reduced	10.10	8.717	566
	Full pay	13.22	7.956	877

RQ13. To what extent is there a difference in sixth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and

2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year?

H25. There is a difference in sixth grade student achievement, as measured by the MAP mathematics score gains, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year.

A two-sample *t* test of independence was conducted to test H25. The average MAP mathematics score gains of students who participated in the one-to-one initiative during the 2014-2015 and 2015-2016 school years was compared with the average MAP mathematics scores of students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year. The level of significance was set at .05. The results of the two-sample *t* test indicated a statistically significant difference between the two values, $t = -2.242$, $df = 1901$, $p = .025$. The sample mean for two years of participation in the one-to-one initiative ($M = 11.27$, $SD = 7.595$) was higher than the sample mean for one year participation in the one-to-one initiative ($M = 10.44$, $SD = 6.993$). Sixth grade students who participated in the one-to-one initiative for two years had a greater gain in mathematics achievement than sixth grade students who participated in the one-to-one initiative for one year.

Table 29

Descriptive Statistics for the Results of the Test for H25

Participation	*M*	*SD*	*N*
Two years	11.27	7.595	501
One year	10.44	6.993	1,402

RQ14. To what extent is the difference in sixth grade student achievement, as measured by the change in MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year affected by one if the following variables: student gender, race, or SES?

H26. The difference in sixth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student gender.

A two-factor ANOVA was conducted to test H26. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student gender (male, female). The two-factor ANOVA was used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student gender, and the two-way interaction effect (participation in the one-to-one initiative X student gender). The two-way interaction effect was used to test H26. 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 in the interaction, $F = 0.259$, $df = 1, 1899$, $p = .611$. See Table 30 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. The hypothesis that the difference in sixth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student gender was not supported by the data.

Table 30

Descriptive Statistics for the Results of the Test for H26

Variable	Gender	*M*	*SD*	*N*
Two years	Male	11.16	7.850	275
	Female	11.41	7.289	226
One year	Male	10.50	7.280	717
	Female	10.37	6.683	685

H27. The difference in sixth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student race.

A two-factor ANOVA was conducted to test H27. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years, participated 1 year) and student race (Asian, Black, Hispanic, Multi, Other, White). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student race, and the two-way interaction effect (participation in the one-to-one initiative X race). The two-way interaction effect was used to test H27. The level of significance was set at .05. The results of the analysis indicated a statistically significant interaction, $F = 3.070$, $df = 5, 1891$, $p = .009$. A follow-up post hoc was conducted to determine which pairs of means were different. Although the results were statistically significant for the interaction effect, the Tukey's HSD post hoc did not detect pairs of means that were statistically significant because of sample size issues. See Table 31 for the means and standard deviations for this analysis. The results indicated that the mean for White students ($M = 11.25$, $SD = 6.804$) was greater than the mean for Black ($M = 9.18$, $SD = 7.909$) and Hispanic students ($M = 9.51$, $SD = 7.581$) regardless of the number of years the student was involved in the one-to-one iPad initiative, $F = 7.351$, $df = 5, 1891$, $p = .000$. Although not statistically significant, the gap between the White students and the Black and Hispanic students was greater for the students who were involved in the one-to-one initiative for two years. To some extent, the hypothesis was supported by the data.

Table 31

Descriptive Statistics for the Results of the Test for H27

Participation	Race	*M*	*SD*	*N*
Yes	Asian	10.800	7.981	5
	Black	6.854	8.425	48
	Hispanic	10.059	6.733	101
	Multi	10.000	9.368	34
	Other	12.000	12.728	2
	White	12.489	7.198	311
No	Asian	11.559	6.510	34
	Black	10.108	7.530	120
	Hispanic	9.300	7.888	260
	Multi	9.924	7.161	79
	Other	7.750	6.292	4
	White	10.821	6.614	905

H28. The difference in sixth grade student achievement, as measured by the MAP mathematics score gains from fall 2015 to spring 2016, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year, is affected by student SES.

A two-factor ANOVA was conducted to test H28. The two categorical factors used to group the dependent variable, MAP mathematics score gains from fall 2015 to spring 2016, were participation in the one-to-one iPad initiative (participated 2 years,

participated 1 year) and student SES (free/reduced, full pay). A two-factor ANOVA is used to test three hypotheses including the main effect for participation in the one-to-one iPad initiative, the main effect for student SES, and the two-way interaction effect (participation in the one-to-one initiative X SES). The two-way interaction effect was used to test H28. The level of significance was set at .05. The results of the analysis indicated a statistically significant interaction within the variables lunch and one-to-one, $F = 6.755$, $df = 1, 1899$, $p = .009$. A follow-up post hoc was conducted to determine which pairs of means were different. See Table 32 for the means and standard deviations for this analysis. The results for the post hoc indicated that the mean for full pay students who participated for two years ($M = 12.75$, $SD = 7.136$) was greater than the mean for free/reduced pay students who participated for two years ($M = 8.83$, $SD = 7.716$). The results indicated that the mean for full pay students was greater than the mean free/reduced pay students regardless of the number of years the student was involved in the one-to-one iPad initiative, $F = 60.430$, $df = 1, 1899$, $p = .000$. The gap between the full pay and free/reduced pay was greater for the students who were involved in the one-to-one initiative for two years. The hypothesis was supported by the data.

Table 32

Descriptive Statistics for the Results of the Test for H28

Participation	SES	*M*	*SD*	*N*
Two years	Free/reduced	8.825	7.716	189
	Full pay	12.753	7.136	312
One year	Free/reduced	9.204	7.531	520
	Full pay	11.163	6.551	882

The data analysis of the one-to-one schools compared with the one-to-many schools showed no significant differences in mathematics growth at every grade level. The data analysis also showed that there were no statistically significant interaction effects of student gender, race, and SES. However, there were main effects related to the hypotheses tests. See Table 33 for the summary of results for RQ1-RQ8.

Table 33

Summary Results by RQ1-RQ8– One-to-One iPad Initiative

RQ	Grade	H	One to One Intervention Program	p-value	Supported
1	Third	1	Mean difference between treatment groups	0.103	No
2		2	Interaction of Treatment and Gender	0.644	No
		3	Interaction of Treatment and Race	0.977	No
		4	Interaction of Treatment and SES	0.147	No
3	Fourth	5	Mean difference between treatment groups	0.921	No
4		6	Interaction of Treatment and Gender	0.784	No
		7	Interaction of Treatment and Race	0.104	No
		8	Interaction of Treatment and SES	0.470	No
5	Fifth	9	Mean difference between treatment groups	0.082	No
6		10	Interaction of Treatment and Gender	0.743	No
		11	Interaction of Treatment and Race	0.547	No*
		12	Interaction of Treatment and SES	0.093	No*
RQ 7	Sixth	13	Mean difference between treatment groups	0.350	No
RQ 8		14	Interaction of Treatment and Gender	0.654	No*
		15	Interaction of Treatment and Race	0.831	No
		16	Interaction of Treatment and SES	0.070	No*

Note. * = one or more main effects were significant.

When comparing students who participated in the one-to-one initiative for one year with students who participated for two years, the results of the data analysis determined four significant differences. There was a significant difference in fourth and sixth grade students who participated in the initiative for two years. Data analysis also showed a significant interaction effect for sixth grade students and race and students SES. Main effect differences were found related to the analysis of three of the hypotheses where there was no interaction effect. See Table 34 for the summary of results for RQ9-RQ14.

Table 34

Summary Results by RQ9-RQ14– Two Years versus One Year of Implementation

RQ	Grade	H	One to One Intervention Program	p-value	Supported
9	Fourth	17	Mean difference between treatment groups	0.001	Yes
10		18	Interaction of Treatment and Gender	0.446	No
		19	Interaction of Treatment and Race	0.508	No*
		20	Interaction of Treatment and SES	0.888	No
11	Fifth	21	Mean difference between treatment groups	0.783	No
12		22	Interaction of Treatment and Gender	0.158	No
		23	Interaction of Treatment and Race	0.367	No*
		24	Interaction of Treatment and SES	0.870	No*
13	Sixth	25	Mean difference between treatment groups	0.025	Yes
14		26	Interaction of Treatment and Gender	0.611	No
		27	Interaction of Treatment and Race	0.009	Yes
		28	Interaction of Treatment and SES	0.009	Yes

Note. * = one or more main effects were significant.

Summary

Chapter four included the data analysis and the hypothesis testing for the research questions that relate to the one-to-one iPad initiative in District S. Chapter five contains a study summary, including an overview of the problem, review of the methodology and major findings. In additional, chapter five contains findings related to the literature, recommendations for future research, and conclusions.

Chapter Five

Interpretation and Recommendations

Across the nation, school districts are implementing technology initiatives in an attempt to improve student performance and prepare students for their future in the increasingly competitive workplace. In 2014, District S implemented a one-to-one iPad initiative at ten elementary schools, while students at the remaining 23 schools had shared use of iPads. The following year, students at these 23 one-to-many schools were provided with additional iPads to join the one-to-one initiative. This study was conducted to compare the difference in math achievement growth between the students at the one-to-one schools with the students at the one-to-many schools, and to compare the difference in math achievement growth between the students who participated in the initiative for two years and students who participated for one year. This chapter includes a study summary, findings related to the literature, and conclusions.

Study Summary

This section provides a summary of the current study. The summary includes an overview of the problem concerning the implementation of technology initiatives and the effect of the implementation on student achievement in mathematics. The purpose statement, research questions, and methodology are reviewed. Finally, major findings of the study are explained.

Overview of the problem. School districts across the country are spending large amounts of money to implement technology initiatives in schools (Goodwin, 2011). According to Herald (2016a), "In 2013 and 2014 alone, schools purchased more than 23 million laptops, tablets, and Chromebooks" (para. 10). District S joined this rapidly growing movement and began a one-to-one technology initiative in 2014. Understanding the impact that technology initiatives have on student learning might help school districts make decisions regarding purchasing new technology and maintaining existing technology.

Purpose statement and research questions. The first purpose of this study was to determine whether there were differences in third through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative and students who did not participate in the initiative during the 2014-2015 school year and participated in the one-to-many initiative. The second purpose of this study was to determine whether the differences in third through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative and students who did not participate in the initiative during the 2014 – 2015 school year were affected by one if the following variables: student gender, race, or SES. The third purpose of this study was to determine whether there were differences in fourth through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative for their second year and students who participated in the one-to-one initiative for their first year during the 2015-2016 school year. The fourth purpose of this study was to determine whether the differences in fourth through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative for their second year and students who participated in the one-to-one initiative for their first year during the

2015-2016 school year were affected by one if the following variables: student gender, race, or SES. To guide this study, 14 research questions were developed, and 28 hypotheses were tested to address the purposes of the study.

Review of the methodology. A quantitative quasi-experimental design using archival data was used for this study. The independent variables used for the study were student participation in the one-to-one initiative, student gender, student race, and student SES. All third, fourth, fifth and sixth grade students enrolled in District S during the 2014-2015 school year who took the MAP mathematics assessment were included in this study. Additionally, all fourth, fifth, and sixth grade students enrolled in District S during the 2015-2016 school year who took the MAP mathematics assessment were included. One-sample *t* tests and two-factor ANOVAs were conducted to test the hypotheses.

Major findings. The results of the data analysis related to RQ1, RQ3, RQ5, and RQ7, which dealt with the differences in third through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative and students who did not participate in the initiative during the 2014-2015 school year indicated there was no significant difference in the mathematics gain of these groups of students. The hypotheses associated with these research questions were not supported. However, at each grade level, the students who participated in the one-to-one initiative had a lower mean gain than non-participants.

The data analysis related to RQ2, RQ4, RQ6, and RQ8 showed no interaction effects for student gender, race, or SES on the differences between students who participated in the one-to-one initiative and students who did not participate in the initiative; therefore, the hypotheses associated with these research questions were not supported. However, there were four main effects. Fifth grade White students had a significantly higher mean gain than did Black and Hispanic students. Fifth grade students on full pay lunch status had a significantly higher mean gain than did free/reduced lunch status students. In sixth grade, females had a significantly higher mean gain than did males. Sixth grade students on full pay lunch status had a significantly higher mean gain than free/reduced lunch status students.

The results of the data analysis for RQ9 and RQ13, which dealt with the differences in fourth and sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative for two years and students who participated in the initiative for one year indicated statistically significant differences in the mathematics gain for these groups of students. The hypotheses associated with these research questions were supported. The students who participated in the one-to-one initiative for two years had a higher mean gain than did the students who participated for one year. The results of the data analysis for RQ11, which dealt with the differences in fifth grade student achievement as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative for two years and students who participated in the initiative for one year indicated there was no statistically significant difference in the mathematics gain for those groups of students. The hypothesis associated with this research question was not supported.

The data analysis related to RQ10 and RQ12 showed no interaction effects for student gender, race, or SES on the differences between fourth and fifth grade students who participated in the one-to-one initiative for two years and students who participated for one year; therefore, the hypotheses associated with these research questions were not supported. However, there were three main effects associated with these research questions. Fourth grade Hispanic and White students both had higher mean gains than did Black students. Fifth grade Hispanic and White students had a higher mean gain than did Black students. Finally, fifth grade full pay lunch students had a higher mean score than did the free/reduced lunch students. The results of the data analysis related to RQ14 showed no interaction effect for student gender on the differences between sixth grade students who participated in the one-to-one initiative for two years and students who participated for one year, but there was an interaction effect for student race and student SES. Sixth grade White students had a higher mean gain than did Black and Hispanic students. Sixth grade full pay lunch students had a higher mean gain than did free/reduced pay students. Hence, two of the hypotheses related to RQ14 related to race and SES were supported.

Findings Related to the Literature.

This section examines the current study's findings as they relate to the literature regarding the impact of one-to-one initiatives on student academic achievement and whether the differences were affected by student gender, race, and SES. The results of the studies included in the literature review found that the use of technology did have a statistically significant difference on student achievement (Boccella, 2015; Cottone, 2013; Gulek & Demirtas, 2005; Herold, 2016a; Lambert, 2014; Middleton & Murray, 1999; Silvernail & Gritter, 2007). The current study results support these findings for fourth and sixth grade students who participated in a one-to-one initiative for two years.

These students made statistically significant gains in mathematics achievement when compared with students who only participated in the initiative for one year. In contrast to these studies, the results of the current study indicated that the one-to-one technology initiative did not make a statistically significant difference for students in third through sixth grade during the pilot year when only 10 schools participated in the initiative. Additionally, the current study differs from these findings because fifth grade students who participated in the initiative for two years did not have significant mathematics gains when compared with fifth grade students who participated for one year.

The results of other studies included in the literature review indicated that technology initiatives did not have a statistically significant impact on student achievement (Dunleavy & Heinecke, 2007; Carr, 2012; Casey, 2014). The current study supports these findings because third through sixth grade students did not have a statistically significant gain in mathematics achievement when participating in a one-to-one initiative when compared to the one-to-many students. The current study has two findings that differ with these results. After two years of implementation, the results of this study found that fourth and sixth grade students did have a statistically significant gain in mathematics achievement.

The findings of a study conducted by Boccella (2015) in a one-to-one elementary school showed that one year of a technology initiative resulted in lower mathematics achievement from students. However, the study showed significant growth after the second year of implementation. The results from this study supported this finding at two grade levels. While there was not a significant difference, student growth in mathematics was lower for students who participated in the one-to-one initiative at every grade level that was studied during the pilot year. After two years of implementation, fourth and sixth grade students showed a statistically significant growth in mathematics achievement when compared with students who participated in the initiative for one year.

This study also examined whether student gender, race, or SES affected mathematics student achievement. Only one study in the literature review had a finding that showed that gender affected student achievement when using technology, with male students scoring higher than females (Dunleavy & Heinecke, 2007). The current study differs from this because no statistically significant effect for student gender on mathematics achievement was found. Casey (2014) found academic achievement increased for fifth and eighth grade Hispanic and Black students who participated in a technology initiative. The current study also found that race did influence student achievement for sixth grade students who participated in the technology initiative for two years. However, this result differs from Casey (2014) because White students had a higher mathematics gain than Black and Hispanic students. This study also showed some main effect interactions for student race: fifth grade White students in the one-to-one initiative had higher gains than Black and Hispanic students, fourth grade White and Hispanic students in the initiative for two years had higher gains than Black students, and fifth grade White and Hispanic students in the imitative for two years had higher gains than Black students. No findings related to student SES could be found in the literature review.

Conclusions

This section provides conclusions drawn from the current study regarding the impact that District S's one-to-one initiative had on student mathematics achievement after one year and two years of implementation. Implications for action and recommendations for future research are included. This section ends with concluding remarks.

Implications for action. Research conducted on effective implementation of technology initiatives provides implications for District S. Greaves, Wilson, & Gielniak (2017) found that the relationship between a building principal's leadership and a one-to-one initiative is imperative because, "When a principal used change management strategies to lead the school, students showed a statistically significant and educationally meaningful positive relationship in mathematics proficiency levels" (p. 4). The fidelity of technology implementation is also pertinent for District S, as programs implemented with high fidelity are associated with higher levels of success (Greaves et al., 2017). District S should ensure that building principals are effectively implementing the technology initiative in their schools, and the District should implement the initiative with fidelity across the district.

The results of this study have implications that can help District S improve student achievement in mathematics. Since there were no significant differences between third through sixth grade students who participated in the one-to-one laptop initiative and students who did not participate in the initiative during the 2014-15 school year, one year of implementation may not be a true indication of the effects of the initiative. District S could analyze how individual building administrators implemented the initiative. District administrators may also need to look at the implementation plan to analyze whether teachers in the one-to-one schools truly implemented the use of technology into mathematics instruction. Additionally, the district may need to look at how strategically the rollout was conducted to identify ways to improve future initiatives.

Data analysis showed a significant difference between fourth and sixth grade students who participated in the one-to-one initiative for two years and students who participated for one year. Therefore, two years of implementation did positively impact student mathematics achievement for two grade levels. The district should continue to invest in the iPad initiative, including providing needed equipment updates, technology support, and teacher professional development.

This study also has implications related to the achievement gap between students from different SES backgrounds. Because the full pay lunch students made higher gains in mathematics than free/reduced lunch students regardless of participation in the one-to-one initiative, the district may not be meeting the needs of students from low SES backgrounds. District S may need to investigate whether low SES families need help in accessing support programs so students can be successful in the classroom. Teachers could also employ strategies to improve home support from low SES families.

The results of this study showed that White students are making greater mathematic gains than Black and Hispanic students regardless of participation in the one-to-one initiative. White student mathematic gains were higher when students participated in the initiative for two years, while Black student scores lowered and Hispanic gains stayed relatively stagnant. This data analysis shows that there is an achievement gap between White and minority students in District S. District leaders may need to analyze the mathematics instruction provided in district elementary schools and find out if minority students are receiving adequate learning opportunities as compared to their

White peers. The district should provide teacher professional development in how to meet the academic needs of diverse students. Furthermore, District S could examine whether differences exist between student's home access to technology, and if these differences contribute to the achievement gap.

Recommendations for future research. This study provided data to add to the low number of research studies conducted on one-to-one initiatives in elementary schools and their impact on student mathematics achievement. While this study provided implications for districts regarding technology implementation, there are other areas that should be explored. The following are recommendations for further research related to this topic.

1. This study only looked at student gains after the initiative was implemented in District S during the pilot year and the first full year of implementation. Future research could compare the mathematics gains in District S before the implementation of the one-to-one initiative with mathematics gains one, two, and three years after the implementation.
2. This study used a quantitative design. Future research could include a mixed methods or qualitative design in which the researcher gathers teacher, student, and parent perceptions of the technology initiative in District S. Data collection could include surveys, observations, and interviews.
3. This study was conducted in a suburban district. Future research could be conducted in rural or urban districts. Additionally, comparisons might be made among all three types of districts.

4. Future research could be conducted to analyze the way that teachers utilized the technology in their classrooms and how this affects student mathematics achievement. Data could be collected through classroom observations and teacher reports of instructional methods used with technology.
5. District S's goals for the technology initiative were to change the way that teaching and learning occurs, promote project-based learning opportunities, and individualize instruction. Research could be conducted to analyze how the initiative impacts these areas.
6. Future research could analyze the achievement gap between free/reduced and full pay students and minority groups in District S from prior years. These results could be used to determine whether the gap between these subgroups has decreased since the inception of the one-to-one initiative.
7. Because of the importance of building principal leadership on the success of technology initiatives, future research could be conducted related to the principal's role in implementing technology. Building principals could be surveyed on topics such as the amount and type of teacher professional development provided, the monitoring of teacher implementation of technology, and the support and encouragement provided to teachers.
8. Finally, research could be conducted using other subject areas as a focus. The researcher could analyze assessment scores in reading, writing, science, or social studies to see how a one-to-one technology initiative impacts student learning in those areas.

Concluding remarks. School districts across the country are incorporating technology in classroom instruction for a variety of reasons. Some educational leaders hope that technology will positively impact student achievement. Another goal of technology in schools is to prepare students for their future work environment and provide students with 21st Century technology skills. It is imperative to have research to provide a rationale for investing large amounts of time, resources, and money into technology initiatives in schools. This study provided data to add to the limited number of studies on how one-to-one initiatives impact elementary student achievement. The results of this study indicated that one year of implementation does not impact student achievement, but after two years of one-to-one participation, students can have greater gains in mathematics.

Technology has the potential to provide deeper learning opportunities for students. Current research on the impact of technology on student achievement has varied results, so additional research in this area is needed (Bebell & Kay, 2010; Carr, 2012; Gulek & Demirtas, 2005; Kuyatt et al., 2015; Middleton & Murray, 1999; White & Martin 2012). Educational leaders need to strive for smooth implementation of new technology initiatives to ensure that students receive the full benefits that technology can offer.

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Appendices

Appendix A: Baker IRB Proposal 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 Rogers	Major Advisor
2. Dr. Phil Messner	Phil Messner	Research Analyst
3. Dr. Verneda Edwards		University Committee Member
4. Dr. Christy Ziegler		External Committee Member

Principal Investigator: Emily K. Cline Emily K. Cline
Phone: 913 961 3936
Email: twcline@smsd.org
Mailing address: 7509 W. 98th Terrace Overland Park, KS 66212

Faculty sponsor: Susan Rogers
Phone: 913 344 1227
Email: susan.rogers@baker.edu

Expected Category of Review: _X_Exempt ___ Expedited ___Full

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

The Impact of One-to-one iPad Technology on Student Achievement as Measured by MAP Math Assessments

Summary

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

This study will be conducted in the [redacted] School District. The purpose of this study is to determine whether there are differences in third through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative and students who did not participate in the initiative during the 2014-2015 school year and whether these differences are affected by student gender, race, or socioeconomic status. Another purpose of this study is to determine whether there are differences in fourth through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year and whether these differences are affected by student gender, race, or socioeconomic status.

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

There will not be any conditions or manipulation in this study.

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.

The instrument used to measure mathematics growth in grades three through six is the NWEA MAP math assessment. The NWEA MAP math assessment is a multiple choice computer adaptive test that measures student growth from the fall to spring.

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

There will be no stress to subjects involved.

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

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

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

There will be no request for information which subjects might consider to be personal or sensitive.

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 which might be considered to be offensive, threatening, or degrading.

Approximately how much time will be demanded of each subject?

The study will not require any extra time from the subjects because archival data will be used.

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

The subjects will be third through sixth grade students enrolled in [redacted] Schools during the 2014-2015 school year and fourth through sixth grade students enrolled in [redacted] Schools during the 2015-2016 school year. Since archival data will be used, no solicitation is necessary.

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?

No inducements will be offered to subjects for their participation.

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.

Archival data will be used so no subject consent is needed.

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

No data from the study will be made a part of any permanent record that can be identified with the subject.

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

No data from the study will be made a part of any permanent record that can be identified with the subject.

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?

The data will be stored electronically under a secured password by the researcher. The data will be stored for approximately one year. After the study is completed, the 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.

NWEA MAP mathematics assessment data for grades third through sixth from the 2014-2015 school year and grades fourth through sixth from the 2015-2016 school year will be used.

Appendix B: District S Research Request Form

REGULATIONS & PROCEDURES FOR RESEARCH PROJECTS

[redacted]

FORM A: Please complete this form and attach the pertinent details regarding your proposal.

Date: December 22, 2016

Emily K. Cline	emilycline@[redacted]org
(Name)	(email)
7509 W. 98th Terrace	913-961-3936
(Mailing Address)	(Telephone)
Overland Park	Kansas
(City)	(State) (Zip)

The research is for: Master's ___ Specialist ___ Ed.D. X Ph.D. ___ Other ___

Project Title or Descriptor:
The Impact of One-to-one iPad Technology on Student Achievement as Measured by MAP Math Assessments.

Has the project been submitted to a committee on human experimentation?
Yes X No ___
If no, please explain:
An institutional review board request has been made to Baker University.

Do you have an Institutional Review Board (IRB) approval for your research?
Yes ___ No X
If no, please explain:
The form has been submitted and approval is expected by January 15, 2017

Participant Description: 3rd, 4th, 5th & 6th grade students for 2014-15 and 4th, 5th & 6th grade students for 2015-16

Number of Schools: 33
Number of Teachers: ___
Number of Students: See participant decscription

Type of Research Design: Quantitative

Anticipated Dates: Data need for the school years Beginning: Fall 2014 Ending: May 2016
Final Report Available: 5/1/17

Send to: [redacted]

Basic List of Documents to Submit for Review

- Brief overview of the research literature and research question(s).
    - Include estimated timeline

The purpose of this study is to determine whether there are differences in third through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative and students who did not participate in the initiative during the 2014-2015 school year and whether these differences are affected by student gender, race, or socioeconomic status. Another purpose of this study is to determine whether there are differences in fourth through sixth grade student achievement, as measured by the change in MAP mathematics assessment scores, between students who participated in the one-to-one iPad initiative during the 2014-2015 and 2015-2016 school years and students who did not participate in the initiative during the 2014-2015 school year but did participate during the 2015-2016 school year and whether these differences are affected by student gender, race, or socioeconomic status.

Data is needed for 3rd, 4th, 5th, and 6th grade students for the 2014-2015 school year and 4th, 5th, and 6th grade students for the 2015-2016 school year.

The data is needed around 2/01/17 with an estimated date of defense around 5/01/17.

- Any tools that will be used for data collection (example: surveys or tests)

NWEA MAP mathematics assessment data for grades third through sixth from the 2014-2015 school year and grades fourth through sixth from the 2015-2016 school year will be used.

- A list of data fields needed (if asking for archival data)

Student ID, school name, gender, race, socioeconomic status, grade during 2014-4015 school year, Fall 2014 MAP Math RIT score, Spring 2015 MAP Math RIT score, Fall 2015 MAP Math RIT Score, Spring 2016 MAP Math RIT score.

Gender (M,F), SES Status (F/R [0] or Full Pay [1]), Race (White (W), African-American (AA), Hispanic (H), Other (O)).

- Drafts of consent/permission forms

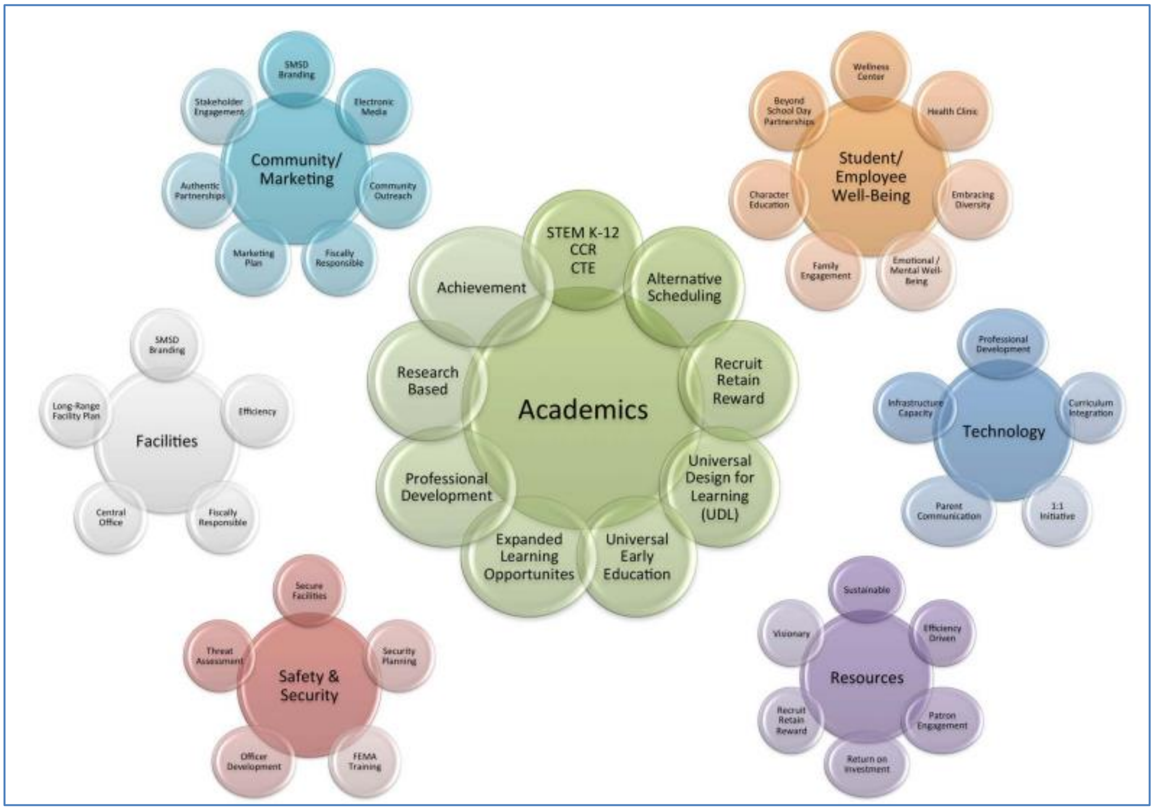
No consent is necessary as only archival data is being requested.

- Human subjects and/or IRB approval documents

See attached copy of the Baker University IRB form.

References to Strategic Plan

This research proposal aligns with the [redacted] Strategic Plan because it will provide information on how the district 1:1 technology initiative affected 3^{rd}, 4^{th}, 5^{th}, and 6^{th} grade student achievement in mathematics.



[redacted]

Regulations and Procedures
For
Research Projects

The [redacted] School District receives many requests to conduct research on educational programs and services. Guidelines have been established to aid persons or organizations seeking permission to utilize facilities, staff, or students in research endeavors. It is necessary to:

1. Protect the rights of the district, its staff, its patrons, and its students.
2. Ensure that the research process does not unduly interfere with the education endeavors of the district.
3. Provide the district with the results of such research in order to improve the educational process.

STEPS FOR OBTAINING
PERMISSION TO CONDUCT RESEARCH

1. Submit a completed copy of this application and a complete description of the proposed research project, including the instruments or tests to be used, and any

pertinent consent or recruitment documents, to the person designated by the district as responsible for approving research requests.
2. The designated approver will work with affected school campuses and/or district departments to review the request.
3. After review, the research will be approved, not approved, or approved providing some changes take place.
4. At the conclusion of the study, a copy of the results of the research shall be provided to the district assessment and research department.

Administration of Student Surveys and Other Data Collection on Students

Under the provisions of the Protection of Pupil Rights Amendment (PPRA), parents of students and eligible students (those who are 18 or older) are afforded various rights with regard to the administration of any student surveys at school. In accordance with PPRA, the following must be adhered to.

1. Parents or eligible students have the right to inspect any survey created by a third party before it is administered or distributed to students in the school. This means that parents or guardians of minors must be notified and given the opportunity to see the survey.
2. If the survey is federally funded (in whole or in part) schools must obtain written parental consent before minor students may be required to participate in any survey.

Kansas Student Data Privacy Act (SB 367)

SB 367 prohibits school districts from collecting biometric data or assessing a student's psychological or emotional state unless written consent is granted. The bill prohibits the administration of any test, questionnaire, survey, or examination containing questions regarding a student's or student's parents' or guardians' beliefs or practices on issues such as sex, family life, morality, or religion, unless permission is requested in writing and granted by a student's parent or guardian.

Given the vague nature of this bill in particular, assume that any survey collection, student observation, or non-archival collection of student data requires parent/guardian consent.

Appendix C: Baker IRB Acceptance Approval Letter

Baker University Institutional Review Board

January 4, 2017

Dear Emily Cline 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 EMorris@BakerU.edu or 785.594.7881.

Sincerely,

Erin Morris PhD
Chair, Baker University IRB

Baker University IRB Committee
Joe Watson PhD
Nate Poell MA
Susan Rogers PhD
Scott Crenshaw