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1:1 Laptop Experience And High-Stakes Testing: Effects On Eighth-Grade Student Achievement

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1:1 LAPTOP EXPERIENCE AND HIGH-STAKES TESTING: EFFECTS ON EIGHTH-GRADE STUDENT ACHIEVEMENT

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ABSTRACT

Research on 1:1 laptop implementations is missing key information about student achievement on high-stakes assessment. This post hoc, quasi-experimental, quantitative study explores how 1:1 laptop access affects student achievement on the mandated eighth-grade online science assessment in five Mississippi school districts throughout the state. Fifth-grade science assessment results are used as a baseline for student achievement. Three research questions examined mean scale scores on the science assessment, change in scores from fifth to eighth-grade, and the effect on scale scores as the duration of the 1:1 laptop implementation increased. Two of the three experimental districts showed a significant difference in the mean scale scores. All three experimental districts showed statistically significant change in scale scores from fifth to eighth-grade. However, one of the control districts had higher scale scores than the comparable experimental district. Because of the mixed finding among the school districts, additional research should be conducted. Helpful information is provided for school administrators who are considering a 1:1 laptop implementation for their schools.

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Since 2010, our nation has seen more emphasis on stringent testing at all K-12 grade levels than ever before in the history of public education in the United States (Bennett, 2015; Quellmalz, Timms, Silberglitt, & Buckley, 2012). The high-stakes testing of the 2010's is unique in the amount of online or technology-based testing used (Chu, 2014; DeBoer et al., 2014). To prepare students and obtain the tools for these high-stakes assessments, school district personnel must justify to their school board, and to the community, the significant expense of a technology project (Smarkola, 2007). This cost benefits analysis requires information supporting both the necessity of the project as well as the expected gain from such a significant outlay of school district funds (Keppler, Weiler, & Maas, 2014). As parents and community members become more knowledgeable about educational data, schools are obligated to provide more than a white paper presented by the company selling the technology. Taxpayers want to know the return on investment (ROI) from technology purchases (Krueger, 2013). According to Krueger (2013), "assessing the value of proposed technology projects is vital if you as a technology leader want to have credibility with your school board, CFO, superintendent and community" (p. 28). Administrators must utilize current research to demonstrate to their constituency the need for new technology in the classrooms which is the purpose of this study.

In 1:1 laptop initiatives, schools and/or districts provide each student with a laptop. In some models, students are allowed to take the laptops home from school, and others maintain the computers at the school. During the early 2000's many schools adopted 1:1 laptop initiatives as their technology project. Maine was the first state to create such a project providing laptops to all public school middle school students (Silvernail & Lane, 2004). Michigan's Freedom-to-Learn program (Lowther, Strahl, Inan, & Bates, 2007) and the Texas Technology Immersion Pilot (Texas Center for Educational Research, 2009) are other examples of large-scale laptop projects.

Another major push during the start of the 21st century was the need for a new set of skills including technology aptitudes such as typing, internet search techniques, research, and recognition of bias in websites. These skills are commonly referred to as "21st century skills" and were developed into a set of standards to guide teachers and students (ISTE, 2012). From the implementation of 1:1 projects and the new technology standards, many studies about the implementations were conducted (Bebell, 2005; Downes & Bishop, 2015; Lane, 2003; Lemke & Martin, 2003; Muir, Knezek, & Christensen, 2004; Texas Center for Educational Research, 2009). In particular, a 2012 study found while student performance was not significantly different on achievement tests, students with computers significantly outperformed the control group on 21st century skills (Lowther, Inan, Ross, & Strahl, 2012).

Most of the research on 1:1 implementations in the past decade has focused on student engagement, teacher implementation, or student grades (Bebell & Kay, 2010; Bebell & O'Dwyer, 2010; Cavanaugh, Dawson, & Ritzhaupt, 2011; Cifuentes, Maxwell, & Bulu, 2011; Downes & Bishop, 2015; Lei & Zhao, 2008; Prettyman, Ward, Jauk, & Awad, 2012; Rutledge, Duran, & Carroll-Miranda, 2007; Storz & Hoffman, 2013; Swallow, 2015; Waters, 2009; Zuniga, 2010). In 2013 a meta–analysis study was published reviewing fifty-eight research studies to determine the impact of teaching and learning with technology use (Lee, Waxman, Wu, Michko, & Lin, 2013). While the meta-analysis showed a positive effect on teaching and learning, none of the studies discussed high-stakes testing or the impact of the technology on such examinations. Studies in both South Korea and the United States show improved academic achievement and improved student perception of their abilities in science during a ubiquitous laptop project but did not discuss the effect on high-stakes testing (Incantalupo, Treagust, & Koul, 2014). The results of this research project will further this line of study as the effects of 1:1 implementations on high-stakes assessment is examined.

Some studies of 1:1 implementations discuss the negative impact these implementations have on student scores on high-stakes assessments (Anderson, 2009; Becker, 2000). Both studies expressed teacher frustration with a lack of best practices for technology-based learning because of the need for traditional teaching to the tests. Cifuentes, Maxwell, and Bulu (2011) go on to suggest the typical rote teaching methods used for high-stakes tests interfere with the student-centered approach needed for effective 1:1 classroom teaching.

High-stakes testing is part of the requirements put in place by the federal government in the Elementary and Secondary Education Act (ESEA). In 2001, ESEA was revised to include required testing for English and mathematics in grades three through high school and renamed the No Child Left Behind Act of 2001 (NCLB) (USDE, 2001). In the 2016-2017 school year the newest version of ESEA, know as Every Student

Succeeds Act (ESSA), will be implemented; this version of the Act will allow states to have more control over their high-stakes testing but does not remove the requirements to test students in English and mathematics in grades three through high school (USDE, 2016). While the new version of ESEA gives states more control over curriculum and testing teachers still must prepare their students for these high-stakes assessments. To help students, educators should teach both the content of the test and in a way reflecting the type of test items the students will likely experience. Until recently, all state tests were typically taken in a paper and pencil format. Because of the format of the assessment, teachers taught paper-pencil test strategies such as multiple choice techniques, how to mark text with pencils and highlighters, crossing off obvious incorrect answer choices, and the use of hand-held calculators.

New assessments such as the Common Core tests from Smarter Balance, and Partnership for Assessment of Readiness for College and Careers (PARCC) are taken online with different expectations. Students should be comfortable with a computer, typing, using a mouse, and viewing material on a computer screen. It is essential students learn to use an "online highlighter" to mark text and understand how to access additional online tools such as a calculator or notepad (T. Cook, personal communication, October, 2013). Reading material on a computer screen is different than from a paper book and must be practiced. When reading material on a screen, students seem less inclined to engage in what psychologists call metacognitive learning regulation—strategies such as setting specific goals, rereading difficult sections, and checking how much one has understood, all of which lead to lower comprehension (Jabr, 2013).

In the 2014-2015 school year (SY), Mississippi converted the required science assessment for eighth-grade students, the Mississippi Science Test 2 (MST2), from a paper-pencil test to an online assessment (MDE, 2014). Starting in the 2016-2017 SY, all state assessments in Mississippi, grades three through twelve, will be taken online via computer or tablet (Mississippi Department of Education (MDE), 2014). Even the Mississippi Kindergarten Assessment (MKAS^2), an assessment for incoming kindergarteners, makes use of an online platform reading the test questions to the student. School districts in Mississippi would be remiss in their duties if they did not attempt to incorporate computer usage and testing in their daily routines in helping students prepare for the high-stakes assessments.

Few studies have examined the effect of 1:1 implementations on high-stakes testing. A recent research project examining state test results and student achievement was a review of the Berkshire Wireless Learning Initiative (Bebell & Kay, 2010). One finding in this research was the correlation between student performance on the 2008 Massachusetts Comprehensive Assessment System (MCAS) and participation in the Berkshire initiative. By controlling for prior student achievement through student regression models, the researchers concluded there was a statistically significant difference in ELA performance on the 2008 MCAS between pupils in the initiative and those in the control group without 1:1 computers.

The information gathered in this study is of particular importance to school and district administrators as they consider 1:1 initiatives within the schools in their districts (Hansen, 2012). Superintendents and principals who want to implement a ubiquitous computer project need data to provide evidence of how the expensive project will affect their community. Administrators who purchase technology devices will have to replace or upgrade these technology devices in increasingly shorter timeframes. Currently, three to five years is considered the maximum life for a computer, and it appears this time frame will continue to decrease (Ritschard & Spencer, 1999). The cost implication to school districts to maintain their technology is substantial and must be a consideration as new technology purchases are considered. A sample technology plan created for Bucknell University and utilized by many educational organizations suggested a five-year rotation for all computers and their related equipment (Ritschard & Spencer, 1999). Technology Acquisition for Curricular and Instructional Technologies (TACIT) is a similar program at the University of Mississippi funded by the Provost's office which attempts to replace faculty computers every five years (http://www.olemiss.edu/tacit/).

To assist school administrators in obtaining the data needed to explain to their community why 1:1 technology initiatives are a cost-benefit advantage, this study will explore how ubiquitous access to laptop technology affects student achievement on a high-stakes online assessment in Mississippi, in particular, the mandated eighth-grade science test, MST2, which recently transitioned to an online assessment from a paper-pencil format.

Statement of the Problem

Research on 1:1 laptop implementations is missing key information about student achievement on high-stakes assessment. The majority of the current research involves teacher professional development related to the project or student engagement as a result of the project (Hansen, 2012). More research is needed to help school administrators in their decisions to create 1:1 laptop initiatives. While most studies have focused on teacher execution and student engagement in the classroom, additional research will provide information on how ubiquitous laptop use affects student achievement on high-stakes tests. This research study will help administrators in identifying the potential effect a 1:1 laptop initiative could have on student achievement as the school district prepares for next-generation, high-stakes testing.

Purpose of the Study

The purpose of this study is to explore if ubiquitous access to laptop technology affects student achievement on high-stakes online assessment using the Mississippi Science Test 2 (MST2) which transitioned to an online assessment from a paper-pencil test in the 2014-2015 SY. School district administrators may utilize the data from this study to discuss the potential of a 1:1 initiative in their school district (Hansen, 2012).

This quasi-experimental, post hoc study will examine the scale scores of eighth-grade students with and without 1:1 laptop implementations and their performance on the 2014-2015 SY mandated science test. Fifth-grade science test scale scores for the students will serve as a baseline for previous academic ability. The study examines six middle schools from different school districts within the state of Mississippi. The schools were matched using the following factors:

- enrollment,
- socioeconomic status,
- state accountability rating,
- graduation rate,
- individual education plan, and
- per pupil expenditure.

Three of the six middle schools undertook a 1:1 laptop program at their schools and will serve as the experimental group. The remaining three middle schools function as the control group due to the fact the schools are without a 1:1 technology program. The three experimental groups have differing lengths to their implementations. E1 has had a 1:1 laptop experience for six years, E2 for three years and E3 for four years. The duration of the experimental groups' implementations is an important data point to answer research question three and hypothesis three. Each district is identified by a letter/number combination to protect student confidentiality.

Research Questions

The following research questions examines how ubiquitous access to laptop technology affects student achievement on high-stakes, online assessment, in particular, the mandated eighth-grade science test, MST2, which transitioned to an online assessment from a paper-pencil test in the 2014-2015 SY:

1. Do students with a district-provided, 1:1 laptop experience have statistically higher scale scores on average as measured by the state mandated eighth-grade science assessment, MST2, than students who do not have a 1:1 laptop experience provided by their school district?
2. Do students with a district-provided, 1:1 laptop experience show a statistically higher level of improvement from fifth to eighth grade on MST2 scale scores than students who do not have a 1:1 laptop experience provided by their school district?
3. Do students with a district-provided, 1:1 laptop experience show statistically higher scale scores on the eighth-grade MST2 as the length of the 1:1 implementation increases?

Research Hypotheses

The subsequent null hypotheses will be used to answer the research questions:

1. H_o: There is no significant difference between student scale scores with a district-provided, 1:1 laptop experience and student scale scores without a district-provided, 1:1 laptop experience as measured by the eighth-grade online science assessment, MST2.
2. H_o: There is no significant difference between student scale score improvement from fifth to eighth grade on MST2 with a district-provided, 1:1 laptop experience and student scale score improvement from fifth to eighth grade on MST2 without a district-provided, 1:1 laptop experience.
3. H_o: There is no significant difference between student scale scores on the eighth-grade online science assessment, MST2, in schools with a district-provided, 1:1 laptop experience regardless of the length of the implementation.

Theoretical Perspective

In 1999, Tapscott published, *Growing Up Digital: The Rise of the Net Generation,* which led to a discussion of the generation of students who have grown up with both computers and the internet, and how the technology has changed the internal processing of information. Siemens (2004) went even further in his research and created a new pedagogy entitled connectivism. His definition of connectivism suggests it is "a model of learning that acknowledges the tectonic shifts in society where learning is no longer an internal, individualistic activity. How people work and function is altered when new tools are utilized" (Siemens, 2004, para. 29). Connectivism contributes quite effectively to the pedagogical theory needed in a 1:1 laptop initiative by expressing the ever increasing speed of learning and amounts of knowledge available to students today. It also suggests ways to improve teaching through focus on learning as a continual, lifelong process in which much of the knowledge gained will not reside in the "head" of the learner but in the technology used for the learning (Siemens, 2004).

Assessment continues to expand and change in format. Companies involved in large scale testing such as the College Board, National Assessment Governing Board and Programme for International Student Assessment Governing Board are creating more project-based, or simulation approached assessments for science and mathematics (Pellegrino & Quellmalz, 2010). With these new assessments, the need for not only the computer but also for the internet, and a level of student discernment concerning use of all the tools will become more critical and tie directly to the core components of connectivism theory.

Limitations

This study is a post hoc examination of both the 1:1 implementations and the high-stakes mandated science assessment, MST2. Since the grouping of students and their classroom teacher is from a previous school year, the ability to use a probability sampling technique is eliminated, thus limiting the capacity to generalize the sample results to the population. All data to be examined is provided through the six school districts. There is no way to ensure all tested students in each district will be reported to the researcher, other than agreement by the districts.

Issues of internal and external validity are a concern because not all the districts approached implementation of their 1:1 laptop experience in the same fashion. It is probable that the fidelity of implementation in each school district could affect the outcomes of this study. Each of the implementations examined in this study involved laptop computers further limiting the comparison of findings to other popular types of technology such at tablets.

The use of the fifth-grade science test data as a baseline for student achievement level is itself a limitation as there are students who move to Mississippi after the fifth grade and do not have the MST2 (fifth-grade) score for comparison. Another shortcoming of the study is the reliability of the results from the fifth-grade test to determine accurately student ability in the eighth-grade. In the spring of the 2011-2012 SY, when students took the fifth grade MST2 it did not have a time limit. However, the eighth-grade assessment is restricted to three hours which could affect students who did well with more time but cannot produce the same results in a more constrained time. Fifth and eighth grade are the only grades tested on the Mississippi science standards which limit the number of years of science data available for comparison.

The MST2 is checked each year for reliability and validity. According to the technical manual released by MDE (2015), Cronbach's alpha was used to estimate the internal consistency of the MST2. Cronbach's alpha is an efficient way to test split-half reliability without actually computing all the possible cases. The alpha values for the eighth-grade test was 0.87 (MDE, 2015). The validity of a test determines if the test measures what it purports to measure. In the case of the MST2, does it measure the eighth-grade science ability of students in Mississippi? According to MDE, the MST2 does appear to measure a single dimension and the competencies of the assessment is correlated (MDE, 2015).

Another limitation of this study is the researcher. As a member of one of the districts studied, a biased view of the data may be presented. An avid fan of computer technology and using technology to capture student engagement in the classroom the researcher is undoubtedly biased in favor of technology. Knowing and acknowledging the tendency will assist the researcher in maintaining an objective perspective throughout the research process.

A fifth limitation is the restricted number of districts for comparison. With the stringent list of matching factors (enrollment, socioeconomic status, state accountability rating, graduation rate, special education rate, and per pupil expenditure) only one to two matches for each of the experimental group school districts within the state were found. The data used to pair the experimental groups with the control groups is shown in Table 1. Enrollment is the number of students listed in the annual count for each school district. Socioeconomic status describes the percentage of free and reduced lunches provided by the school district. State accountability rating is the level given by MDE. The graduation rate is determined by MDE and includes only those students completing their high school degree in four years. Special education rate is the percentage of the student population which receives special education services. Per pupil expenditure is the average amount of money per student, per year, spent in a school district.

Table 1

Matching Data for Control and Experimental School Districts

District	Enrollment	SES	State Acct. Rating	Grad Rate	SPED Rate	PPE
C1	7177	62%	C	67%	14%	$8282
E1	7523	61%	B	79%	14%	$9793
C2	5590	43%	A	84%	13%	$8617
E2	3944	39%	A	88%	10%	$10,117
C2	5590	43%	A	84%	13%	$8617
E3	4756	47%	A	85%	10%	$8186

Note. C = Control Districts; E = Experimental Districts; SES = Socioeconomic Status; SPED = Special Education; PPE = Per Pupil Expenditure.

Delimitations

The researcher is choosing to look only at the middle school level because this is typically where most 1:1 implementations start (Abell Foundation, 2008; Bebell & Kay, 2010; Bebell & O'Dwyer, 2010; Downes & Bishop, 2015; Lei & Zhao, 2008; Manchester, Muir, & Moulton, 2004; Prettyman et al., 2012; Rutledge et al., 2007; Shapley, Sheehan, Maloney, & Caranikas-Walker, 2011; Storz & Hoffman, 2012; Swallow, 2015; Waters, 2009). The researcher is electing to compare each of the three 1:1 laptop districts to a single non-laptop district due to time constraints.

This study is limited to the MST2 because it was the only test consistently administered in the state of Mississippi during the 2012-2013, 2013-2014, and 2014-2015 school years. Changes in assessments during the three academic years above have occurred because of Mississippi's transition to the Common Core State Standards (CCSS) and a new assessment created by the Partnership for Assessment of Readiness for College and Careers (PARCC). In 2009, the National Governors Association Center for Best Practices (NGA Center) formed an alliance with the Council of Chief State School Officers

(CCSSO) to create a single set of educational standards to be used nationally so schools, districts, and states could compare their academic results (CCSS Initiative, 2015). Using the MST2 allows continuity in the score results compared.

Definitions

1:1 Laptop Implementation – An initiative which provides each student, and sometimes each teacher, with personal technology such as laptops, or tablets. These devices contain standardized productivity software and in some implementations electronic textbooks for student use. The students typically have access to the internet through the school's wireless network, and the devices are a primary source of academic work in the classroom (Penuel & SRI International, 2006).

Mississippi Science Test 2 (MST2) – Criterion-referenced assessments given in grades five and eight allowing Mississippi to be in full compliance with the requirements of the federal legislation in No Child Left Behind. A committee of Mississippi teachers who were selected by the MDE approved the items appearing on these tests to ensure the tests alignment with the portions of the 2010 Mississippi Science Framework specified by the teacher committee. The results of these assessments provide information used to improve student achievement and report to Mississippi's school accountability system (MDE, 2015).

Ubiquitous Laptop Implementation – synonymous for 1:1 laptop implementation.

Accountability Rating – The performance classification assigned to a school or a district, or both, which is determined by (a) the percentage of students who are performing at the proficient and advanced criterion levels and (b) the degree to which student performance has improved over time (based on an expected growth value for the school). The results from the achievement model and the growth model are combined to assign a rating of A, B, C, D, or F (MDE, 2015).

21st Century Skills – Combining the traditional three R's: reading, writing, and mathematics, with four C's: critical thinking, creativity, communication, and collaboration. Students must apply the four C's, and the three R's in a technology-filled learning environment. The concept implies teachers and administrators must trust the students with the technology and allow the pupils to progress at their pace. (Partnership for 21st Century Skills, 2011).

Student Engagement – Refers to the "degree of attention, curiosity, interest, optimism, and passion students show when they are learning or being taught, which extends to the level of motivation they have to learn and progress in their education" (Student Engagement, 2015).

Connectivism – A theory of learning, "that acknowledges the tectonic shifts in society where learning is no longer an internal, individualistic activity. How people work and function is altered when new tools are utilized" (Siemens, 2004, para. 32).

Summary

Chapter I presents the importance for the study of 1:1 implementations and high-stakes testing. In this study, the three hypotheses test to determine answers to the central questions. The information gathered in this study provides school administrators data to discuss with their stakeholders prior to a significant outlay of district funds to implement a 1:1 initiative. In Chapter II, the research briefly described in Chapter I is expanded to provide an in-depth view of the issues related to ubiquitous technology implementations and high-stakes testing. Chapter III discusses the methods used in the study and what statistical tests are used to answer the research questions.

CHAPTER II

LITERATURE REVIEW

The purpose of Chapter II is to provide a review of the relevant research related to 1:1 laptop implementations and high stakes assessment. The impact of 21st century skills on student achievement is examined for both school and community. Digital natives and connectivism theory are discussed. A review of 1:1 laptop implementations from the early 2000s includes areas such as student engagement, and teacher implementation and professional development. Next, a section on academic achievement reviews the often confusing and conflicting results from many studies. Changing course, a review of high stakes testing encompasses test evolution, specifically science testing, and international and national assessments. Finally, a discussion of NCLB and its effect on state assessments along with curriculum-related research explores how online testing is changing not only the course-specific assessment but the course curriculums.

21st Century Skills

In the 1990's as the world shifted to the 21st century, educational experts explored what skills pupils would need in this new day and age. "We have learned that preparing schools for 21st century learning is less about designing engaging activities for students and more about unleashing the learning potential of students and the technologies with which they are familiar" (Downes & Bishop, 2012, p. 14). The learning potential of a student in the new century is not about rote memorization and core competencies but rather involves problem-solving and teamwork. The term "21st Century Skills" was coined by the Partnership for 21st Century Skills to explain pupils' needs for various technology aptitudes such as typing, internet search techniques, research, and recognition of bias to name a few. The Partnership for 21st Century Skills (2011) created the 4Cs: creativity and innovation, critical thinking and problem solving, communication, and collaboration. Each skill has a direct impact on education and changes in teaching styles and techniques. However, one area did not change as quickly – assessment. Throughout the early 2000s, students continued to be tested using paper-pencil tests even as technology expanded to include individualized student learning plans through diagnostic software.

Outside of school, students embraced new technologies and became inseparable from their smartphones, tablets, and computers of all types. As access to the internet became readily available to the masses, students and teachers saw their world shrink and flatten (Friedman, 2005) as they were able to converse with people all over the world through their computer as easily as their neighbor next door. In addition to the access to internet use, the ability to afford computers, smartphones, and tablets led to more devices becoming available to students of all socioeconomic classes. In the 21st century, technology is not limited to the financially elite but is a common item in even low socioeconomic households (Friedman, 2005).

Schools continue to refine 21st century skills as new technologies emerge. An emphasis is placed on what students can do with their knowledge rather than what knowledge they have (Silva, 2008; Cavanaugh et al., 2011). It is the schools' responsibility to train students, as the first step toward becoming a model citizen, for both college and career paths. As early as 1999, the business world was suggesting computer literacy as a critical job skill (Attewell & Battle, 1999). The first set of computer literacy standards was created by International Society for Technology in Education (ISTE) in 1999 and published in 2000. The standards were called the National Educational Technology Standards (NETS) and contained six standards each for teachers, administrators, and students. These standards were updated in 2008 to reflect changes in technology and teaching (Morphew, 2012).

Great Lakes Middle School (GLS, as identified by the researcher) is an example of a 21st century learning environment. As a science, technology, engineering, and math (STEM) school, as well as a 1:1 initiative school, GLS creates classroom settings where students collaborate but also learn independently. Students use technology throughout the school day structured around problem-based learning (Prettyman et al., 2012). The researchers argue pupils in this program are becoming proficient at 21st century skills such as critical thinking, problem-solving, and communication.

Despite positive results such as GLS, some researchers are concerned access to laptop or desktop technology does not guarantee fluency with technology (Barron, 2004). A study of special education students in a career and technical high school with a 1:1 initiative also expressed this concern. Although the students were able to utilize their laptops for writing and reading, none of the technical software from their career classes was available. Students were only able to access technical software at school on the classroom lab computers and did not gain the fluency needed with the technical software because they did not have it available outside of the classroom (Mouza, Cavalier, & Nadolny, 2008).

Digital Natives

With computers becoming a ubiquitous item outside of school and children embracing technology at younger and younger ages, a new term was coined, “digital natives,” to describe these students (Prensky, 2001; Tapscott, 1999). The term digital native describes a student who learns best by trial and effort, process information quickly, connect with graphics before text and require relevance in their learning (Deubel, 2006; Glasser, 1998). Digital native students have never known life without the internet and social media. Most digital natives adapt well to classrooms using the 4C’s, as described by the Partnership for 21st Century Skills (2011). According to Downes and Bishop (2012), 80% of middle school students own an MP3 player, 69% have cell phones and video game players, and 27% have a personal laptop illustrating how pervasive these devices are to digital natives.

One of the major concerns with teaching digital natives is the lack of activities at school which match the level of technology integration these students experience outside of school. In 1993, the percentage of pupils using computers at school vs. home was 60.1:24.5, by 1997 those numbers increased to 70.4:42.8 for students. In 2003, the numbers jumped to 83.5% at school and 70.7% at home (Snyder & Dillow, 2012). The same rapid growth in computer use in the community and at work is also seen; however, schools moved much more slowly. Computers themselves have changed from bulky machines taking up multiple rooms to a handheld smartphone. Children not yet walking are already familiar with and using smartphones and tablets for entertainment and learning. These digital natives expect technology not to be a tool used for learning but an environment in which learning occurs (Pitler, Flynn, & Gaddy, 2004).

In a 2007 study by Dunleavy and Heinecke, the researchers compared effective instruction through laptop software; boys had larger gains through the use of software than their female counterparts. Perhaps the appeal of instructional software, especially in the science area is geared more to boys resulting in more effective instruction than for the girls. However, the researchers suggested boys are naturally more fluent with computers due to their attraction to and interaction with video games.

Connectivism Theory

Understanding how technology impacts educational pedagogy has long been an area of research. Siemens' research led to the creation of a new pedagogy of connectivism (2004). His research was supported by the work of Downes (2005) who expanded the topic to include four key traits: diversity, autonomy, interactivity, and openness. Students who spend much of their time immersed in technology, such as young men who play video games, reflect the key traits identified by Downes and the standards expressed by Siemens. Teachers should examine this pedagogical theory to help better instruct the internet generation.

Trnova and Trna (2015) suggest in their research on science and technology education; teachers must work with this generation of students by respecting their learning styles and tailoring the curriculum to meet their unique needs. "Students learn more effectively when taught in accordance with their learning style preferences and when their worldviews are acknowledged" (Trnova & Trna, 2015, p. 112). Learning through inquiry and in teams of peers are just a few of the techniques suggested for students taught through the connectivism model.

A key component of connectivism is its seamless integration with communication technologies (Siemens, 2004). This new theory works best to explain complex learning with diverse knowledge sources such as those found on the internet. While digital natives or net generation students have many positive learning style preferences, there also exist some traits which can hinder these students learning. Traits such as preferring speed to accuracy in their work, intuitively using technology without truly understanding it, and lack of text literacy can be lessened through the use of connectivism theory (Trnova & Trna, 2015).

Flipped Classrooms

One teaching method which uses connectivism theory to better reach digital natives is the concept of a flipped classroom. Internet generation students have little patience with traditional lecture and teacher driven classrooms (Prensky, 2001). Flipped classrooms appeal because the teacher puts the lecture material into a video or PowerPoint presentation for homework and classtime is used for more active cooperative learning. Classtime may include such activities as collaborative writing, role-playing, simulation, project-based learning, peer teaching, and small group instruction (Roehl, Reddy, & Shannon, 2013). Teachers also gain much more insight into what their students have learned because of the increase in teacher and student interaction through this method.

Not all courses fit well in the flipped classroom model. Mathematics courses seem to be particularly difficult to change to this method (Roehl et al., 2013). Another area of concern is adapting a lecture to an online format. Teachers must have some technology aptitude and be open to making changes on a daily basis depending on how well the students grasped the "homework" from the night before (Prensky, 2001). One of the largest shifts of the flipped classroom is changing is the culture around homework. Students must watch the videos to be prepared for class the next day. Moving to a flipped classroom requires students to have access to at a minimum a computer after school hours and ideally internet access as well (N. Peel, personal communication, October, 2015). A 1:1 laptop initiative provides the hardware needed to utilize this teaching method which offers such promise for reaching digital natives.

1:1 Computer Projects

Many of the largest computer initiatives started in the middle grades: Michigan's Freedom-to-Learn program which provided tens of thousands of laptops (Lowther et al., 2007); the Texas Technology Immersion Pilot provided twenty-two middle schools with laptops for each student (Texas Center for Educational Research, 2009); and the Maine Learning Technology Initiative providing laptops for over ten years to middle school students (Silvernail & Lane, 2004). One reason for starting in middle school with a 1:1 initiative is the relative maturity of the students to handle the equipment and the responsibility associated with maintaining a school computer. Another suggestion given for this focus on middle grades is the work typically done by the students lends itself to better use of a laptop. For example, at the sixth through the eighth-grade level, students begin to move from learning to read and toward reading to learn (S. Herll, personal communication, May 2004). Having access to the internet allows students with laptops to explore the web and read to learn.

Parsad and Jones (2005) found the ratio of pupils to computers decreased from 12:1 in 1999 to 4.4:1 in 2003 in the United States. In 2006, a survey of 2,500 school districts found 24% had 1:1 initiatives. The overall goals for all programs studied included:

increasing academic achievement, improving student engagement, increasing equity, and teaching 21st century skills (Swallow, 2015; Waters, 2009).

Some 1:1 initiatives such as the one at GLS connect to STEM initiatives. With proper planning, such combination initiatives can attain more funding through grants than each initiative alone. The subject matter also seems to tie in with and promote the concept of problem-based learning and integrated learning (Prettyman et al., 2012).

Computer technology has been integrated into some schools since the 1960's according to Suppes and Searle (1971). These schools manage the positive integration of computers by using quality training, mentoring for teachers, and strong administrative leadership during the integration process (Casey & Rakes, 2002; Chanlin, 2007; Ertmer, Addison, Lane, Ross, & Woods, 1999; Sumner & Hostetler, 1999). To help other schools improve their implementation process, the work from the early-adopting schools, especially their best practices, must be utilized. Gibson (2001) stated, "the number one issue in the effective integration of educational technology into the learning environment is not the preparation of the teachers for tech use, but the presence of informed and effective leadership" (p. 502). By utilizing the lessons learned in previous computer implementations, current administrators avoid the most common pitfalls and lead their school or district through effective implementation (Krueger, 2013).

Updating Technology. For schools to be successful and continue to improve their technology resources is it imperative school districts provide clear data to their community members and communicate to these stakeholders how the data is used to make technology-oriented budget decisions (Hansen, 2012; Keppler et al., 2014; Smarkola, 2007; Texas Center for Educational Research, 2008). This information must address not only the initial costs but also the repair and upgrades expected as the implementation moves forward. Ritschard and Spencer suggested in 1999 three to five years was the maximum life to expect from a laptop computer. As a cost effective measure, districts should consider buying refurbished computers which are one to three years old and utilize cloud technology, according to Erez Pikar, CEO of CDI Computers Inc. whose company supplies computers to schools throughout North America (McLester, 2012).

Student Engagement. Most of the 1:1 or ubiquitous laptop initiatives have focused on student engagement or teacher implementation and professional development (Storz & Hoffman, 2012). While much research shows increased student engagement, better school attendance, and decreased behavior referrals (Bebell, 2005; Bebell & Kay, 2010; Lane, 2003; Lemke & Martin, 2003; Muir et al., 2004; Texas Center for Educational Research, 2009), there are few studies in the research related to student achievement and 1:1 initiatives. Student engagement was particularly important in the early implementations of 1:1 laptops in the late 1990's and early 2000's because computers in the home and education were scarce due to the significant cost associated with such machines. The Freedom to Learn Initiative in Michigan, which provided over 30,000 laptops to students in the state, has shown substantial gains in student achievement (O'Hanion, 2007). The Maine Learning Technology Initiative (MLTI) also stresses students are more motivated to learn with the 1:1 laptop initiative (O'Hanion, 2007).

The Abell Foundation (2008) in their review of six 1:1 laptop initiatives found all the initiatives increased student engagement in the classroom and lead to more student-centered learning. In particular, Talbot County, Virginia showed increased engagement for their students in special education. This laptop initiative started with ninth-grade students in 2005 and expanded each year through grade twelve. In addition to motivating special education students, teachers felt students from low socioeconomic backgrounds and second language students benefited from the initiative.

Teacher Implementation and Professional Development. Teacher implementation and professional development were necessary for the early implementations of 1:1 laptops in the late 1990's and early 2000's because very few teachers had experience with computers or how to use them in an educational setting (Bebell, 2005). A key component of any technology plan is how the professional development for all stakeholders, teachers, parents, and students will roll out in an efficient and effective manner (Manchester et al., 2004; Ritzhaupt, Dawson, & Cavanaugh, 2012).

Despite the volume of professional development, early adopters of 1:1 laptop experiences often found the teachers to be uncomfortable with the technology and concerned it would prevent students from learning to write and value books (Lei & Zhao, 2008). Teachers new to technology were hesitant to use it in the classroom while those who considered themselves to be sophisticated users were eager to use it in the classroom (Zuniga, 2010). The high-end users felt technology was a permanent tool and would be valuable in the classroom. Over half the teachers felt a lack of training by the schools was a hindrance to improved use of technology in the classroom leading to less improvement in student achievement.

Another hindrance to complete integration of computers into the classroom was the focus of teacher professional development on how to use the computers rather than how to teach with the computers (Franklin, Turner, Kariuki, & Duran, 2001; Zuniga, 2010). Casey and Rakes (2002) suggested teacher professional development, which makes the teachers more comfortable will lead to greater integration in the classroom. The Michigan Freedom to Learn project used intensive summer training, and school-based lead teachers to provide technical support for the implementation. Because of this supportive professional development, teachers involved in this study felt they could integrate laptop use into their classrooms effectively (Lowther et al., 2012).

Educators and the students involved in the Vermont I-Leap project expressed how access to technology both motivated the teachers and enriched the students understanding. Teachers felt using both innovative technology access and middle school concept team building activities added to the comfortable environment created in the classrooms. The educators did worry about how the lack of technology in future years would negatively impact students who are accustomed to such an open culture and access to technology. One caution from the teachers to other educators considering such a project was the lack of support from individuals not involved in the project. A second concern from the participating educators was how the low-tech attitude of the state testing could put the implementing teachers at odds with other educators in their buildings (Downes & Bishop, 2015). Teachers not involved in the laptop program felt their peers in the program were too busy playing with computers to get students prepared for the high-stakes state assessment.

The Abell Foundation (2008) found professional development to be a critical component in 1:1 laptop initiative success and included not only how to use the hardware but also teaching techniques to take advantage of the technology. In a meta-analysis of 58 studies conducted between 1997 and 2011, Lee, Waxman, Wu, Michko, and Lin, (2013) found three areas of professional development needs for teachers to affect student learning with technology:

- collaboration in small or paired groups;
- sense-making in context; and
- project-based learning.

In particular, the researchers stressed project-based learning to help students see the interconnectedness of the subjects studied through the project. O'Hanion (2007) in her review of the Texas Technology Immersion Project, discusses how teachers in their second year of the implementation have switched from using the technology in addition to regular classroom tools to using the technology in place of classroom tools. This change shows how even adults who are not part of the digital native group can become more secure in their knowledge of technology through continued use of technology. The technology has become a tool for teaching instead of the focus of teaching.

Academic Achievement

Academic Achievement is one of the four outcomes typically studied in a 1:1 laptop implementation study (Penuel & SRI International, 2006). Penuel suggests more research needs to be done in this area to determine if 1:1 initiatives have a positive, negative, or inconclusive result on student achievement.

Positive Results. Lemek and Fadel, 2006 found higher English and mathematics test scores for students in 1:1 initiatives along with many others (Campuzano, Dynarski, Agodini, & Rail, 2009; Eden, Shamir, & Fershtman, 2011; Shapley et al., 2011; Suhr, Hernandez, Grimes, & Warchauer, 2010). Studies in the early 2000s have shown notable increases in course grades and on tests with the implementation of 1:1 initiatives (Efaw, Hampton, Martinez, & Smith, 2004; Gulek & Demirtas, 2005; Light, McDermott, & Honey, 2002; Ross, Lowther, Wilson-Relyea, & Wang, 2003; Siegle & Foster, 2001). In particular, increases in writing scores and problem-solving skills have been seen (Lowther, Ross, & Morrison, 2003).

A recent study examining state test results and student achievement reviewed the Berkshire Wireless Learning Initiative (Bebell & Kay, 2010). One of the more interesting findings in this study was the relationship between student performance on the 2008 Massachusetts Comprehensive Assessment System (MCAS) and participation in the Berkshire initiative. By controlling for prior student achievement through student regression models, the researchers concluded there was a statistically significant relationship on ELA performance on the 2008 MCAS between pupils in the initiative and those in the control group without 1:1 computers.

Students involved in the New Mexico Laptop Learning Initiative (NMLLI) showed higher levels of intellectual complexity according to their teachers at the school (Rutledge, Duran, & Carroll-Miranda, 2007). The teachers believed the student growth was due in no small part to having computers which allowed students to view and read source materials. The complex texts the students were reading began to show in the increased depth of writing produced.

According to Tang and Austin (2009), students report their perceptions of their achievement changes when using technology. Specific studies of science and technology in both Korea and the United States show improved academic achievement and improved student perception of their abilities in science (Incantalupo et al., 2014). The researchers continue to suggest educational technology can gain students' interest in the subject resulting in higher achievement as the teachers create technology-enhanced lessons and labs.

Negative Results. The number of researchers who found little to no improvement in student academic achievement are not as large (Donovan, Green, & Hartley, 2010; Hur & Oh, 2012; Johnson & Maddux, 2006). Hur and Oh (2012) found improved student engagement in the classroom, but the difference in student achievement was not significant between students with and without laptops. Donovan, Green, and Hartley (2010) supported this result but found even the student engagement declined as the excitement over using the laptops waned. Johnson and Maddux (2006) suggest a lack of strong implementation has led to negative student achievement.

Inconclusive Results. In 1998 Jones and Paolucci meta-analyzed over 800 journal articles and determined there is no significant evidence for the claim computer use increases student achievement on assessments. Bain and Weston (2009) suggest it is hard to expect a significant return on investment (ROI) from a technology initiative, especially in the area of student achievement, when the school itself does not encourage consistent deployment of computers and thoroughly integrated computer use in the classrooms. The Abell Foundation (2008) studied three types of laptop initiatives, none of which showed increased student achievement.

High-Stakes Testing

High-stakes testing has been found to negatively affect the integration of computer technology as teachers feel compelled to focus on drilling for the test rather than creating innovative student-centered instruction (Anderson, 2009; Cavanaugh et al., 2011). Becker (2000) suggests computer integration is more often found in classrooms where students possess 1:1 computers rather than a separate computer lab. Teachers involved in the STAR project in three school districts in Texas and a nearby university focused on improving their technology integration in the classroom by mentoring and through the use of the Texas STAR chart rubrics. During the project, from 2006-2009, the participants found the time required to integrate technology negatively affected their ability to teach to the high-stakes test required by Texas as an end-of-course assessment (Cifuentes et al., 2011).

A recent study by Kposowa and Valdez (2013) examined ubiquitous laptop use and student achievement on ELA, math, and science standardized tests in an elementary school. Students with laptops scored 35 raw score points higher (β=35.02, t = 3.91, p =.0002) than students without on ELA assessments. In mathematics, students with laptops scored 53.4 raw score points higher (β = 45.62, t = 3.72, p =.0003). In science, scores for students with laptops versus students without laptops was over 46 raw score points higher (β = 46.74, t = 3.36, p =.0014). The results showed there was a statistically significant improvement in ELA, math, and science scores with ubiquitous laptop activity in direct contradiction to other studies such as Angrist and Lavy (2002).

According to the Center on Education Policy (2012) in their report on high school exit exams, approximately twenty-five states have exit exams. These exams are "a substantial force in educational policy, currently affecting nearly 7 out of 10 public school students across the nation" (p. 2). States with exit exams have a disproportionate number of African-American and Hispanic students with 69% of African American students, and 71% of Hispanic student in the United States required taking the assessments for graduation (Center on Educational Policy, 2012). One major reason given for the use of these exit exams is the need to ensure students are ready for both college and career paths at the end of high school. Despite a change in focus on these required exams to college and career readiness, most colleges in these states do not use the results of the exit exams for placement or admission. The major question as to whether these exit exams help student achievement has not been answered through the current research and requires more study.

Assessment Evolution. Bennett (1998) identified three stages in the evolution of technology-based assessments. The first stage looks very similar to the paper or traditional test and differs only slightly in design from the original test. These first assessments typically do not take full advantage of the technology format and are often seen as a "one-time" event. One example of these first online assessments is multiple choice tests created by classroom teachers within their web-based learning-management software. Schools with 1:1 laptop implementations often combine the hardware purchase with web-based learning-management software such as Blackboard, Canvas, or Haiku. Within these software packages are options to test students online through basic multiple choice style questions and provide the option to grade the tests for the instructor (N. Peel, personal communication 2015).

In the second stage, efficiency of the testing becomes more important than the substance of the assessment. At this point in test creation, the individuals may attempt new types of item constructs and use these non-traditional questions such as short constructed response and essay items simply to have a different look and feel from the original paper tests. For example, the Part A-Part B problems found on the PARCC and SMARTER Balance assessments were created specifically for those assessments through the CCSS curriculum (Bennett, 2015). Part A is a standard multiple choice question such as what is the author's purpose for writing the text. Part B then requires the student to identify in the text passage the specific line or lines which justify the students answer to Part A. A student can receive full credit for getting the entire problem correct or partial credit if Part A is correct. No credit is given if only Part B is correct since the student's text choice does not justify the correct answer.

The third and final stage happens when the focus moves from automation of the scoring and testing to substantive measurement of learning. Third stage assessments look and feel very different from paper tests and have a very different purpose. No longer are assessments only for institutional use but now benefit the individual learner by using complex performance tasks which require both cognitive and technical skills. Many stage three assessments are seen as formative tools to help the teacher and the learner improve instruction and thus understanding of the material being studied (Bennett, 2015).

Another tool to increase student understanding is the use of metacognitive learning regulation to improve reading comprehension in an online text (Jabr, 2013). Without regulation strategies, students do not set specific goals for their reading, reread difficult sections, or check their understanding at key points in the reading. According to Lee and Wu (2013) these regulation strategies can be taught to students but a special emphasis must be placed on their use when students engage in information seeking activities while reading online (Chu, 2014).

Science Assessments. The rise of stage three assessments and their more complex items has led to more research especially on problem-solving. The first significant national study was the 2003 NAEP Problem Solving in Technology-Rich Environments Study (Bennet, Persky, Weiss, & Jenkins, 2007). Two simulations were created for this groundbreaking study – one using the internet for research and the other including an actual experiment. The results were accurate psychometrically, and student answers showed high quality in the problem-solving area.

National Assessment of Educational Progress (NAEP) then created a special study specifically for science in 2009 with its Interactive Computer Tasks (ICTs) which included simulations and hands-on experiments for grades 4, 8, and 12 (National Center for Education Statistics, 2012). The newest test developed by NAEP is the 2014 Technology and Engineering Literary Framework. As an entirely computer-based assessment, this expanded test allows students to solve simulations using problem-solving, and communications technology (DeBoer et al., 2014).

A second global assessment is the Programme for International Student Assessment (PISA) Computer-Based Assessment of Science (CBAS). Piloted in 2006, this test used complex, multi-part problems to test students' knowledge and inquiry level skills in science (Quellmalz & Pelligrino, 2009). Students took part of the assessment with paper-pencil testing traditional science skills. The online portion of the test was specifically created to test science inquiry skills which could not have been tested effectively on a paper-pencil test (Koomen, 2006). Students found the online portion of the CBAS more enjoyable and male students performed better on that part of the assessment. Male students expressed the shorter reading items on the online part of the CBAS were easier to read (OECD, 2010).

Not all of the advanced science assessments are created for national and international use. The state of Minnesota has created an online state science test with simulated lab experiments and phenomena observations (Pellegrino & Quellmalz, 2010).

Six other states participated in a study using simulation-based science assessments from WestEd to determine if such in-depth assessments could be utilized in schools without 1:1 laptop initiatives. While the teachers and students all felt they benefited from the study, they also agreed having individual computers would make such assessments much more functional. Other concerns from the study included the cost to create similar assessments for all grade levels (Quellmalz et al., 2012).

A major concern arising from the new generation of assessments is the cost to score them. According to Silva (2008) in 2003 the cost to score a multiple-choice test using machine scoring cost 60 cents per test. At the same time, a multiple-choice and open-ended response test cost seven dollars per test. The 2014 PARCC assessment which included multiple-choice, open-ended, and performance-based items cost on average, $27.78 per student (Gewertz, 2013).

National/International Tests. Eighth-grade students in the United States were considered to be above average on science TIMSS tests from 1999 to 2003. However, 15-year-old students in the United States were not in the top ten on the PISA test for math and science, which measured students' ability to use problem-solving skills with real world examples. Data from these international assessments suggest United States students do master instructional information but seem to have some trouble applying the information learned to real world problems in a high-stakes testing situation (Silva, 2008).

In an attempt to improve student achievement in the United States especially in the areas of math and science, the National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO) created a national set of common standards for student achievement. Common Core State Standards (CCSS) began as an attempt to accurately compare states using a common set of standards and creating national tests to measure achievement on those standards (CCSS Initiative, 2015). Two companies PARCC and SMARTER Balance were given contracts to create the CCSS assessments. The new assessments utilized technology to move them into stage two of Bennett's (2015) test evolution by placing accessibility features such as a highlighter, line reader, and a text reader directly into the electronic version of the test. The types of items created also moved the new assessments further into stage two and even stage three with multi-select, drag and drop, text selection and open-ended response items including essay items (Bennett, 2015).

State Tests. In 2002, the United States Congress authorized the No Child Left Behind Act (NCLB) as a reauthorization of the Elementary and Secondary Education Act. NCLB was created to implement a Federal Accountability model in addition to the state models were already in place. With the passage of NCLB in 2002, all states in the United States were required to test their public school students in grades three through eight in the areas of mathematics and English-language arts (USDE, 2001). The states must also administer an assessment in four core areas at the high school level: English, mathematics, US history, and biology. The final evaluation requirement was science be tested once in elementary and once in middle school to complement the Biology test in high school (USDE, 2001).

The newest reauthorization of ESEA will take effect during the 2016-2017 school year and is known as the Every Student Succeeds Act (ESSA). This newest version gives much of the decision-making back to the individual states but does still require yearly testing in grades three through high school. Mathematics and English must be tested each of those years and science in grades five and eight (USDE, 2016). No stipulation is made within the act itself as to the type of testing, online or paper-pencil. However, the need for a rapid turnaround for reporting of scores and the increasing cost of paper-pencil tests suggests that online assessments will continue to be used (W. Drain, personal communication, February, 2016).

History of Mississippi State Tests. Mississippi began modern state assessments with the passage of the Mississippi Student Achievement Improvement Act of 1999 (MDE, 2012b). This bill led to the development of the 2001 Mississippi Science Curriculum Framework from which the required state assessments at grades five and eight were created. When NCLB was signed into law in 2002, it reinforced the requirement for science assessment at the elementary and middle school level (USDE, 2001). The Mississippi Science Test (MST) was administered from spring 2007 to spring 2010. In 2010, a revised curriculum framework, the 2010 Mississippi Science Framework was created and adopted leading to the need for a revised science assessment in the spring of 2011. The revised assessment is titled the Mississippi Science Test 2 (MST2).

The MST2 is a criterion-referenced test with multiple-choice items containing four response choices per item (MDE, 2012b). The test was untimed until the 2014-2015 school year in which it became limited to three hours. The time limit was added as the test transitioned to an online version and required school districts to obtain the necessary technology resources to give the assessment via computer or tablet. A three-hour window allowed school districts to test two groups of students each day decreasing the number of required computers for testing (R. Baliko, personal communication, January 2015).

Summary

This research study explores 1:1 laptop implementations and high-stakes testing. In Chapter I the need for this research was shown. Most current research suggests a need for more detailed information on the impact of ubiquitous laptop use and its effect on student achievement (Lemke & Martin, 2003; Penuel & SRI International, 2006; Russell, Bebell, & Higgins, 2004; Zucker, 2004). As assessments change from traditional paper-pencil to enhanced online items research is needed to show what if any advantage can be gained by supplying students with 1:1 laptops. Chapter II showed the extended research on 1:1 laptop implementations and high-stakes testing. Chapter III will discuss methods used in this study including the subjects, instruments, and data analysis.

CHAPTER III

METHODOLOGY

Chapter III provides an overview of the study's methodology by discussing the research design, research questions and hypotheses, population, sample and subjects, research instruments, research procedures, statistical tests, data analysis, and experiment validity. In this chapter, each section explains the details of the study related to their research function. The population, sample, and subject sections identify the rational for the group studied and the components of the sample. The research design, questions, and hypotheses detail the researcher's choice of design and the specific hypotheses tested. In the research instruments section, the validity and reliability of the chosen instruments are described.

Research Design

This post hoc, quasi-experimental, quantitative study explores how the experience of a 1:1 laptop implementation affects student achievement on the mandated eighth-grade online science assessment at six Mississippi middle schools in separate school districts. The study uses the fifth-grade science assessment scale scores as the pretest and the eighth-grade scale scores as the posttest.   Nonequivalent control group is used as the design which provides strong internal and external validity (Creswell, 2014). In this design, groups are not randomly assigned, and all participants in the control and treatment group take the pretest and the posttest (See Figure 1).

Nonequivalent Control Group Design

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Figure 1. Nonequivalent Control Group Design

In a nonequivalent control group design, the researcher does not assign subject to groups randomly. The Web Center for Social Research Methods (2015) suggests the nonequivalent control group design's most substantial internal validity threat is differential selection. This internal validity threat suggests schools chosen for 1:1 laptop initiatives were in some way superior to the ones not chosen therefore it is not known if treatment or selection caused the difference between the two groups. While differential selection is the most grievous threat to internal validity, it is not the only threat.

Internal Validity. According to Creswell (2014), internal validity threats are "experimental procedures, treatments, or experiences of the participants which threaten the researcher's ability to draw correct inferences from the data about the population in an experiment" (p. 174). Internal validity is determined by how well the researcher controls for extraneous variables such as history, maturation, testing, instrumentation, statistical regression, and attrition (Gall et al., 2007). History is an internal threat to any experiment over time and best controlled by ensuring the control and experimental groups are as similar as possible. The six schools chosen for this study were carefully selected to closely align many factors which will be discussed later in this chapter. Maturation deals with the growth of the subjects over the time of the experiment which could lead to gains not related to the experimental treatment. To minimize this internal validity threat, all the students in this experiment are from the same grade level, so all students involved in the study have the potential to change at the same rate. Testing becomes a threat for example when participants memorize the items from the pretest for the posttest, but this problem is avoided by extending the time between the tests (Creswell, 2014). In this study, the students take the pretest in the fifth grade and the posttest three years later in the eighth grade. The fifth and eighth grade MST2 tests have been standardized to allow comparison between the two assessments (MDE, 2014). MST2 standardization of scores prevents the internal threat of instrumentation (MDE, 2012b). Statistical regression is, "the tendency for research participants whose scores fall at either extreme on a measure to score nearer the mean when the variable is measured a second time" (Gall et al., 2007, p. 385). This threat can be examined and minimized through the examination of pretest fifth-grade scores and posttest eighth-grade scores. Experimental mortality or attrition is losing participants during the experiment. Since this study is post hoc, all the data has already been collected, and any students who were not tested in both fifth and eighth grade have already been removed.

External Validity. This type of validity suggests if the findings of the study can be applied to individuals and groups beyond the actual study subjects. If a researcher extends the generalization for their study beyond groups found in the sample then this type of validity would be violated (Creswell, 2014). External validity is divided into two basic types: population and ecological (Gall et al., 2007). Ecological validity examines the testing environment to determine if it influences subject behavior. For example, if students regularly take math assessments in the morning, the ecological validity of a morning test would be high because it is what the students are comfortable doing. Population validity illustrates how well the sample from the study can be extended to a population. If a study looks at a single elementary school in one school district and then generalized to the all the elementary schools in the nation, it would violate population validity.

The factors listed below are considered by Bracht and Glass (1968) as threats to an experiment's external validity. Population validity can be threatened by the inability to generalize from the sample to the population. This study uses eighth-grade students from six middle schools as its sample from a population of eighth-grade students. A second threat to population validity is the extent which personological variables, such as age, gender, and academic ability interact with treatment effects. In this study, all students selected as subjects are in the same grade and took the same pretest in fifth grade which should reduce the threat to population validity.

Ecological validity has many more factors which can threaten the validity of the experiment (Gall et al., 2007). The first element is an explicit description of the experimental treatment. Explicit description is necessary, so other researchers can replicate the experiment. The Hawthorne effect, which is the idea just receiving the treatment may cause a change in the subject, is much harder to remove as a threat, particularly when the treatment is providing the student with a computer. Use of the fifth-grade MST2 test scores as a pretest helps alleviate this hazard by showing student achievement prior to the treatment. The interaction of history and treatment effects can be a threat to validity if the researcher tries to generalize beyond the current time frame. The current study does not generalize beyond the current time frame. The type of instrument used as the measurement of the dependent variable can also threaten ecological validity. In this experiment, both the pretest and the posttest are criterion-referenced multiple-choice assessments and are assumed to be unidimensional. By comparing the competencies tested on the MST2 through a correlation shown in Table 2, page 47, unidimensionality is established (MDE, 2014). The interaction of time of measurement and treatment effects can lead to a lack of ecological validity if students do not take the assessment at the same time. All students in the study took the fifth-grade MST2 on the same day and the eighth-grade MST2 within a two-week window provided by the Mississippi Department of Education (R. Baliko, personal communication, October 3, 2015).

Research Questions

The three research questions below explore student achievement on a high-stakes, online assessment, MST2 and the implementation of a district-provided 1:1 laptop experience:

1. Do students with a district-provided, 1:1 laptop experience have statistically higher scale scores on average as measured by the state mandated eighth-grade science assessment, MST2, than students who do not have a 1:1 laptop experience provided by their school district?
2. Do students with a district-provided, 1:1 laptop experience show a statistically higher level of improvement from fifth to eighth grade on MST2 scale scores than students who do not have a 1:1 laptop experience provided by their school district?
3. Do students with a district-provided, 1:1 laptop experience show statistically higher scale scores on the eighth-grade MST2 as the length of the 1:1 implementation increases?

Research Hypotheses

The research questions driving this study are specified as null hypotheses in the following statements:

1. H_o: There is no significant difference between student scale scores with a district-provided, 1:1 laptop experience and student scale scores without a district-provided, 1:1 laptop experience as measured by the eighth-grade online science assessment, MST2.
2. H_o: There is no significant difference between student scale score improvement from fifth to eighth grade on MST2 with a district-provided, 1:1 laptop experience and student scale score improvement from fifth to eighth grade on MST2 without a district-provided, 1:1 laptop experience.
3. H_o: There is no significant difference between student scale scores on the eighth-grade online science assessment, MST2, in schools with a district-provided, 1:1 laptop experience regardless of the length of the implementation.

Population, Sample, and Subjects

The target population for this study is eighth-grade students in the state of Mississippi. The accessible population is eighth-grade students in the six participating districts who took and recieved scores for the fifth-grade MST2 test from the 2011-2012 SY. These same schools also have the MST2 test data for the 2014-2015 SY. The study does not use a random sample, therefore it is necessary to compare the accessible populations on critical characteristics to ascertain if they are similar in demographic and accountability measures. Three of the six school districts were chosen because they have implemented a 1:1 laptop initiative. A stringent list of matching factors was created to determine non-implementation school district which could be used for comparison with the three experimental school districts. After examining 145 school districts within the state of Mississippi, a maximum of two districts for each of the control groups were found. The relevant data used to match the schools can be found in Table 1, page 13.

Research Instruments

Two instruments are used in this study: the fifth-grade Mississippi Science Test 2 (MST2) from the 2011-2012 SY and the eighth-grade Mississippi Science Test 2 from 2014-2015 SY. The scores from the eighth-grade assessment are the primary data focus of this study while the fifth-grade scores are used as a pretest for establishing a baseline of student achievement. In the upcoming section, discussion around the history of the MST2 and characteristics of a useful test as defined by research experts will be addressed.

MST2 History. In 2010, the Mississippi Science Framework was revised necessitating the creation of a new assessment deemed the Mississippi Science Test 2 (MST2). Changes in curriculum forced changes in the state assessment of the curriculum. The goal from the original assessment per NCLB in which every student should be classified as Proficient has not changed. The MST2 is a criterion-referenced test with multiple-choice items containing four response choices per item (MDE, 2012b). The test was untimed until the 2014-2015 SY at which time the MST2 became limited to three hours. The change in time was a result of the assessment moving from a paper-pencil test to an online format. The three-hour time limit allowed schools to test multiple groups of students during a school day – a critical need for districts with few computer resources (J. Mason, personal communication, September, 2013).

Test Quality. According to Gall et al., (2007) objectivity, standard conditions of administration and scoring, standards for interpretation, and fairness are the four areas used to determine the quality of assessment. Extensive work is done at both Riverside, now known as Pearson Education and the MDE to ensure these four areas meet or exceed the state requirements. Test administrators use detailed manuals for the MST2, which explain "testing guidelines, materials handling, and standardized administration instructions" (MDE, 2012b, p. 30). At the testing company, Riverside/Pearson Education a "series of quality checks, image editing, and school district verifications ensure that accurate data is submitted to the Psychometric and Information Technology teams for the scoring process" (MDE, 2014, p. 19).

Test Validity. The definition of validity is the "degree to which evidence and theory support the interpretation of test scores entailed by proposed uses of tests" (AERA, APA, & NCME, 1999, p. 9). It is important to note this definition does not define the scores as valid or invalid but rather the interpretation of the scores (Gall et al., 2007). Four types of evidence can be used to show the validity of test score interpretations.

Evidence from Test Content. "Content-related validity evidence is particularly important in selecting tests to use in experiments involving the effect of instructional methods on achievement" (Gall et al., 2007, p. 196). The process used to construct the MST2 began with revising the Mississippi Science Frameworks in 2010. Content-area experts created performance level descriptors (PLDs) to define what a student should be able to do at three performance levels (basic, proficient, and advanced). Items were written and evaluated for bias (MDE, 2012b).

Evidence from Response Processes. Taking an assessment requires the test taker to utilize both cognitive and evaluative processes which should fit the construct of the assessment to provide substantiation of validity. The MST2 assessment uses multiple-choice items with four answer choices. Item writers provide rationales for not only the correct solution to each question but also for the distractors as part of best-practice item development (MDE, 2012b).

Evidence from Internal Structure. The internal structure of an assessment will add to the validity if the correlation between the competencies measured is strong. The Pearson correlation coefficients between the competencies are summarized in Table 2 (MDE, 2012b; MDE, 2014). As can be seen in Table 2, all the coefficients are above .50 which suggests a moderately strong to strong positive correlation.

Table 2

Pearson Correlation Coefficients between Competencies for Grade 5 & 8 Science

	Grade 5 Science				Grade 8 Science			
Competency	1	2	3	4	1	2	3	4
1	1.00				1.00			
2	.53	1.00			.52	1.00		
3	.51	.57	1.00		.60	.65	1.00	
4	.55	.56	.69	1.00	.55	.63	.68	1.00

Evidence from Consequences of Testing. Evidence of how the test results are used can be used to show the validity of the test. The MST2 results "are intended to guide decisions in the area of improving student achievement in science" (MDE, 2012b, p. 73). The validity of a test determines if the test measures what it purports to measure. According to MDE, the MST2 does appear to measure a single dimension, and the competencies of the assessment are correlated (MDE, 2015).

Test Reliability. The degree of consistency in scores when the same or similar tests are given to the same individuals indicates the reliability (Crocker & Algina, 1986). Test reliability is based on two areas: internal consistency and standard error of measurement.

Internal Consistency. The reliability of a test can be estimated by examining individual items of the test (Gall et al., 2007). Cronbach's alpha was used to estimate the internal consistency of the MST2 (MDE, 2015). Cronbach's alpha is an efficient way to test split-half reliability without actually computing all the possible cases. An assessment needs a reliability of .80 or higher according to Gall, Gall, and Borg (2007). The alpha values for the fifth and eighth-grade MST2 was 0.87 (MDE, 2012b; MDE, 2014).

Standard Error of Measurement. The student's score within the probable range of his true score is the standard error of measurement (SEM) which helps to show scores on a test are only estimates and may not reflect accurately a student's true score. This understanding is particularly important when mean scores are close between two groups. If the test has a large SEM, then the mean scores could reverse if taken again or at another time. The SEM for the fifth-grade MST2 was 2.98 and for the eighth-grade MST2 was 3.24, indicating a highly effective measure related to the standard error (MDE, 2012b; MDE, 2014).

Procedures

Before any research begins, approval will be initiated by the doctoral research committee approval and then through the Institutional Review Board (IRB) at the University of Mississippi. All human subject research requires IRB approval, and it will be obtained prior to data management. For each of the six school districts in the study permission to use their data will be acquired.

Once the IRB approves, the researcher will contact the school districts to obtain the fifth and eighth-grade MST2 scores. Student scores from the fifth and eighth-grade MST2 will be cleaned to ensure all students included in the study from each school have a scale score for both assessments. All students with incomplete data will be removed from the study. Statistical testing will occur from the finalized data sets from each school utilizing SPSS.

Data Analysis

Exploratory data analysis will be performed on the data collected from each of the schools including descriptive data analysis. In addition, a stem and leaf plot will be created to examine the distribution of data and outliers. Ultimately, the stem and leaf plot will be converted to a histogram to further examine the distribution of the data points.

Hypothesis one is tested using independent *t*-tests. An independent *t*-test evaluates "the significance of the difference between two sample means" (Gall et al., 2007, p. 315). Six major assumptions are required for a *t*-test (Statistics.laerd.com, 2015):

- One dependent variable measured at the continuous level;
- One independent variable consisting of two categorical, independent groups;
- Independence of observations;
- There are no outliers;
- The dependent variable is normally distributed; and
- Homogeneity of variance.

For hypothesis one, the dependent variable is the student scale scores on the MST2 eighth-grade assessment which is a continuous value between 112 and 192 (MDE, 2014). The independent variable is the middle school's participation in a 1:1 laptop experience and is categorical. Because the students are grouped by school district attended each group of students is independent of the other groups. Boxplots created in SPSS will be used to determine if any outliers exist. Should outliers occur, the data will be reexamined to ensure there were no data entry or measurement errors. If the outliers still exist at this point, the most extreme will be removed one at a time, and the boxplot recreated. This process will be repeated until all outliers are accounted for or removed. Normal distribution is not as critical in a *t*-test because of the robust nature to violations of normality. Also, the removal of outliers should lead to a more normal distribution. "The assumption of homogeneity of variances states that the population variance for each group of your independent variable is the same" (Statistics.laerd.com, 2015, para. 7). Levene's test of equality of variances will be run in SPSS to check for this assumption. The significance level of Levene's test must be greater than 0.05 or homogeneity of variance is violated. Should heterogeneity of variance occur, the Welch *t*-test, which is also called the unequal variance t-test, will be run.

Hypothesis two is also tested using independent *t*-tests and the same six assumptions as hypothesis one. The independent variable is again the middle school's participation in a 1:1 laptop experience and is categorical. The dependent variable is the change in student achievement from fifth to eighth-grade using scale scores from the MST2, which is a continuous value. Because the students are grouped by middle school attended each group of students is independent of the other groups. For assumptions three through six, the same procedures will be used as given under hypothesis one.

Hypothesis three is tested using a one-way analysis of variance (ANOVA). Gall et al. (2007) suggest an ANOVA is useful to avoid completing many *t*-tests. An ANOVA provides "a comparison of more than two groups in terms of outcomes" (Creswell, 2014, p. 164). Six major assumptions are required for an ANOVA test:

- One dependent variable measured at the continuous level;
- One independent variable consisting of two or more categorical, independent groups;
- Independence of observations;
- There are no outliers;
- The dependent variable is normally distributed; and
- Homogeneity of variance.

The independent variable is the length of the middle school's involvement in a 1:1 laptop experience. The dependent variable is the student scale scores on the MST2 eighth-grade assessment which is a continuous value between 112 and 192 (MDE, 2014). Because the students are grouped by middle school attended each group of students is independent of the other groups. Again, boxplots will be used to determine outliers and the procedures listed under hypothesis one utilized for assumptions of normality. Levene's test will be used to check for homogeneity of variance.

Power Analysis. A power analysis is used to ensure the tests used for statistical analysis are sufficient to reject a false null hypothesis. In this study G*Power 3.1 is used for an a priori analysis of the three tests used for the three hypotheses. The results for the analyses are shown in Table 3. For each of these analyses an alpha level of .05 and a moderate effect size of .25 and a power (1-β err prob) of .80 was chosen.

Table 3

Required Sample Size for Hypotheses

Hypothesis	Sample Size
One (*t*-test)	506
Two (*t*-test)	506
Three (ANOVA)	269

Summary

This research study explores how the experience of a 1:1 laptop implementation affects student achievement on the mandated eighth-grade online science assessment at six Mississippi middle schools in separate school districts. The purpose of the study is to provide district administrators with information on 1:1 laptop implementations and high-stakes testing. The need for more study of these issues was shown in Chapter I. Research supporting this study was introduced in Chapter I and expanded in Chapter II. Chapter III provided an overview of this post hoc, quasi-experimental, quantitative study including the study's methodology, participants, procedures and data analysis.

CHAPTER IV

DATA ANALYSIS

Chapter IV explains the experimental portion of the study and the results of the statistical analysis by discussing data collection, population and sample, research instruments, data analysis, and experiment validity. The study explores how participating in the experience of a 1:1 laptop implementation affects student achievement on a high stakes science assessment through a post hoc, quasi-experimental study.

Data Collection Procedures

For each of the six school districts in the study permission to use their data was requested. One school district declined to participate which lead to the removal of control group three from the study. Control group two was used in its place for comparison purposes. The data from all five of the school districts was converted to an Excel format. For each district, the students were matched for fifth-grade, and eighth-grade comparison of the science test scores. Finally, the data from all schools was collected in the appropriate combinations for the hypotheses and analyzed using SPSS, version 23.

Population and Sample

The target population for this study is eighth-grade students in the state of Mississippi. The accessible population is eighth-grade students in the five participating districts which took and had scores for the fifth-grade MST2 test from the 2011-2012 SY. These same schools also have eighth-grade MST2 test data for the 2014-2015 SY. The study does not use a random sample. Therefore, it is necessary to compare the accessible populations on critical characteristics to ascertain if they are similar in demographic and accountability measures. Three of the five school districts were chosen because they have implemented a 1:1 laptop initiative and are labeled as E1, E2, and E3. The remaining two districts did not have a 1:1 experience with a district-provided laptop and are labeled as C1 and C2. The relevant data used to match the schools is found in Table 1, page 13.

The population and sample numbers for each school district are shown in Table 4 as are the total counts for the study.

Table 4

Population and Sample Numbers for Control and Experimental School Districts.

District	Population	n	Percentage
E1	570	413	72.5
E2	304	196	64.5
E3	363	243	66.9
C1	586	387	66.0
C2	446	305	68.4
Total	2269	1544	68.0

Research Questions

The three research questions for this study examined student achievement on a high-stakes, online assessment, MST2 and the implementation of a district-provided 1:1 laptop experience:

1. Do students with a district-provided, 1:1 laptop experience have statistically higher scale scores on average as measured by the state mandated eighth-grade science assessment, MST2, than students who do not have a 1:1 laptop experience provided by their school district?

2. Do students with a district-provided, 1:1 laptop experience show a statistically higher level of improvement from fifth to eighth grade on MST2 scale scores than students who do not have a 1:1 laptop experience provided by their school district?
3. Do students with a district-provided, 1:1 laptop experience show statistically higher scale scores on the eighth-grade MST2 as the length of the 1:1 implementation increases?

Research Hypotheses

The research questions driving this study are specified as null hypotheses in the following statements:

1. H_o: There is no significant difference between student scale scores with a district-provided, 1:1 laptop experience and student scale scores without a district-provided, 1:1 laptop experience as measured by the eighth-grade online science assessment, MST2.
2. H_o: There is no significant difference between student scale score improvement from fifth to eighth grade on MST2 with a district-provided, 1:1 laptop experience and student scale score improvement from fifth to eighth grade on MST2 without a district-provided, 1:1 laptop experience.
3. H_o: There is no significant difference between student scale scores on the eighth-grade online science assessment, MST2, in schools with a district-provided, 1:1 laptop experience regardless of the length of the implementation.

Research Instruments

Two instruments were used in this study: the fifth-grade Mississippi Science Test 2 (MST2) from the 2011-2012 SY and the eighth-grade Mississippi Science Test 2 from

2014-2015 SY. The scores from the eighth-grade assessment were the primary data focus of this study while the fifth-grade scores were used as a pretest for establishing a baseline of student achievement.

Pearson's Correlation Coefficient, which describes the correlation between the individual items of these two instruments can be found in Table 2, page 47. Each competency is compared to the other three competencies at the fifth and eighth-grade level in the table. Based on the information in the table, the Mississippi Department of Education has determined the MST2 assessments measure a single dimension, and the competencies of the assessment are correlated (MDE, 2015). The reliability of the MST2 assessments was examined using Cronbach's alpha which estimates the internal consistency of the assessment (MDE, 2015). An assessment needs a reliability of .80 or higher according to Gall, Gall, and Borg (2007). The alpha values for the fifth and eighth-grade MST2 was 0.87 (MDE, 2012b; MDE, 2014). The MST2 meets the requirements to be both reliable and valid for use as a data collection tool for this study.

Statistical Tests

Two different statistical tests were used to review the data collected. Both hypothesis one and hypothesis two were examined through the use of independent t-tests. The major assumptions for this type of test include having one dependent variable measured at the continuous level and one independent variable consisting of two categorical, independent groups. There must be independence of observations and no outliers. However, the assumption of outliers and normal distribution can be checked through skewness as well as visual review of the boxplots. The final assumption is homogeneity of variance which can be ascertained through Levene's test of equality of variances. Hypothesis three was tested using a one-way ANOVA. The assumptions for this test are the same as for the independent t-test except the independent variable can contain more than two groups. This test is recommended to help control the problem of an increase in the likelihood of a Type I error, falsely rejecting the null hypothesis.

Data Analysis

Exploratory data analysis was performed on the data collected from each of the schools including descriptive data analysis. Sample size, mean, and standard deviation were some of the statistics examined in the exploratory data analysis for each hypothesis. In addition, a stem and leaf plot was created to examine the distribution of data and outliers for each hypothesis. For hypothesis one and two, three different plots were created, one for each control group/experimental group combination. For hypothesis three only one plot was generated.

Hypothesis One. H_o: There is no significant difference between student scale scores with a district-provided, 1:1 laptop experience and student scale scores without a district-provided, 1:1 laptop experience as measured by the eighth-grade online science assessment, MST2.

Hypothesis one was tested using independent samples *t*-tests. Table 5 shows the descriptive statistics for the school districts. The dependent variable was the student scale scores on the MST2 eighth-grade science assessment which was a continuous value between 112 and 190. The independent variable was categorical based on the school districts involvement in a 1:1 laptop experience. All of the groups had some outliers in their data when the boxplots were examined. While normal distribution is not as critical in a *t*-test, it is necessary to address outliers in the data. In each case, an independent-samples *t*-test was run with and without the outliers resulting in a statistically significant result in two instances and a not statistically significant result in the final case. Based on these tests the outliers were retained in the data.

The dependent variable was found to be normally distributed when examining the skewness descriptive shown in Table 5. According to Morgan et al. (2013), ". . . With large samples most variables would be found to be non-normal, yet actually, data for large samples are more likely to be approximately normal" ("Statistical Assumptions," para 16). For all school districts, the skewness was less than one when the absolute value was examined which is in the acceptable range for a normal distribution of a large sample (Morgan et al., 2013).

Table 5

Descriptive Statistics for Eighth-Grade Science Scale Scores

District	*n*	*M*	*SD*	*SDE*	Skewness
C1	387	153.58	10.852	0.552	-0.842
E1	413	151.28	12.013	0.591	-0.751
C2	305	156.79	9.646	0.552	-0.722
E2	196	160.50	11.056	0.790	-0.547
C2	305	156.79	9.646	0.552	-0.722
E3	243	157.37	10.501	0.674	-0.581

Note. *n* = sample size; *M* = mean; SD = standard deviation; SDE = standard deviation error mean.

Table 6 represents the independent *t*-test results including Levene's test for homogeneity of variance. The purpose of Levene's test is to ensure that the population variances are equal and must return a *p*-value less than 0.05. In all three instances Levene's test of equality of variances shows the assumption of homogeneity of variance being met ($p = .057$; $p = .129$; $p = .484$).

Table 6

Independent t-Test Results for Eighth-Grade Science Scale Scores

	F	*Sig.*	*t*	*df*	Sig. (2-tailed)	MD	SDE
E1 vs. C1							
EV assumed	3.648	.057	-2.845	798	.005**	-2.308	0.811
EV not assumed			-2.855	798	.004**	-2.308	0.809
E2 vs. C2							
EV assumed	2.310	.129	3.965	499	.000***	3.710	0.936
EV not assumed			3.850	375	.000***	3.710	0.964
E3 vs. C2							
EV assumed	0.491	.484	0.677	546	.499	0.584	0.863
EV not assumed			0.671	498	.503	0.584	0.871

Note. EV = equal variances; *F* = f distribution; Sig = significance level of Levene's test; *t* = *t* statistic; *df* = degrees of freedom; *Sig(2-tailed) = t test significance level;* MD = mean difference; SDE = standard deviation error mean.
*p < .05. **p < .01. ***p < .001

District E1 vs. District C1. Table 5 indicates district E1 had a mean science scale score average of 151.28, with a mean difference of -2.308 from the district C1 mean science scale score average of 153.58. This difference was found to be statistically significant between district E1 and district C1, $t(798) = -2.845$, $p < .005$. The null hypothesis was rejected because the p-value of .005 is less than the required level of significance of .05. There is a significant difference between student scale scores on the eight-grade MST2 in schools with a district-provided, 1:1 laptop experience and without a district-provided 1:1 laptop experience. Achievement on the MST2 was greater for district C1($M = 153.58$, $SD = 10.85$) than for district E1($M = 151.28$, $SD = 12.01$) despite the lack of a 1:1 laptop experience in district C1.

District E2 vs. District C2. District E2 had a mean scale score average 160.50 with a mean difference of 3.710 higher than the district C2 mean science scale score average of 156.79. The difference between district E2 and district C2 was found to be statistically significant, $t(499) = 3.965$, $p < .001$. The p-value of less than .001 is less than the required significance value of .05, therefore the null hypothesis was rejected. There is a significant difference between student scale scores on the MST2 test with district-provided, 1:1 laptop experience and without a district-provided laptop 1:1 experience. Achievement on the MST2 was greater for district E2($M = 160.50$, $SD = 11.06$) than for the district C2($M = 156.79$, $SD = 9.65$).

District E3 vs. District C2. District E3 had a mean scale score average 157.37 with a mean difference 0.584 higher than the district C2 mean science scale score average of 156.79. The difference was found to be not statistically significant between district E3 and district C2, $t(546) = 0.677$, $p = .499$. The p-value of .499 exceeds the required significance value of .05, therefore the null hypothesis cannot be rejected. There is no significant difference between student scale scores on the MST2 test with district-provided, 1:1 laptop experience and without a district-provided laptop 1:1 experience. Achievement on the MST2 was greater for district E3($M = 157.37$, $SD = 10.50$) than for the district C2($M = 156.79$, $SD = 9.65$).

Hypothesis Two. H_o: There is no significant difference between student scale score improvement from fifth to eighth grade on MST2 with a district-provided, 1:1 laptop experience and student scale score improvement from fifth to eighth grade on MST2 without a district-provided, 1:1 laptop experience.

Hypothesis two was tested using an independent samples *t*-test. The independent variable is the middle school's participation in a 1:1 laptop experience and is categorical. The dependent variable is the change in student achievement from fifth to eighth-grade using scale scores from the MST2, which is a continuous value. Table 7 shows the descriptive statistics for the school districts. All of the groups again had outliers, but when comparative tests with and without the values in question were run, the data was found to be statistically significant in all cases, resulting in retention of the outliers in the data.

Table 7

Descriptive Statistics for Science Scale Score Improvement

District	*n*	*M*	*SD*	*SDE*	Skewness
E1	414	-0.90	9.29	0.456	-0.280
C1	387	1.43	8.03	0.408	-0.118
E2	196	4.23	7.54	0.539	0.289
C2	305	-1.47	7.36	0.421	-0.206
E3	243	-0.02	7.88	0.5056	-0.707
C2	305	-1.47	7.36	0.421	-0.206

Note. *n* = sample size; *M* = mean; SD = standard deviation; SDE = standard deviation error mean.

Based on Table 7 the dependent variable was found to be normally distributed after examining the skewness. For all five school districts, the absolute value of each was determined to be less than one. Table 8 represents the independent *t*-test results including Levene's test for homogeneity of variance for hypothesis two.

Table 8

Independent t-Test Results for Student Scale Score Improvement

	F	*Sig.*	*t*	*df*	Sig. (2-tailed)	MD	SDE
E1 vs. C1							
EV assumed	6.477	.011	3.783	799	.000***	2.328	.615
EV not assumed			3.802	794	.000***	2.328	.612
E2 vs. C2							
EV assumed	.502	.479	8.380	499	.000***	5.700	.68019
EV not assumed			8.335	408	.000***	5.700	.68391
E3 vs. C2							
EV assumed	.677	.411	2.213	546	.027*	1.445	.653
EV not assumed			2.196	502	.029*	1.445	.658

Note. EV = equal variance; *F* = f distribution; Sig = significance level of Levene's test; *t* = *t* statistic; *df* = degrees of freedom; *Sig(2-tailed) = t test significance level;* MD = mean difference; SDE = standard deviation error mean.
*p < .05. **p < .01. ***p < .001

District E1 vs. District C1. Levene's test of equality of variances shows the assumption of homogeneity of variance as met (*p* = .011). District C1 has a mean science scale score change of 1.43 which was 2.328 points higher than district E1. This difference was found to be statistically significant between the two districts, *t*(794) = 2.328, *p* <.001. The *p*-value is less than .001 which is less than the required significant value of .05 resulting in rejection of the null hypothesis. There is a significant difference in the scale score improvement from fifth to eighth grade on the MST2 in districts with a district-provided 1:1 laptop experience and without a district-provided 1:1 laptop experience. The change in average scale score from fifth to eighth grade was greater for C1(M = 1.43, SD = 8.03) than for district E1(M = -0.90, SD = 9.29).

District E2 vs. District C2. Leven's test of equality of variances shows the assumption of homogeneity of variance as not being met (p = .479). District E2 has a mean scale score change average of 4.23 which is 5.700 points higher than district C2. The difference was statistically significant between district E1 and district C1, t(499) = 8.380, p <.001. The null hypothesis was rejected because the p-value of .001 is less than the required significance value of .05. There is a significant difference in the scale score improvement from fifth to eighth grade on the MST2 in districts with a district-provided 1:1 laptop experience and districts without a district-provided 1:1 laptop experience. The change in average scale score from fifth to eighth grade was greater for E2(M = 4.23, SD = 7.54) than for district C2(M = -1.47, SD = 7.36).

District E3 vs. District C2. Leven's test of equality of variances shows the assumption of homogeneity of variance as not being met (p = .411). District E3 has a mean average science scale score change of -0.02 which is 1.445 points higher than district C2. The difference was statistically significant between district E3 and C2, t(546) = 2.213, p = .027. The p-value of .027 is less than the required significant value of .05, therefore the null hypothesis can be rejected. There is a significant difference in the scale score improvement from the fifth to eighth grade on the MST2 in a district with a district-provided 1:1 laptop experience and a district without a district-provided 1:1 laptop experience. The change in average scale score from fifth to eighth grade was greater for E3(M = -0.02, SD = 7.88) than for district C2(M = -1.47, SD = 7.36).

Hypothesis Three. H_o: There is no significant difference between student scale scores on the eighth-grade online science assessment, MST2, in schools with a district-provided, 1:1 laptop experience regardless of the length of the implementation.

Hypothesis three is tested using a one-way analysis of variance (ANOVA). Gall et al. (2007) suggest using an ANOVA is more efficient and avoids the errors often associated with completing multiple *t*-tests. The independent variable is the length of the middle school's involvement in a 1:1 laptop experience. District E1 has had the longest implementation of six years while district E2 has had the shortest 1:1 experience of three years. District E3's length of 1:1 laptop implementation was four years. The dependent variable is the student scale scores on the MST2 eighth-grade assessment which is a continuous value between 112 and 192 (MDE, 2014). All of the groups had outliers in their data when the boxplots were examined. Upon inspection, it was determined all the outliers were neither data entry or measurement errors. The ANOVA was run with and without the outliers resulting in a statistically significant result in all instances. Based on these tests the outliers were retained in the data.

Table 9

Descriptive Statistics for Scale Scores Based on Implementation Length

District	*n*	*M*	*SD*	*SDE*	Skewness
E1 (6 years)	414	151.25	12.008	0.590	-0.746
E2 (3 years)	196	160.50	11.056	0.790	-0.547
E3 (4 years)	243	157.37	10.501	0.674	-0.581
Total	853	155.12	12.024	0.412	

Note. *n* = sample size; *M* = mean; SD = standard deviation; SDE = standard deviation error mean.

Table 9 revealed a normal distribution of the dependent variable through the skewness values which were all less than one when the absolute value was examined. There was homogeneity of variances, as assessed by Levene's test for equality of variances ($p = .215$). The change in scale scores was statistically significantly different for the various lengths of 1:1 laptop implementations based on the results in Table 10, $F(2, 850) = 50.586$, $p < .001$.

Table 10

ANOVA Test Results for Scale Score Change Based on Implementation Length

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	13101.456	2	6550.728	50.586	.000
Within Groups	110073.208	850	129.498		
Total	123174.664	852			

Note. df = degrees of freedom; *F* = f distribution; Sig = significance level of Levene's test.

A one-way ANOVA was conducted to determine if an increase in the scale score on the MST2 was different for groups with differing durations of a district-provided 1:1 laptop experiences. Three districts were classified as E1(n = 414), E2(n = 196), and E3(n = 243). The mean scale score increased from E1(M = 151.26, SD = 12.008) to E3 (M = 157.37, SD 10.501), and ultimately E2(M = 160.50, SD = 11.056). A Tukey post hoc analysis revealed the mean difference between E1 and E2(9.25, $p < .001$), between E1 and E3(6.12, $p < .001$), and between E3 and E2(3.13, $p < .05$). All experimental groups were found to possess significant differences from one another as seen in Table 11.

Table 11

Tukey Group Comparisons for SS Change Based on Implementation Length

District		Mean Difference	Std. Error	Sig.
E1	E2	-9.248	0.987	.000***
	E3	-6.122	0.920	.000***
E2	E1	9.248	0.987	.000***
	E3	3.126	1.093	.012*
E3	E1	6.122	0.920	.000***
	E2	-3.126	1.093	.012*

*p < .05. **p < .01. ***p < .001

Summary

In Chapter IV this post hoc, quasi-experimental, quantitative study reported the experimental findings on the three hypotheses related to student achievement on the MST2, a high-stakes, online assessment. An independent *t*-test was used for hypotheses one and two and a one-way ANOVA for hypothesis three. Details of the study were discussed in sections relating to population and sample, research instruments, and data analysis. These sections will be further examined in Chapter V and expanded through recommendations and implementations of the study which seeks to explore how the experience of 1:1 laptop implementations affects student achievement on an online science assessment.

CHAPTER V

CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS OF THE RESEARCH STUDY

The purpose of this research study was to explore the effect of technology, specifically 1:1 laptop use, on student achievement on a high-stakes online assessment. Chapter I provided an introduction and rationale for the research questions and hypotheses used in this study. Chapter II expanded the review of research as it relates to the study. In chapter III the methods, theoretical framework, and statistical tests to be used were defined. Chapter IV explains the experimental portion of the study and the results of the statistical tests used in this post hoc, quasi-experimental study. Chapter V will include a brief summary of the results of the study, conclusions drawn from the results, implications of those results, and recommendations for further future research to expand the knowledge around the use of technology in a 1:1 setting and effects on high-stakes tests.

Research Questions

The three research questions for this study examined student achievement on a high-stakes, online assessment, MST2 and the implementation of a district-provided 1:1 laptop experience:

1. Do students with a district-provided, 1:1 laptop experience have statistically higher scale scores on average as measured by the state mandated eighth-grade science

assessment, MST2, than students who do not have a 1:1 laptop experience provided by their school district?

2. Do students with a district-provided, 1:1 laptop experience show a statistically higher level of improvement from fifth to eighth grade on MST2 scale scores than students who do not have a 1:1 laptop experience provided by their school district?
3. Do students with a district-provided, 1:1 laptop experience show statistically higher scale scores on the eighth-grade MST2 as the length of the 1:1 implementation increases?

Research Hypotheses

The research questions driving this study are specified as null hypotheses in the following statements:

1. H_o: There is no significant difference between student scale scores with a district-provided, 1:1 laptop experience and student scale scores without a district-provided, 1:1 laptop experience as measured by the eighth-grade online science assessment, MST2.
2. H_o: There is no significant difference between student scale score improvement from fifth to eighth grade on MST2 with a district-provided, 1:1 laptop experience and student scale score improvement from fifth to eighth grade on MST2 without a district-provided, 1:1 laptop experience.
3. H_o: There is no significant difference between student scale scores on the eighth-grade online science assessment, MST2, in schools with a district-provided, 1:1 laptop experience regardless of the length of the implementation.

Summary of Results

A summary of the results of each statistical test is discussed and further broken down by each matched pair of districts compared.

Hypothesis One Results. The first research question from this study asked if students with a district-provided, 1:1 laptop experience have statistically higher scale scores on average as measured by the state mandated eighth-grade science assessment, MST2, than students who do not have a 1:1 laptop experience provided by their school district.

District E1 vs. District C1. For district E1 and district C1, there was a significant difference in the mean scale scores on the eighth-grade MST2. The district E1 had mean science scale score average of 151.28, with a mean difference of -2.308 from the district C1 mean science scale score average of 153.58. This difference was found to be statistically significant between district E1 and district C1, $t(798) = -2.845$, $p < .005$. Achievement on the MST2 was greater for district C1 ($M = 153.58$, $SD = 10.85$) than for district E1 ($M = 151.28$, $SD = 12.01$) despite the lack of a 1:1 laptop experience in district C1.

District E2 vs. District C2. District E2 had a mean scale score average 160.50 with a mean difference of 3.710 higher than the district C2 mean science scale score average of 156.79. The difference between district E2 and district C2 was found to be statistically significant, $t(499) = 3.965$, $p < .001$.

District E3 vs. District C2. For district E3 and district C2, there was no significant difference in the mean scale scores on the eighth-grade MST2. District E3 had a mean scale score average 157.37 with a mean difference 0.584 higher than the district C2 mean science scale score average of 156.79. The difference was found to be not statistically significant between district E3 and district C2, $t(546) = 0.677$, $p = .499$. Achievement on the MST2 was greater for district E3 ($M = 157.37$, $SD = 10.50$) than for the district C2 ($M = 156.79$, $SD = 9.65$).

Hypothesis Two Results. The second research question from this study explored if students with a district-provided, 1:1 laptop experience show a statistically higher level of improvement from fifth to eighth grade on MST2 scale scores than students who do not have a 1:1 laptop experience provided by their school district.

District E1 vs. District C1. District C1 has a mean science scale score change of 2.328, more than district E1. This difference was found to be statistically significant between the two districts, $t(794.16) = 2.328$, $p < .001$. The change in scale score from fifth to eighth grade was greater for C1 (M = 1.43, SD = 8.03) than for district E1 (M = -0.90, SD = 9.29).

District E2 vs. District C2. District E2 has a mean scale score change average of 5.700, more than district C2. The difference was statistically significant between district E1 and district C1, $t(499) = 8.380$, $p < .001$. The change in scale score from fifth to eighth grade was greater for E2(M = 4.23, SD = 7.54) than for district C2(M = -1.47, SD = 7.36).

District E3 vs. District C2. District E3 has a mean average science scale score change of 1.445, more than district C2. The difference was statistically significant between district E3 and C2, $t(546) = 2.213$, p = .027. The change in scale score from fifth to eighth grade was greater for E3 (M = -.02, SD = 7.88) than for district C2 (M = -1.47, SD = 7.36).

Hypothesis Three Results. The final research question from this study examined if students with a district-provided, 1:1 laptop experience show statistically higher scale scores on the eighth-grade MST2 as the length of the 1:1 implementation increases. The mean scale score was statistically significantly different between implementations of different lengths, $F(2, 850) = 50.586$, $p < .001$. The mean scale score increased from E1 ($M = 151.26$, $SD = 12.008$) to E3 ($M = 157.37$, SD 10.501), and ultimately E2 ($M = 160.50$, $SD = 11.056$), in that order. Tukey post hoc analysis revealed that the mean difference increases between E1 and E2 (9.25, $p < .001$), between E1 and E3 (6.12, $p < .001$), and between E3 and E2 (3.13, $p < .05$) were statistically significant.

Conclusions from Results

The research study results indicated six of the seven tests ran were statistically significant. Each research hypothesis is discussed and further delineated by the set of districts compared in the accompanying hypothesis.

Hypothesis One Conclusions. The first research question from this study asked if students with a district-provided, 1:1 laptop experience have statistically higher scale scores on average as measured by the state mandated eighth-grade science assessment, MST2, than students who do not have a 1:1 laptop experience provided by their school district.

District E1 vs. District C1. This comparison did not return the consistent results. For district E1 and district C1, there was a significant difference in the mean scale scores on the eighth-grade MST2. Unlike the other two examinations, the differences between district E1 and district C1 resulted in higher scale scores for the district without the 1:1 laptop experience. Achievement on the MST2 was greater for district C1($M = 153.58$, $SD = 10.85$) than for district E1($M = 151.28$, $SD = 12.01$) despite the lack of a 1:1 laptop experience in district C1. The results for E1 support the work of Anderson, 2009 and

Becker, 2000 who found 1:1 implementations have a negative effect on students' scores on high-stakes assessments. Teachers in these two studies described moving away from a student-centered classroom into a teacher directed, rote-memorization classroom because it matched more closely the state-mandated assessments. The work of E1 to be a more student-centric learning environment with the 1:1 laptop experience may be the cause of the slightly lower scores as compared to C1, which did not have a 1:1 laptop experience. Cifuentes, Maxwell, and Bulu (2011) suggest normal teaching methods used to increase scores on high stakes tests are very different from those used by teachers who have fully implemented a 1:1 laptop classroom that is technology based and student centered.

District E2 vs. District C2. District E2 has a mean scale score change average of 3.710 higher than district C2. The difference was statistically significant between district E2 and district C2, $t(499) = 3.965$, $p < .001$. Kposowa and Valdez (2013), had similar results. In their research, Kposowa and Valdez (2013), found students with a laptop experience scored over 46 raw score points higher in science students who did not have the laptop experience. Other studies also support this result (Light, McDermott, & Honey, 2002; Ross, Lowther, Wilson-Relyea & Wang, 2003).

District E3 vs. District C2. District E3 had a mean scale score change average of 0.584 higher than the district C2. The difference was found to be not statistically significant between district E3 and district C2, $t(546) = 0.677$, $p = .499$. Although achievement on the MST2 was greater for district E3($M = 157.37$, $SD = 10.50$) than for the district C2($M = 156.79$, $SD = 9.65$) the difference is not statistically significant. This finding matches the work of the Texas Center for Education Research (2008), which found in its third-year report that academic growth while still positive, was not statistically significant.

Hypothesis Two Conclusions. The second research question from this study explored if students with a district-provided, 1:1 laptop experience show a statistically higher level of improvement from fifth to eighth grade on MST2 scale scores than students who do not have a 1:1 laptop experience provided by their school district.

District E1 vs. District C1. District C1 had a mean science scale score change of 2.328 more than district E1. This difference was found to be statistically significant between the two districts, $t(794) = 3.783$, $p < .001$. The change in scale score from fifth to eighth grade was greater for C1(M = 1.43, SD = 8.03) than for district E1(M = -0.90, SD = 9.29).

The negative gain for E1 compared to C1 does match much of the work of Donovan, Green, and Hartley (2010), and Johnson and Maddux (2006). In particular, the work of Donovan et al. (2010), is relevant as they suggest not only was student improvement not as substantial for 1:1 implementation but the difference became even more pronounced at the novelty of the laptops wore off. Hur and Oh (2012), performed a similar examination to this study using a *t*-test to compare gains over two years on English and science test scores with similar results. However, the results for Hur and Oh were statistically significant in favor of the schools without laptop implementations.

District E2 vs. District C2. District E2 had a mean scale score change average of 5.700 more than district C2. The difference was statistically significant between district E1 and district C1, $t(499) = 8.380$, $p < .001$. The specific test resulted in the largest gain among all the groups tested. Researchers focusing on technology invested districts experienced similar gains with similar lengths of implementation suggest the most growth may be seen in the first few years of a 1:1 laptop experience (Lemek & Fadel, 2006; Campuzano, Dynarski, Agodini, & Rail, 2009; Eden Shamir, & Fershtman, 2001).

District E3 vs. District C2. District E3 has a mean average science scale score change of 1.445 more than district C2. The difference was statistically significant between district E3 and C2, $t(546) = 2.213$, p = .027. The change in scale score from fifth to eighth grade was greater for E3(M = -.02, SD = 7.88) than for district C2(M = -1.47, SD = 7.36). While the negative gain for E3 was less than the negative gain for district C2, there was still a significant difference in student achievement.

The results from this study differ from the Shapley et al. (2001) study on the Texas Immersion project. On the Texas Immersion project, the researchers found no significant effect ($p = .06$) on student achievement on a high stakes test. In their research on the Michigan's Freedom to Learn One-to-One initiative, Lowther, Inan, Ross, and Strahl (2012), more closely matched the current study when they found, "the examination of student performance did not show positive impact of laptops on students'' state test scores" (p. 25). It should be noted the significance level of the Texas Immersion project study was nearing significance and should be seen as a possible advantage for 1:1 districts in their planning for technology expansion.

Hypothesis Three Conclusions. The final research question from this study examined if students with a district-provided, 1:1 laptop experience show statistically higher scale scores on the eighth-grade MST2 as the length of the 1:1 implementation increases? The mean scale score was statistically significantly different between implementations of different lengths, $F(2, 850) = 50.586$, $p < .001$. The mean scale score increased from E1(M = 151.26, SD = 12.008) to E3 (M = 157.37, SD = 10.501), and E2(M = 160.50, SD = 11.056). The Tukey post hoc analysis revealed the mean increase from E1 to E2(9.25, $p < .001$), from E1 to E3(6.12, $p < .001$), and from E3 to E2(3.13, $p = .012$) were each statistically significant.

District E1's lower level of mean scale score change could be the result of a weak implementation (Johnson & Maddux, 2006). Another possibility is the length of the implementation which suggests the computers used for the 1:1 experience might be approaching obsolescence as they would be five years old at the time of the study (Krueger, 2013). A final suggestion is based on the work of Donovan et al. (2010), and Hur and Oh (2012) who found student interest in the laptops and subsequent student academic gain decreased as the student excitement over the new computers decreased.

Implications and Recommendations

The lack of improvement for district E1 in comparison to its control district C1 was a surprise as so much of the research examined espoused stronger growth for districts with 1:1 laptop implementations. There are many factors which may have led to this conclusion including the lack of continuity in the implementation (Johnson & Maddux, 2006). The age of the laptops used in this district and the multiple changes in district-level administration over the length of the implementation could have affected the findings. Changing socioeconomic levels of students within district E1 and a higher mobility rate than the control district C1 could also have impacted the results.

Table 12 shows the percentage of students scoring "proficient and advanced" on the eighth grade MST2 test for the past six years for districts E1 and C1. The state average proficient and advanced is also included. As can be seen in Table 12, the entire state saw a drop of 8 percentage points in students scoring proficient and advanced between the 2013-2014 and the 2014-2015 school year. This large state-wide change in scores on the MST2 test could quantify why E1 does not show improvement in comparison to C1. One recommendation is to repeat this study with data from the 2015-2016 school year.

Table 12

Eighth-Grade MST2 Percent Proficient and Advanced Scores Longitudinally

Year	State %PA	E1 %PA	C1 %PA
2015	56	56	**
2014	64	69	62
2013	64	65	72
2012	56	54	56
2011	58	59	64
2010	48	48	47

Note. %PA = percentage of students scoring proficient and advanced.
** data not available for district C1.

The findings of districts E2 and E3 suggest 1:1 laptop districts experience significant improvement in online science test scores when compared to districts without 1:1 laptop implementations. Further examination of these two school districts is warranted to understand their 1:1 implementation strategies and techniques used. School district administrators and technology directors should use this research to help support new implementations of 1:1 laptop experiences especially as they prepare for high-stakes testing.

The findings of district E1 suggest there is a limit to the gain achieved by a 1:1 laptop experience however further examination of the school district revealed three different superintendents and numerous principal changes at each building during the six years of the 1:1 laptop implementation. Because a t-test does not account for variables such as leadership and consistent implementation, research by repeating this study with different school districts would provide more insight into the apparent loss of return on investment. Further research should expand to include the specific best practices of implementation to continue to improve schools 1:1 laptop experiences.

The districts chosen for this study do not adequately represent the entire state of Mississippi school districts. The socioeconomic range of the districts in the study varied from 39 to 62 percent free and reduced all of which were lower than the state average of 63.85 percent (MDE, 2012a). To increase the external validity, it is suggested that this study is repeated with a more representative sample of school districts from throughout the state. Another possible study would be to utilize school districts from throughout the United States, so the variables are equally distributed.

A potential future study is possible when the students from this research study enter high school and take the final high-stakes science exam, the state biology test, which is the next state-mandated test in science for these students (MDE, 2014). Exploring these results will allow all experimental districts to have longer implementations and an updated assessment with technology enhanced items. As assessments become more widely accessible via technology platforms and become better aligned with technology enhanced items, this research should be repeated and extended as these new types of assessments may better show the contribution of 1:1 laptop experiences on student achievement.

Another recommendation for future study is to examine the productivity of 1:1 laptop implementations. As the devices age, they become more prone to failure in both hardware and software resulting in a loss of productivity (D. Masley, personal communication, August 2015). This future study might examine the appropriate length of an implementation and suggest a time frame for computers or other technological devices to be replaced or upgraded, perhaps reviewing the work of Hansen (2012), or Ritschard and Spencer (1999).

An expansion of this study could include a qualitative investigation for insights regarding the differences between and within technology and non-technology groups. A meaningful look into the effects of socioeconomic status on student achievement with 1:1 laptop experiences is also warranted. Finally, a longitudinal version of this study utilizing fifth and eighth-grade data from more than one set of years would expand the understanding of the effects of district-provided 1:1 laptop experiences on student achievement particularly related to high-stakes online assessments.

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APPENDIX

APPENDIX A

LETTER TO DISTRICT FOR RESEARCH STUDY PARTICIPATION APPROVAL

12/15/15

In an interest to support research in the field of K-12 education, as Superintendent of XXXXX, upon University of Mississippi IRB approval, I am consenting my district to participate in Mary L. Johnson's research study.

*Name Date

______________________________ __________________________

* XXXXX – represents name of school district

*Name – Superintendent Signature

VITA

Mary L. Johnson

Education

Principal Licensure Program	University of Denver	May 2007
Masters of Arts in Teaching and Learning	Regis University	June 2002
Bachelor of Science in Mathematics	Mississippi University for Women	May 1991

Experience

Director of School Improvement		
Tupelo Public School District	Tupelo, MS	July 2015 –Present
District Testing Coordinator		
Tupelo Public School District	Tupelo, MS	July 2011 –June 2015
Assistant Principal		
Tupelo High School	Tupelo, MS	July 2007 –June 2011
Teacher on Special Assignment – Curriculum		
School District 27J	Brighton, CO	May 2003 –May 2007
Teacher		
School District 27J,	Brighton, CO	November 1999 – May 2003
Teacher		
Grenada Middle School	Grenada, MS	August 1995-June 1998
Teacher		
Murrah High School	Jackson, MS	August 1993-June 1995
Teacher		
Northwest Rankin Attendance Center	Brandon, MS	August 1991-June1993

Honors

- Phi Kappa Phi, 2014
- Fred Factor Award, April 2008
- Outstanding Mathematics Teacher 2002 for Colorado District 4