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1:1 Technology Initiatives, Socioeconomic Status, Gender, and Native Language on Student Academic Performance

Nic Mounts

1:1 TECHNOLOGY INITIATIVES, SOCIOECONOMIC STATUS, GENDER, AND NATIVE LANGUAGE ON STUDENT ACADEMIC PERFORMANCE

by

Nic Mounts

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ABSTRACT

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Nic Mounts
Harding University
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Title: 1:1 Technology Initiatives, Socioeconomic Status, Gender, and Native Language on Student Academic Performance (Under the direction of Dr. Michael Brooks)

The purpose of this dissertation was to determine the effects of socioeconomic status, gender, native language, and 1:1 initiative participation on academic performance as measured by ACT composite scores for 11th-grade students in seven high schools in Southwest Arkansas. In this study, 1:1 initiative participation was defined as providing all students in a school with a laptop or other mobile-computing device for school and home use each day. Scores chosen for this study were from the 2017 and 2018 11th-grade students in seven high schools in Southwest Arkansas. The samples were chosen from the two main accessible populations, which included scores from students in the four schools participating in a 1:1 initiative and scores from students in the three schools not participating in a 1:1 initiative. ACT composite scores were used to provide the academic performance data for the dependent variable used in each hypothesis. During the spring semesters of 2017 and 2018, the ACT was administered to 11th-grade students across the state of Arkansas including students from the seven high schools in Southwest Arkansas. For the three hypotheses, none displayed a significant interaction effect between 1:1 initiative participation and its moderator variable. Additionally, the main effect for 1:1

initiative participation was not significant for the three hypotheses. Similarly, the main effect for gender was not significant for Hypothesis 2. However, the main effects of socioeconomic status in Hypothesis 1 and native language in Hypothesis 3 were significant, regardless of their 1:1 initiative participation.

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CHAPTER I

INTRODUCTION

The classrooms of today look very different compared to the classrooms of just a few years ago, and one major change is the amount of information and technology that is available to students. Students went from simply learning from the resources available to their teachers, which many times came in the forms of outdated textbooks, supplies, and instructional practices, to having an almost unlimited amount of online information that was being consistently updated (Arnaud, n.d.). Information that was once only available through their teachers became available with only a few keystrokes and clicks of a mouse through an Internet connection. Yet, even with the increase in the *availability* of resources, *accessibility* was still an issue for some schools and their students because of limited Internet connectivity (Bentley, 2017; Warschauer, Zheng, Niiya, Cotton, & Farkas, 2014). Online tutorials, virtual instruction, free software and applications, and learning management systems could make teaching and learning easier and more engaging, but nothing could happen without a computer and a reliable Internet connection.

In an effort to solve the part of this problem dealing with accessibility, educators needed to increase the accessibility of technological materials and applications for all students in the schools. One way educators gave students access to the resources and capabilities of the Internet was to provide students with their own personal laptops as part

of a 1:1 initiative, which in its simplest terms means one personal computer for every student (Weston & Baine, 2010). Weston and Baine (2010) noted that this trend has grown in popularity in all areas of the United States with little regard to district or school student enrollment, location, or status. The first 1:1 initiative was actually implemented in 1989 at the Ladies' Methodist College in Australia (Bebell, 2005). Since that time, 1:1 initiatives have expanded and are now in place around the world and in all levels of education (Stanley, 2015). Bebell and Kay (2010) estimated that in 2006, almost a quarter of all school districts had implemented a 1:1 initiative in some capacity, and Molnar (2015) predicted that 2016 would be the first year that over half of American students would have a school-issued laptop computer. However, does the increased accessibility of technology actually increase student achievement?

With the increased use of technology in the classrooms, the following questions began to surface. Does the implementation of a 1:1 initiative increase student achievement? If so, does the implementation of a 1:1 initiative help increase student achievement for all students or just a select few? Does the increased accessibility of technology increase the achievement of low socioeconomic students? Does providing students from a low socioeconomic background with their own laptops increase their academic achievement? Human nature tends to lead educators to believe that providing students this *luxury* can only help them catch up to their peers who already have their own personal device. Unfortunately, there have been few in-depth studies to back up these assumptions even though Former United States Secretary of Education John King references one of the most important aspects of technology as "its ability to level the field of opportunity for students" (South, 2017, p. 3). Regardless, many school administrators,

in an attempt to level the playing field between the haves and the have-nots, have spent large amounts of money on expanding the availability and use of technology in their classrooms (Ullman, 2013).

In addition to students from a low socioeconomic backgrounds, there tends to be an equally disturbing divide between males and females when discussing student achievement. When examining standardized test scores, many times the difference in performance between boys and girls is double digits. In their study of 75 countries' test scores, Stoet and Geary (2013) found that the top 5% of scores showed girls to be lower in mathematics and boys were lower in reading. According to the researchers, mathematics scores eventually leveled out between genders as the scores went down, but the gap in reading scores increased. Would the addition of a personal computer significantly increase boys' reading scores and girls' mathematics scores?

Finally, one subpopulation that tends to repeatedly get ignored when discussing their unique disadvantages and equally unique needs is English Language Learners (ELLs). Because they must learn the same content as traditional students while at the same time learning a new language, the simplest of lessons can pose a monumental challenge. Diallo (2014) argued the following:

> Technology tools help ELLs become more proficient English speakers because of the efficiency and the rich learning environment technology represents when compared to traditional teaching methods characterized by learning complex rules of English syntax and grammar in a stressful environment. (p. 36)

Therefore, does providing ELLs a personal computer raise their academic achievement?

After controlling for gender, low socioeconomic and ELL students continue to struggle with access to home computers and specifically access to reliable Internet access (Bentley, 2017; Warschauer et al., 2014), which increases the importance of additional studies to determine how 1:1 initiatives affect academic performance of these students. Certainly, if technology does help students increase their academic achievement, the ideal technological supplement to instruction would help all students learn without leaving out a particular subpopulation. If 1:1 initiatives met the criterion of helping all learners, educators would need to seriously consider the implementation of these types of initiatives despite costs or other potential obstacles.

Statement of the Problem

There were three purposes of this study. The first purpose was to determine the effects by socioeconomic status of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools. The second purpose was to determine the effects by gender of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools. The third purpose was to determine the effects by native language of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools.

Background

When examining the research concerning the effectiveness of 1:1 initiatives, there was a distinct difference between the research of the early 2000s compared to the more recent research of 2013 and later. Many of the earlier studies concluded that there was little to no positive effect, and sometimes even a negative effect, when schools implemented an initiative that gave every student a personal computer. Although more research needs to be conducted to determine the exact reason for this, two assumptions can be made to help provide an explanation.

First, with the increase in the number of schools implementing a 1:1 initiative, teachers are better at teaching with this technology. Corn, Tagsold, and Patel (2011) concluded that many teachers indicated they needed time to adjust to the new technology and to help their students do the same. Despite a common drop in perceived technology skills in the early stages of adoption because of technical challenges, Corn et al. noted that most teachers' self-reported technology skills ratings improved over the course of the 1:1 initiative implementation. This could explain why earlier implementations of these initiatives did not equal the instructional quality of later applications of the programs.

The second possible explanation for the discrepancy in findings is the availability of technology. Stanley (2015) emphasized that, until recently, specific portable technology has not been widely available or affordable for the average American student. Smith (2015) found that smartphone use increased 29% from 35% in 2011 to 64% in 2015. Now, Americans have more access to portable technology, and they are taking advantage of the availability. Theoretically, this proliferation of technology in all realms

of life has made incorporating, embracing, and adopting similar forms of technology easier and more widespread in teachers' classrooms.

Early 1:1 Initiatives

Beginning in the late 1990s, American schools began experimenting with 1:1 initiatives. However, it was not until 2002 that Maine rolled out their ambitious statewide initiative becoming the first state to make such a bold commitment to technology integration. Beginning in a single middle school, they eventually provided every seventh- and eighth-grade student in the state's 241 middle schools with his or her own personal computer (Doran & Herold, 2016; Gulek & Demirtas, 2005). With a total price tag of nearly $120 million, which was paid for in part by the Bill and Melinda Gates Foundation (Weston & Baine, 2010), the initiative was known as the Maine Learning and Technology Initiative and was not only ambitious but an expensive gamble in a time when 1:1 educational technology was not the norm in American schools. As an entire country of educators and technology advocates awaited the findings of this initiative, the results were not exactly what the Maine Department of Education had expected. Although writing scores did show significant improvement almost immediately (Argueta, Huff, Tingen, & Corn, 2011), standardized test results in other academic subjects remained relatively unchanged for several years (Silvernail & Gritter, 2007).

While few other states have attempted rollouts of initiatives as widespread as Maine's, there have been several districts that have followed suit. As time has passed, many have seen promising results in student academic achievement. In a study conducted by Rosen and Beck-Hill (2012), they found that student achievement increased significantly as measured by the Texas Assessment of Knowledge and Skills for the

fourth- and fifth-grade students in a Dallas-area elementary school who were given access to technology through a 1:1 initiative. When compared to the control group, the experimental group outscored their peers in reading and mathematics in both grade levels. Similar results were also found at Harvest Park Middle School in Pleasanton, California. There, Gulek and Demirtas (2005) conducted a 3-year study aimed at focusing solely on student academic achievement. They found that the 259 Harvest Park students who were provided laptops significantly outperformed the 1,085 students without laptops when examined by multiple learning outcomes including end-of-course grades, writing assessments, and on both a norm-referenced test (California Achievement Test Sixth Edition) and a criterion-referenced test (Standardized Testing and Reporting [STAR] Program).

While deemed successes in some parts of the country, 1:1 initiatives have received mixed reviews concerning student academic achievement in other areas leading some districts to delay, downsize, or even abandon their pursuits altogether (Hu, 2007). Liverpool (New York) Central School District officials dropped their 1:1 initiative after only seven years because they failed to see improvement in standardized test scores (Hu, 2007). Officials in the Henrico County School District in Virginia found mixed results—significant test score increases in some subject areas compared to declines in Algebra I and II test scores (Argueta et al., 2011). They also discovered a wide variance in achievement from year to year within the same subject areas. Because significant increases in student achievement results cannot be guaranteed simply by making the transition to a 1:1 initiative, many educational leaders remain hesitant to plan technology initiatives on such a large scale.

Financial Costs

One of the biggest hurdles school leaders face when beginning discussions concerning the implementation of a 1:1 initiative is the costs of doing so. Not only is the initial purchase price expensive but so are other costs such as warranties, maintenance, professional development for teachers, and replacement (Rhor, 2013). School leaders must examine their needs, determine the best way to meet those needs, and then develop a funding plan that is adequate and sustainable. Initiatives such as 1:1 initiatives are as varied as the schools themselves, and because of that, it is often difficult to pinpoint an accurate per unit or per student price. Project RED, which is a group aimed at revolutionizing education through 1:1 initiatives, conducted a study and determined that 1:1 initiatives cost between $100 and $400 per student per year (Ullman, 2013). That price tag included hardware, software, professional development for teachers, training, and support.

Depending on the state and federal laws applicable to schools and districts, leaders have a variety of options from which to use revenue. Some schools opt to pass bond issues, others reorganize or reprioritize budgets, and others rely on grants to purchase or lease devices. Depending largely upon the makeup of a school's student population, some leaders opt to use Title I or National School Lunch funds to cover most or all of the costs (Rhor, 2013). While the Los Angeles Unified School District in California spent over $1 billion to purchase Apple iPads and all peripheral accessories needed to go with them, other districts such as Reeds Springs in Missouri chose to lease Lenovo tablets in order to spread the purchase price over a more manageable timeframe

(Rhor, 2013; Ullman, 2013). There is little doubt that the expense of the 1:1 initiatives is a limiting factor for many school districts.

Added Benefits

Perhaps the most interesting aspects of 1:1 initiatives are the added, and many times unanticipated, benefits of such a programs, which may prove more important or significant than any gains they see in academic achievement. For example, many schools have reported an increase in student attendance, student engagement, learner satisfaction, and a reduction in disciplinary referrals (Argueta et al., 2011; Holcomb, 2009). Zheng and Warschauer (2016) noted that through their interviews with teachers and classroom observations, students with laptops worked more autonomously and were able to synthesize and critically apply knowledge more so than those students working without laptops.

Lowther, Ross, and Morrison (2003) found that a 1:1 initiative resulted in a highly significant increase in problem-solving abilities when compared to a group of students who did not have access to personal computers. That same study found that students who had access to a personal computer viewed their technology skills as having improved, thought they could better conduct Internet research, and were glad to have the devices. Students in this study also demonstrated higher engagement or interest, more proficient use of technology as a learning tool, and more proficient writing skills in all areas. In a separate study, Warschauer et al. (2014) found that students in a middle school consisting primarily of low socioeconomic students and ELLs scored significantly higher in mathematics (80% proficiency versus 69% proficiency) and reading (79% proficiency versus 59% proficiency) when given access to technology as part of a 1:1 initiative.

The added benefits of a 1:1 initiative are not limited to students either. Holcomb (2009) discovered that teachers benefit also. They reported an increase in teachers' computer skills and their proficiency within those skills. Teachers also reported that their lessons were more creative, customized, and collaborative and that they were using technology in a way they had not prior to the initiative. Additionally, as teachers became even more proficient with their technology skills, their instruction became more technologically complex, and they became more collaborative with their peers (Holcomb, 2009).

When it came to writing—the one skill that most educators admit students need the most improvement—Zheng and Warschauer (2016) found students with laptops wrote more frequently, received more feedback from teachers, and revised their papers more often. They were also inclined to share their work more frequently with their peers. The researchers subsequently found that these same students were more capable of working collaboratively with one another when compared to their peers who did not have access to a laptop. Similar results were found in a separate study in which students in 1:1 initiatives wrote more and more often, and they received more feedback from both their peers and their teachers (Jeroski, 2008).

Long gone are the days of focusing solely on reading, writing, and mathematics. Educators now must teach and assess skills such as analysis, critical thinking, character education, digital citizenry, social/emotional learning, and collaboration (Moseley, 2015). Although few would argue the validity of including these additional skills, there are only so many hours in a school day and only so many dollars in the budget. The addition of all these skills force educators to highly scrutinize subsequent additions and even current

educational offerings that have long been available to students (Thompson, 2014). Educational leaders must ensure that the taxpayers' funds are spent wisely and that their teachers' time is used effectively. Because of the increased scrutiny and sometimes a reduction in funding, adding something as expensive and culture changing as a personal laptop for each student is something that must be given an enormous amount of thought, planning, and preparation.

Hypotheses

Although Holcomb (2009) found that 1:1 initiatives could increase student attendance, student engagement, learner and satisfaction, and reduce disciplinary referrals, the literature is still mixed regarding technology's effect on academic achievement for all students. Therefore, I generated the following null hypotheses.

1. No significant differences will exist by socioeconomic status of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools.
2. No significant differences will exist by gender of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools.
3. No significant differences will exist by native language of students who participated in a 1:1 initiative (provided a personal computer) versus those

students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools.

Description of Terms

ACT composite score. According to ACT (2017), a student's composite score ranges from a low of 1 to a high of 36 and is the average of a student's four test scores including English, mathematics, reading, and science. For this study, composite scores from the spring semester of the students' 11th-grade year were used.

English Language Learner (ELL). Great Schools Partnership (2013) defined ELLs as students who are unable to communicate fluently in English, who often come from non-English-speaking homes and backgrounds, and who typically require specialized or modified instruction in both the English language and in their academic courses.

Native language. As defined by Farlex (2018), "native language" is "the language that a person has spoken from earliest childhood" (para. 1).

1:1 initiative. Great Schools Partnership (2013) defined a 1:1 initiative or program as one that "provides all students in a school, district, or state with their own laptop, netbook, tablet computer, or other mobile-computing device" (para. 1). To further expand that definition, a 1:1 environment is one in which each learner has access to a portable device that connects him or her to teachers, other learners, and the Internet. In addition, learners are allowed to remove these devices from school so that access to the device remains constant while they are at home. For the purpose of this study, a school is

defined as having implemented a 1:1 initiative if students are allowed to take their school-issued computers home each day.

Socioeconomic status. For this study, socioeconomic status was defined by school lunch status per the guidelines set forth by the U.S. Department of Agriculture, Food, and Nutrition Services Child Nutrition Programs (2016). Students were identified as participating in the free or reduced school lunch program or not participating.

Superscore. The practice of using the highest scores from each of the four sections of the ACT regardless of the testing date to formulate a single superscore (Arkansas State University, 2017).

Virtual instruction. For the purposes of this study, virtual instruction, as defined by Van Beek (2011), is coursework that falls under a wide array of categories including Internet-based instruction, remote teacher online instruction, and blended learning. Specifically, Van Beek defined Internet-based instruction as instruction not delivered by a teacher; instead, instruction is provided by software, which can be readily customized to meet the specific needs of students. Remote teacher online instruction is defined as instruction delivered by a teacher through the Internet. The teacher interacts with students through videos, online forums, and/or email. Blended learning is more specifically defined as a combination of traditional face-to-face instruction with a mixture of Internet-based or remote teacher online instruction (Van Beek, 2011).

Significance

Research Gaps

Although a substantial amount of research has been conducted regarding 1:1 initiatives, very little of that research has focused on direct effects between 1:1 initiative

implementation and student academic performance regarding specific subpopulations, especially including socioeconomic status and ELLs. Although typical studies focus on costs, academic gains versus costs, or correlations of 1:1 initiatives on writing scores or mathematics scores, more research is needed to focus on the effect of providing personal computers to different groups of students.

Potential Implications for Practice

Traditionally, students of low socioeconomic backgrounds and those classified as ELLs are lacking in technology use, access, and skills. According to Becker (2000), 91% of children whose families earned incomes of more than $75,000 per year had access to a home computer. Conversely, only 22% of children coming from families making less than $20,000 per year were afforded the same opportunity. Even children from low socioeconomic backgrounds who had access to a computer were reported to use the computer less than their counterparts from high-income families (Warschauer et al., 2014). Gowen (2009) described a similar situation for ELLs. According to her, the problem is not access to a computer. Instead, the problem is access to the Internet at home, and many ELLs simply do not have it (Bentley, 2017). Having specific data concerning these two subpopulations could assist educational administrators when making decisions concerning implementation or expansion of potential 1:1 initiatives.

With administrators looking for every advantage to give their students and teachers and with the recent competition brought on by school choice, charter schools, and private schools, serious thought must be given for every dollar spent. Instead of investing heavily in the 1:1 initiative and hoping it makes a difference in students' academic performance, school leaders should be taking a hard look at providing

resources, technological or otherwise, to those students and in those areas where the needs are the greatest. In addition, they should be investing in programs that are research-based and have a proven record of increased achievement. The research conducted in this study provides those in charge of funding the necessary information to make informed decisions regarding technology purchases and the implementation of a 1:1 initiative when considering the unique needs of student subpopulations.

Process to Accomplish

Design

A quantitative, causal-comparative strategy was used in this study to examine the three hypotheses. The common independent variable for all three statements of problems was student participation in a 1:1 initiative (participated by receiving and using a personal computer) versus those students who did not participate. The second independent variables for Hypotheses 1-3 were socioeconomic status defined by school lunch status (free/reduced or regular), gender (male or female), and native language defined by ELL program participation (participate or not participate), respectively. The dependent variable for all three statements of problems was overall student academic performance as defined by the composite ACT score taken during the students' 11th-grade year.

Sample

The sample in this study was ACT scores from 11th-grade students in seven Southwest Arkansas rural high schools. I chose these schools because of similar student demographics, similar student body populations in regard to student enrollment, and similar participation in a 1:1 initiative. The accessible population consisted of 772

students consisting of Caucasian (78%), African-American (3%), and Hispanic (19%). Concerning socioeconomic status, 69% of the combined population was eligible for free or reduced meals. A stratified random sample of 140 students was used for each hypothesis.

Instrumentation

The ACT, a battery of four multiple-choice tests, was first administered in 1959 and has been used to determine students' levels of college and career readiness and for college entrance in all states since 1960 (Fletcher, 2009). Although the ACT has been taken by hundreds of thousands of students across the state, in Spring 2016, for the first time ever, 11th-grade students across the state of Arkansas took the ACT as part of a new state initiative (Arkansas State Senate, 2017). The test measures content knowledge in four key core academic content areas: English, reading, mathematics, and science. Beginning with the February 2015 national testing date, an optional writing section was included with the test, and it continues to be an option for students (Fletcher, 2009). Because it is not included in Arkansas' testing requirements for 11th-grade students, I chose not to include it in this study (Arkansas Department of Education, 2017). Over 2 million American students in the class of 2017 took the ACT, which accounted for 60% of all students nationwide. The average composite score for this group was 21.0, which was an increase from the previous year's average score of 20.8 (Gewertz, 2017).

ACT has a reliability score in English of .92, in mathematics of .91, in reading of .87, and in science of .85. For the overall composite, a reliability score of .94 was reported (ACT, 2017). In Arkansas, 31,110 11th-grade students took the ACT that was administered in February 2017. Those students had an average composite score of 18.8,

which included average scores of 18.4 in English, 18.5 in Mathematics, 18.9 in Reading, and 18.9 in Science (Arkansas Department of Education, 2017). In 2018, 31,227 students took the ACT earning an average composite score of 18.7.

Data including English, Mathematics, Reading, and Science subtest scores in addition to composite scores were collected from high school principals and counselors through the school summary report provided annually by ACT. Superscoring, which is the practice of using the highest scores from each of the four sections of the test regardless of the testing date to formulate a single superscore, is being accepted at an increasing number of higher education institutions (Arkansas State University, 2017). Despite this growing trend and because this study was focused on the academic performance as measured by composite scores of the state-mandated ACT administered during the 11th grade, I did not use superscores for this study.

Data Analysis

To address each of the three hypotheses, a 2 x 2 factorial between-groups Analysis of Variance (ANOVA) was conducted. Hypothesis 1 was analyzed using a 2 x 2 factorial between-groups ANOVA with 1:1 initiative participation and socioeconomic status as the independent variables and student academic performance as measured by the students' composite score on the ACT as the dependent variable. Hypothesis 2 was analyzed using a 2 x 2 factorial between-groups ANOVA with 1:1 initiative participation and gender as the independent variables and student academic performance as measured by the students' composite score on the ACT as the dependent variable. Hypothesis 3 was analyzed using a 2 x 2 factorial between-groups ANOVA with 1:1 initiative participation and native language as the independent variables and student academic performance as

measured by the students' composite score on the ACT as the dependent variable. To test the null hypotheses, a two-tailed test with a .05 level of significance was used.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

This literature review provided an examination of the related literature and was broken into six parts. First, a broad overview of the history of the role instructional technology has played in schools was presented. Second, an overview of the implementation challenges of 1:1 initiatives was offered. Third, the effects of 1:1 initiatives on academic achievement was examined. Fourth, an examination of the added benefits of 1:1 initiatives to students including improved 21st-century skills and increased student engagement and satisfaction was described. Fifth, the benefits to special subpopulations of students including low socioeconomic students and ELLs were presented. Finally, an examination was made of the benefits 1:1 initiatives provide to teachers and how the initiatives are helping instruction.

History and Influence of Instructional Technology in Schools

When discussing instructional technology in current terms, the discussion generally centers on laptops, 3D printers, interactive whiteboards, iPads, and virtual reality systems and software, but it is important to remember that teaching and learning has been changing because of technology for hundreds of years. Before the turn of the 20th century and long before research on instructional technology was common, two pieces of what would now be considered the most rudimentary of technologies made their way into American classrooms: the slate board and the pencil (Dunn, 2011). When first

introduced to the classroom, slate boards were approximately the size of today's textbooks. Each student had his or her piece of slate, and he or she was required to practice mathematics skills, writing, or geography within the confines of the slate. Because of the small size of the slate, little whole-class instruction could take place. Instead, teachers were forced to walk around the room to each desk to ensure that students were progressing appropriately. The slate also limited the students' ability to take and archive notes. Because students were constantly writing and erasing, a strong emphasis was put on being able to memorize and internalize facts quickly (Muttappallymyalil & Mendis, 2016). Subsequent research has shown that this rote memorization method of learning does not translate well to increasing critical thinking skills, nor does it provide what experts refer to as *deep* learning (Towler, 2014). Not until an innovative teacher named George Baron, a mathematics teacher from the United States, hung several smaller pieces of slate onto the board that the idea of today's chalkboard entered America's classroom. Since that time, some form of board has been used for instructional purposes in almost every classroom at every level across the country (Dunn, 2011).

The second major technological advancement that affected classrooms pre-1900 was the pencil, which was invented in 1795 by Nicholas-Jacques Contea (Popova, 2013). Until the mass production of the pencil, teachers and students had only one true option for writing: the fountain pen, which was prone to leaks and messes. The pencil changed the way teachers taught and what they could expect of their students (Schifman, 2016). Teachers, for the first time, could reasonably expect their students to take notes and practice their subject matter without the limits and constraints of the slate board.

Researchers have shown that the process of taking notes is imperative to students taking ownership of the material so that it can be restructured in a way that is meaningful to the student (Weimer, 2015). These two advancements in technology changed the instructional practices of teachers, and they were the primary improvements to teaching and learning until the 20th century.

The Introduction of Film

As the motion picture industry grew exponentially in the United States during the 1920s, people all over the country became enamored with movies, and the invention of the first filmstrip projectors brought that technology into the classrooms. These projectors enabled teachers to add elements to their lessons that were previously impossible. According to Dunn (2011) and Akanegbu (2013), projectors so changed the world of education that Thomas Edison declared they would replace books within the next 10 years. In addition to adding a motion picture aspect that kept students' attention, with the twist of a knob or the push of a button, the teacher could stop the film and engage his or her students in a class discussion regarding the content within the film (Akanegbu, 2013). These devices became so trusted by teachers that they remained in many classrooms until the invention of the video cassette recorder in the 1980s. A successor to the filmstrip projector came in the form of the overhead projector invented by Roger Appledorn in the 1960s. According to Muttappallymyalil and Mendisto (2016), the United States Army was the first to use the new technology during World War II for training purposes. Afterward, Appledorn began marketing his product to schools where they became a mainstay until early into the 21st century (Akanegbu, 2013).

Other breakthroughs in instructional technology appeared in classrooms across the country. The handheld calculator was introduced around 1970, and according to Banks (2011), the National Advisory Committee on Mathematical Education suggested in a 1975 report that students in the eighth grade and above should have constant access to them for all classwork and exams. This recommendation was met with resistance from both teachers and parents who felt strongly that increasing access to calculators would lead to students forgetting basic mathematical concepts (Banks, 2011). Even today, the topic of whether to allow certain pieces of technology is debated by educators and researchers alike.

The Introduction and Adoption of the Computer

The first known attempt to use computers as a means to complement or replace instruction was in 1963 at Stanford University. There, Patrick Suppes and Richard Atkinson designed a program with the goal of providing students with an alternative to the traditional group instruction (Tobias & Duffy, 2009). They began to examine the benefits of replacing a teacher during lessons that required few cognitive steps of students. Students participated in learning activities in mathematics and reading and were quickly corrected or rewarded by the computer program through what many educators now refer to as drill-and-kill instruction (Molnar, 1997). This attempt by Suppes and Atkinson proved useful because the programs were focused on specific objectives, and they were designed in a way that promoted motivation and engagement through interactions that were specific to the students' needs, according to Tobias and Duffy (2009). Their vision was to provide instruction that was both individualized and self-paced through the use of a computer.

The desktop computer was introduced to most public schools in the early 1980s, but they were not necessarily placed in classrooms for teacher and student access. The idea of using computers in teachers' instruction was still a few years away; instead, schools primarily used them for administrative and counseling services (Murdock, 2007). Less than 20% of schools were using computers as a part of classroom instruction as late as 1981 (Ferrell, 1987). That changed, however, as software developers began designing products that allowed students to complete simple tasks such as practicing geography and mathematics problems on a computer screen. The research was beginning to indicate that by practicing these simple tasks, students could progress through lessons faster than they could through a whole-group setting (Tobias & Duffy, 2009). By 1983, Apple was developing a niche in the K-12 market with its new Apple II computer (Topper & Lancaster, 2013), and by 1984, as more schools continued to realize the advantages of adopting computers as a means of instruction, there was roughly 1 computer for every 92 students nationwide (Dunn, 2011). The first laptops were being developed by the late 1980s, and roughly 60% of all workers in the United States were using computers in some capacity (Murdock, 2007). The 1990s finally saw the introduction of computers that were true multimedia machines capable of displaying video and operating virtual reality software and the Internet that changed the world of education forever by linking learners and ideas from around the globe (Murdock, 2007).

Challenges with 1:1 Initiative Adoptions

Beginning with Maine's rollout of the nation's first true 1:1 initiative, there have been challenges associated with meeting the goals that educators have of such programs (Argueta et al., 2011; Hu, 2007). From making decisions about the types of devices to

funding the initial purchase of computers and peripherals to providing teachers with the appropriate professional development needed to make such a drastic change in their instruction, administrators quickly learned that even though adding hundreds of devices to classrooms solved, in part, the problem of access to educational resources, their presence also presented a new set of challenges (Topper & Lancaster, 2013). Those challenges, although varied among schools across the nation based on dozens of factors, can be summed up in two categories based on influence and proliferation: an inadequate vision for implementation and sustained success and the lack of skill and will of the teachers tasked with integrating 1:1 initiatives in their classrooms.

Inadequate Vision for Implementation and Sustained Success

Although the goal of any major change to the educational landscape is to increase student achievement, to ignore these challenges and subsequently to fail to have a plan to address them have caused missteps in some of the nation's largest districts such as Los Angeles, California; Guilford County, North Carolina; Fort Bend, Texas; and Miami-Dade County, Florida (Herold, 2014). Issues with financing and device security (Los Angeles), hardware (Guilford County), and a combination of unrealistic goals and inadequate planning (Fort Bend and Miami-Dade County) made meeting the goals of these 1:1 initiatives more difficult or next to impossible in these districts (Herold, 2014). Because of these high profile missteps, other district leaders take note and often choose to alter their plans to avoid the pitfalls of implementation including scaling back their previous plans by grade level or subjects (Herman, 2015). Some opt to roll out devices to students after teachers have been trained using the same devices (Downes & Bishop,

2015; Topper & Lancaster, 2013), or to focus on the vision and evaluation pieces of the initiatives (Topper & Lancaster, 2013).

Even in Maine where leaders were inundated with requests for advice and guidance on all aspects of 1:1 initiatives, mistakes were made from the beginning. Implementation of the Maine Learning Technology Initiative was possible in large part thanks to a statewide contract with Apple that allowed school leaders to purchase products in bulk (Muir, Knezek, & Christensen, 2004). The problem was not necessarily with the devices. Instead, the problem presented itself when technology directors around the state began the process of integrating Apple devices into a PC-only network. Under regulations adopted by Maine lawmakers, districts were not allowed to opt out of Apple products, nor were they allowed to purchase additional products for other staff members at the state-negotiated prices (Trotter, 2004). The program also faced questions from state leaders and educational technology specialists who said that the state did not do enough to monitor the program's impact and its implementation. With the added benefit of hindsight, leaders recognized that they veered from the main goals, according to Mike Muir, who oversaw much of the implementation of the Maine Learning Technology Initiative (Herold & Kazi, 2016).

Other districts failed to fully comprehend the magnitude of the financial costs associated with implementing a 1:1 initiative. Despite planning for initial costs, maintenance costs, and replacement costs, some school leaders fail to recognize that there will always be costs that are simply unforeseeable. Warschauer et al. (2014) described writing software that was purchased for students in the Saugus Unified School District in California. The software, subscribed to on a per-student basis, was an ongoing expense

that was to be evaluated and renewed annually. Additionally, district leaders in Birmingham, Alabama, decided early in the implementation of their 1:1 initiative that parents would bear the responsibility of paying to repair any damaged laptops. Warschauer et al. noted that in some classrooms, more than half of the students reported that their laptops did not function, presumably as a result of their parents' unwillingness or inability to pay for the needed repairs.

Finally, 1:1 initiatives require a network capable of supporting the program. One area that is easily neglected by those making decisions regarding the implementation of 1:1 initiatives is WiFi quality and accessibility (Barrett, 2016; Bentley, 2017; Cavanagh, 2018; Rideout & Katz, 2016). Cavanagh (2018) noted that the Consortium for School Networking conducted a survey of school technology officers from around the United States and found that having the WiFi networks to support the number of devices on their campuses was the biggest challenge for the K-12 educational world. Despite 86% of technology directors indicating they were confident their wireless networks have the ability to support the technology needs of their students and teachers, the results of the study also indicated that the percentage of district leaders who indicated their students have the ability to connect to the Internet outside the walls of the school was still unsatisfactorily low, and more disturbingly, unchanged for three consecutive years. Rideout and Katz (2016) discovered that the problem was not necessarily computer and Internet access. They found that 94% of families have some access, even if that was merely through a smartphone. Their results indicated that even those families living below the poverty level were very likely (91%) to have Internet access. The problem was the quality and sustainability of that access. Half of the respondents said their access was

too slow, 20% said that their service was disrupted within the last year because of inability to make the monthly payment for the service, and 29% said they had reached their data limits on their plans within the last year, which typically results in a drastic reduction in download speeds. This lack of quality and reliable home access was also noted by Bentley (2017), who said that home connectivity is especially important for those students who learn in a 1:1 initiative. Without access at home, according to Bentley, the learning stops because access to instructional materials, even when downloaded and stored locally on the device, requires additional planning by students and sometimes teachers.

To combat the problem of accessibility outside the traditional school hours, many schools, such as Indian Trail High School and Academy in Kenosha, Wisconsin, are taking it upon themselves to provide home access to the Internet that is both fast and reliable (Barrett, 2016). By leasing mobile hotspots, schools bring students whose families may not be able to afford quality WiFi services to a level playing field with those students whose families can. Similar to the program in Kenosha, students around the country are gaining access to WiFi through mobile hotspots by checking them out just like they would a book from the library. Students in these participating schools no longer have to worry about the added demands of taking intensive Advanced Placement classes, often with hours of added reading and research, without the luxury of reliable and fast Internet access. Other schools have found creative ways to provide Internet access on buses for students to use during long bus rides to rural areas of school districts. According to Kajeet, a company based in McLean, Virginia, who provides mobile

hotspots, 170 schools in 33 states have their product in the hands of needy students (Barrett, 2016).

Lack of Skill and Will of Teachers

When funding and planning 1:1 initiatives, district and building leaders must not neglect to provide the appropriate training and support to teachers so that those teachers will be willing to embrace and prepared to use a more technology-centric approach to teaching and learning. In their study, Noelle and Gansle (2009) concluded that three common components lead to a sustained change in schools. Those three components include reducing barriers to implementation by providing relevant and timely training and support to teachers, assessing the performance of the teachers implementing the change, and providing feedback to teachers. Holcomb (2009) found similar results in his study, which indicated that laptops must be distributed along with quality and sustained professional development for teachers. In addition to these noted researchers, others such as Warshauer et al. (2014), Zheng and Warshauer (2016), Owen, Farsaii, Knezek, and Christensen (2005-2006), and Moseley (2015) found that the success of any 1:1 initiative is intrinsically connected to the amount, type, quality, consistency, and relevancy of the support and training provided to the teachers charged with implementing the new technology into their classrooms and curriculums.

While few would disagree that providing appropriate professional development is vital to developing the skills needed for a change of this magnitude, a few researchers pointed to a different issue that manifests itself where teachers and training meet. Stanley (2015) described this issue as a "long history of resistance to change on the part of teachers, particularly regarding educational technology" (p. 12). More importantly than

whether training was provided, Agyei and Voogt (2011) argued in their study that the teachers' will, defined as the attitudes of teachers toward the technology, and skill, defined as the ability of teachers to integrate technology competently in a classroom setting, are essential to teachers using a 1:1 initiative effectively. Using 180 teachers or prospective teachers, the researchers concluded that the lack of anxiety of teachers was the most important aspect of the will of teachers, and that skill was the most significant predictor of classroom technology integration. Lowther, Strahl, Inan, and Ross (2008) conducted a similar, but much larger, study as part of a review of the Tennessee EdTech Launch. They identified six key obstacles that often threaten the successful integration of technology by teachers. Those obstacles included availability and access to computers, availability of curriculum materials that support technology integration, teachers' beliefs about the use of technology, demographic characteristics of teachers, teachers' technological and content knowledge, and technical, administrative, and peer support provided to teachers. Of the teachers in the study, 270 were a part of a focus group. The focus group's teachers' attitudes toward technology integration were positive, and their attitudes improved as the program progressed. Almost 30,000 students and over 1,700 teachers from 54 schools participated between 2003 and 2006.

Although quality professional development before, during, and after the implementation of a 1:1 initiative is preferred and encouraged, this type of training is not necessary for program success. Owen et al. (2005-2006) noted in their research that one of the significant contributions of a 1:1 initiative has been the overall experience provided to teachers regarding growing professionally in their craft. In other words, the implementing of a 1:1 initiative itself can be considered a valuable tool for teachers

because the professional development in which a teacher must participate requires them to learn more about technology and, specifically, technology integration appropriate to their content areas. Although they pointed out that initial training is vital to a 1:1 initiative, simply being exposed to and having ready access to the technology encourages teachers to become better and more frequent users. Teachers in the Owen et al. study ranked themselves as being more comfortable with the technology the longer they used it with full adjustment to the 1:1 initiative generally taking place by the third year. Similarly, Stanley (2015) found that the success of a 1:1 initiative is significantly dependent on the practice of the teachers charged with its implementation. According to Owen et al. (2005-2006), "the implementation of the program itself provided the impetus for teachers to take charge of their own learning and improve themselves" (p. 14). Thompson (2014) was even more direct in her thoughts regarding professional development. She argued that it was not enough for teachers simply to rely on administrators to provide professional development. Instead, teachers must be able to express the types of training needed accurately.

Effects on Academic Achievement

When spending a combined $13 billion on technology and technology integration across the country, both political and educational leaders expect to see an increase in student achievement (Lacy, 2016). In a study of almost 500 students in four Dallas-area elementary schools, Rosen and Beck-Hill (2012) found that the impact of learning in a 1:1 initiative resulted in significant growth in both reading and mathematics scores when compared to a control group of students. This study focused on *A Time to Know*, which is a program that includes an environment that is both teacher-driven and student-centered.

This approach includes a curriculum designed specifically for a 1:1 environment, technological and pedagogical support for teachers, and a digital teaching platform that enables teachers to not only teach technology-rich lessons but also easily collect and evaluate formative and summative assessment data. The researchers pointed out that *A Time to Know* is intentionally designed to be used in a way that is different from most other 1:1 initiatives that they considered "technology-centric" (p. 228). Instead of using technology only for those activities considered technology-related, *A Time to Know* infused technology in a way that completely changes teaching and learning through technology-rich learning environments.

The Hanover Research Council (2010) conducted a meta-analysis in which they examined seven major studies. Of those seven studies, six were designed specifically to measure the effects of 1:1 initiatives on student achievement. The remaining study measured student attitudes toward school after having implemented a 1:1 initiative. At one site in Stillwater, Minnesota, researchers divided the participants into a group with 1:1 access and a group in the traditional settings with approximately a 3:1 ratio of students to computers where the computers were only accessible through a mobile cart system. Despite finding that students' achievement levels increased the longer they were participants in the laptop initiatives, there were no significant differences between the 1:1 group and the 3:1 group.

In Massachusetts, a study was conducted of the Berskshire Wireless Learning Initiative in which the goal was to determine both the effects of a 1:1 initiative on student achievement and also to examine students' abilities to conduct research (Bebell & Kay, 2010). They analyzed 10 years' worth of achievement data to determine the level of

effectiveness of the 1:1 initiative. At the conclusion of the study, researchers noted that the group of eighth-grade students who had been participants in the 1:1 initiative for all of their eighth-grade year and at least half of their seventh-grade year saw improvement in mathematics achievement, which carried into their eighth-grade year. Those same eighth-grade students also saw improvement in their writing achievement when allowed to use their laptops compared to the control group. In a similar study, 42 public schools across Texas were evaluated to determine the effectiveness of the Texas Immersion Pilot, which was legislated in 2003 but implemented before the 2006-2007 school year (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010). Researchers formed a control group comprised of 21 schools along with a Texas Immersion Pilot group comprised of 21 schools. The dependent variable for the study was student performance on the statewide Texas Assessment of Knowledge and Skills. Over 7,500 students participated in the study with 76% of those students classified as economically disadvantaged. The 4-year study revealed that having increased access to 1:1 technology had a positive effect on the state assessment for those students in the 21 Texas Immersion Pilot schools. The study also revealed that the strongest predictor of reading achievement was the amount of time a student spent using the school-issued laptop at home after the school day had ended (Shapley et al., 2010).

Students in Pleasanton, California, participated in a study designed differently than other studies. Instead of the researcher assigning students to groups, Gulek and Demirtas (2005) allowed participants in Pleasanton to self-select their groups. In addition, instead of the school district providing laptops, parents were required either to provide students with a laptop or to petition the school to provide a laptop based on

family financial need. The study was designed to reveal the impact of the laptop program on students' GPA, end-of-course grades, writing skills, and standardized test scores. Although the difference in GPA was only 0.29 in favor of laptop students, after three years, a significant difference was noted in academic performance between the laptop group and the non-laptop group when measuring end-of-course grades. Of the sixth-grade students who had opted to use a laptop, 92% earned an A or B in English language arts compared to only 70% of the non-laptop students. For seventh-grade students, the difference was 84% to 56%, and with eighth-grade students, the gap was 90% to 79%. Little difference was noted between the groups in regards to performance on the writing assessment, but students in the laptop group outperformed their peers by a significant margin on state standardized tests (Gulek & Demirtas, 2005). In a study by the Center for Technology in Education at the Johns Hopkins University, researchers found that students participating in a 1:1 initiative in the Talbot County Public School System in Maryland during the 2010 school year passed the Maryland Algebra HSA at a higher rate (90%) compared to students in 2008 (55%) and 2009 (66%) when students were not participating in a 1:1 initiative. Talbot students also passed the Biology HSA and the English HSA at a significantly higher rate after participating in a 1:1 initiative (The Abell Foundation, 2008).

Other studies showed similar increases in academic achievement of students. Lowther et al. (2003) found that students increased significantly in science and writing when participating in a 1:1 initiative. A study by Kposowa and Valdez (2013) indicated that students who participated in a 1:1 initiative scored higher in mathematics and English language arts. Lowther et al. (2008) found that the use of laptops increased

student learning in Michigan, and Keengwe, Schnellert, and Mills (2012) found that there was a significant correlation between 1:1 initiatives and both student engagement and student achievement. Muir et al. (2004) found that after analyzing three years of standardized achievement data for eighth-grade students, those students had significantly increased academic performance in science, social studies, and mathematics when compared to their peers at control sites.

Despite many instances of significant increases in student achievement, these results are not guaranteed. A few studies, such as one conducted by Dunleavy and Heinecke (2007), found that there was no significant main effect when examining students' standardized achievement test scores based on student participation in a 1:1 initiative versus no participation. Bryan (2011) found that although reading fluency and comprehension scores for both control and experimental groups increased during his study, laptop usage did not have a statistically significant effect on either. Officials in the Henrico County School District in Virginia found that although students had significant test score increases in some areas, students declined in other areas such as high school mathematics courses (Argueta et al., 2011).

Additional Benefits to Students

Increases in student achievement measures are crucially important to the continuing implementation of 1:1 initiatives around the country. Without at least a marginal increase in student achievement, district leaders will always remain hesitant to allocate the funds necessary for a 1:1 initiative. However, what if proponents of 1:1 initiatives could provide leaders with evidence that the true value of a 1:1 initiative is what comes in addition to the anticipated increases in student achievement? Although

more difficult to measure in many cases, variables such as 21st-century skills, student engagement, satisfaction, writing frequency, and attendance have all been noted to increase when taking part in a 1:1 initiative (Argueta et al., 2011; Bebell, 2005; Garthwait & Weller, 2005; Lowther et al., 2003; Moseley, 2015; Rosen & Beck-Hill, 2012; Warschauer et al., 2014).

21st-Century Skills: Problem Solving, Thinking Critically, Collaborating, Communicating, and Creating

Among the many changes throughout education, one overarching change is the skill set expected of students. Known as 21st-century skills, these skills focus on exhibiting mastery on a much deeper level than required in the past. Students must be able to gather, synthesize, analyze, and then clearly communicate their findings on a topic. They must be able to work in collaborative groups to break down a problem and collectively develop a potential solution (Budhai & Taddei, 2015). These skills are better and more easily taught with the assistance of technology and in particular 1:1 initiatives. Moseley (2015) said, "To be a capable 21st-century citizen, students need to be able to think critically, communicate clearly and effectively, and problem solve" (p. 23). She went on to say that many of these skills now required of students can be learned and even enhanced through the use of technology. Zheng and Warschauer (2016) found that in addition to test scores in science, writing, mathematics, and English improving significantly in schools using a 1:1 initiative, students in those schools had enhanced skills of working collaboratively with their peers, locating and using Internet resources, and creating digital evidence of learning. In a separate study, Warschauer et al. (2014) found that laptops transformed writing into an activity focused more on collaboration as

opposed to the solitary activity that it was. Students in their study posted blogs, assisted peers in editing their work, and collaborated with students from across the world.

Like others, Keengwe et al. (2012) found that students spent more time working collaboratively and had more project-based instruction, better access to information, and improved research skills. Rideout and Katz (2016) discovered that 70% of students they surveyed indicated they use their laptops to create art or music. Holcomb (2009) found that students who are participants in 1:1 initiatives were more engaged, reflective, and active in their learning. The Abell Foundation (2008) found that 1:1 initiatives helped develop students' problem-solving skills and helped students use technology more proficiently, which are likely to help students in their workplaces. South (2017) said that technology integration helps prepare students for a culture that requires participation and collaboration.

Student Engagement in and Satisfaction with School

Educators at all levels know that when students are engaged and participatory in a lesson, the results can be transformative for a classroom and students' academic performance. Cothren (2017) referred to student engagement as critical for student success and defined it as "the degree of interest and involvement students exhibit in the classroom setting" (p. 22). As Schwallier (2016) noted, technology makes it possible for learning to become more connected, which results in increased levels of student achievement through an increase in student engagement. Conversely, when students are apathetic and disinterested in the lesson, rarely can true learning take place in a way that is meaningful and constructive. Despite the best planning and curriculum, engaging and motivating students can be a problem for even the most seasoned teachers. In many cases

across the country, 1:1 initiatives implemented to increase students' academic performance are demonstrating that some of the most significant advantages to the technology come in the forms of engagement, motivation, and a renewed excitement about learning in a new and creative way (The Abell Foundation, 2008).

Downes and Bishop (2015) conducted a 4-year qualitative study to determine the effectiveness of a 1:1 initiative in a middle school setting. They found that students attributed their increased engagement levels to the significance of technology available to them. Similar results were found in a study in New Hampshire by Bebell (2005), in Pennsylvania, Texas, Michigan, Maine, Virginia, and West Virginia by The Abell Foundation (2008), and in Maine by Silvernail and Lane (2004). Muir et al. (2004) noted that students displayed a "significant more positive attitude toward school" (p. 9). Doran and Herold (2016) noted that students expressed very positive attitudes about their 1:1 initiative, and their findings consistently revealed that using laptops as part of a 1:1 initiative resulted in higher levels of student engagement and motivation. In a research study of elementary students, Vasquez-Dewein (2017) found that students in the control group using iPads were more motivated and engaged than those in the group without iPads. The researcher noted that the students without iPads "appeared to be less motivated and were just completing the task," (p. 13), and they began asking the teachers when they would be allowed to use the technology. Thompson (2014) found that students in all grade levels reported significantly higher satisfaction when participating in a 1:1 initiative and that students expressed that they would be more willing to spend more time outside of class learning about topics because of the access to computers. Similar results were noted by Zheng, Arada, Niiya, and Warschauer in a 2014 study where students said

that their schoolwork was more interesting while working on their laptops and that having such a device helped them significantly with their homework.

Not only did the researchers find and students acknowledge their increased engagement and interest in school, but teachers noticed it as well. Based on survey responses, researchers at The Abell Foundation (2008) found that 90% of teachers reported their students displayed increased motivation, 95% reported an increase in students' technology skills, and 85% reported a belief that both instruction and learning improved when students were engaged in lessons using 1:1 technology. Silvernail and Lane (2004) found that teachers reported all students were more engaged through the implementation of a 1:1 initiative, especially at-risk students and students with special needs. In a study by Muir et al. (2004), researchers noted that there was even a difference between those schools who allow students to take their personal computers home. In their study, students who were not allowed to take their school-issued computer home exhibited lower computer skills along with a poorer attitude toward school and a lower self-concept when compared to students who were able to take their computers home. A teacher in the 2005 study by Garthwait and Weller noted the increased student motivation in her classes. "Many students spontaneously used their laptop's *World Book Encyclopedia*, whereas in the past they would not have cracked a textbook or asked for a library pass" (p. 366). The teacher went on to say that her students complained less and worked and thought more independently since the implementation of the 1:1 initiative.

Of course, when students are excited about school, are engaged by relevant lessons and technology, and are allowed to explore areas of learning through the use of that technology, other benefits will follow. The problem for many educators is

consistently *keeping* students interested, engaged, and excited about learning over time. The problem of sustaining interest and engagement may cause some educators to believe that once the novelty of the new technology wains, students will lose interest. However, Zheng et al. (2014) found that the attitudes of the students in her study improved gradually as they became more accustomed to the new technology. Benefits of 1:1 initiatives that can be linked potentially to student engagement and satisfaction levels noted by researchers include increased student attendance (The Abell Foundation, 2008; Goodwin, 2011; Moseley, 2015; Rosen & Beck-Hill, 2012; Schwallier, 2016). Another benefit included decreased behavioral issues (Bebell, 2005; Rosen & Beck-Hill, 2012; Schwallier, 2016; Silvernail & Lane, 2004). The Abell Foundation (2008) found that even though classroom management became more challenging with the introduction of a 1:1 initiative, teachers reported fewer disciplinary actions as a result of the overall engagement.

Another additional benefit of 1:1 initiatives that was noted with regularity by researchers involved writing. Students spent more time writing and editing, and the frequency in which they did these tasks increased. Warschauer et al. (2014) found that in addition to 70% of students acknowledging they spent more time writing because of the 1:1 initiative, 64% felt that their writing had improved because of access to the technology. The students' teachers also said that the laptops offered their students, particularly ELLs, more opportunities to practice needed communication skills by offering better opportunities for writing and online discussion. In two 2016 studies, Zheng and Warschauer and, in a separate study, Doran and Herold found that in addition to writing more and more often, students participating in a 1:1 initiative wrote across a

wider variety of genres. Students also received more feedback from peers and teachers. Zheng et al. (2014) noted that in discussions with students, students said that having their laptops "not only enhanced the content and appearance of their writing, but also improved their physical ability to write, fostered their creativity, improved the overall approach to their class work, and increased their writing productivity" (p. 286). Lowther et al. (2003) wrote that teachers found their students were better writers because having the laptops eliminated the fear associated with the writing process because of the ease in which students were able to revise their writing. Zheng and Warschauer (2016) found that elementary teachers said their students used laptops to further their writing by creating digital storybooks and reports that would have been impossible without the availability of computers. Doran and Herold (2016) observed similar results as students increased the formats for their written work through email, online chats, blogs, and wikis.

For some families with limited or no access to laptop or desktop computers, the introduction of the device in the household can have transformational effects on the entire family. Rideout and Katz (2016) observed that family interactions involving computers, especially for families of low socioeconomic backgrounds, were increased through access to 1:1 technology. Additionally, Schawllier (2016) noted that the advantages of students having access to Internet-connected devices could have positive ramifications for students far beyond the limitations of both the classroom and the typical school day. Students who took their computers home worked with their parents whom many times had no access to the Internet or access only through a mobile device. Parents and their children were able to take advantage of the new technology within the home in a way that engaged both generations. One parent noted that she was grateful for her daughters'

school because “there are no libraries nearby, and I didn’t have a car or a ride to take them to the library, so sometimes they would get frustrated” (p. 29). The addition of technology not only helped students with academic work at school but also changed the learning dynamics in the home environment.

Other benefits of 1:1 initiatives noted by researchers were increased organization skills of students (Lowther et al., 2003; Silvernail & Lane, 2004), increased community support (Moseley, 2015), and more flexibility in providing personalized or project-based learning opportunities for students (Downes & Bishop, 2015; Moseley, 2015; Schwallier, 2016). Benefits also included increased ownership of student learning (Doran & Herold, 2016), better technology and/or research skills (The Abell Foundation, 2008; Goodwin, 2011; Lacy, 2016; Moseley, 2015; Silvernail & Lane, 2004; Thompson, 2014) and increased overall knowledge (Lowther et al., 2003).

Benefits to Low Socioeconomic Students and English Language Learners

Perhaps no other distinction is a more accurate predictor of a student’s academic success than the label of *low socioeconomic* or *economically disadvantaged*. Because of what that label often encompasses—food insecurity, poor nutrition, less intellectual stimulation, a lack of books at home, too much television, unstable home life, and parents who are often single and work more than one job, which results in less parental involvement—these students face a steep climb to an education that is equitable to their peers who are better off financially (Gulick, 2012). The result is known as the digital divide. Defined as the disparity between students who have access to computers and the Internet and those who do not (Hanover Research Council, 2010), the divide is naturally more present when taking into account students from low socioeconomic backgrounds.

To complicate and deepen the divide even more for some students, ELLs typically are classified as economically disadvantaged at a higher rate compared to their English-speaking peers (Rideout & Katz, 2016). As Moseley (2015) noted:

> One-to-one computing initiatives provide access to technology for students that no other policy or initiative has offered before. This type of program puts all students, regardless of their socioeconomic status, on the same level with access to the same technology while at school. The potential benefits of an initiative—if implemented correctly and carefully—are much greater than potential concerns. (p. 25)

While 1:1 initiatives vary in their scope, they help students make gains academically in hundreds of districts across the nation in a way that removes barriers and closes equity deficiencies.

LownSocioeconomic Students

Even though many students of low socioeconomic status do not necessarily have an access problem, they do not have access to quality, reliable, and steady Internet connections through home computers because they are much more dependent on mobile devices such as cell phones to access the Internet (Rideout & Katz, 2016). Although this divide is shrinking because of innovative practices and an increased awareness of student needs (Barrett, 2016; Cavanagh, 2018), attention is demanded when educators understand that low socioeconomic students are more likely than their peers to function as teachers to their parents by providing assistance with technology-related skills. Rideout and Katz (2016) found that parents with lower levels of income are more likely to ask for assistance from their children (32%) compared to parents defined as having high incomes

(15%). These researchers also found that the technological relationship between parents and their children becomes reciprocal during homework sessions with children helping parents with technology and parents helping their children to evaluate the resources located throughout the completion of their assignments.

There are multiple examples of schools with high populations of students from low socioeconomic backgrounds improving academic achievement with the assistance of 1:1 initiatives. The Agnes Risley School in Nevada faces the challenge of educating students from two traditionally disadvantaged backgrounds. In addition to a student population of more than 90% low socioeconomic students, approximately half of those students are ELLs. Despite these odds, educators have seen increased academic achievement since implementing their 1:1 initiative (Hanover Research Council, 2010). In Wisconsin, both McKinley Middle School and Washington Middle School were classified as *high achieving* despite their majority populations of low socioeconomic students (Hanover Research Council, 2010). Students in Littleton, Colorado, have seen significant gains in academic achievement for both ELLs and students of low socioeconomic backgrounds (Warschauer et al., 2014). On a larger scale, the Texas Technology Immersion Pilot, where approximately 75% of the 7,873 students in the program were classified as low socioeconomic (The Abell Foundation, 2008), found that economically disadvantaged students in the immersion program reached proficiency levels that matched the skills of the advantaged students in the control group.

In addition to the already-defined digital divide and perhaps because of the proliferation of 1:1 initiatives, there is a new divide being discussed by educators and researchers. South (2017) referred to it as the *digital use* divide, which he summarizes as

the disparity between those students who use technology constructively within the context of an academic or creative project versus those students who simply use technology passively. He warned educators that simply providing access to 1:1 technology does not guarantee that their experiences will be quality and engaging and advises educators to establish interventions so that this new divide does not begin to inhibit the gains made through 1:1 initiatives.

English Language Learners

In findings released by the Annie E. Casey Foundation's Kids Count Data Center, almost a quarter of all children in the United States speaks a language other than English at home with almost 80% of those children being Hispanic (Mitchell, 2018). That is approximately 12 million children who are typically classified as ELLs during their school years (Mitchell, 2018), and they make up the fastest growing subpopulation of students in American public schools (Gere et al., 2008).

Educators have been using technology to reach ELLs for years. From audiotapes to language immersion labs and communicative language instruction, ELLs long have been the recipients of technology-integrated instruction (Warschauer & Meskill, 2000). Although gains have been made in supporting ELLs through technology, like students of low socioeconomic backgrounds, these students still experience a problem with access to computers and fast and reliable Internet access. When compared to the population as a whole, Hispanics are less connected than other low socioeconomic subpopulations. According to Rideout and Katz (2016), Hispanic families are approximately twice as likely (37%) to have neither a desktop or laptop computer at home when compared to all other ethnic groups (less than 20%). Hispanics are also less likely to own a mobile phone,

which results in 20% reporting that they never use the Internet compared to only 6% of all people.

To combat the challenges that come with educating a population that is not yet fluent in English and who has a lack of access to technology at home, many school districts have discovered that 1:1 technology is the key to reaching these students more efficiently and consistently (Andrei, 2014). Technology has become a useful tool in furthering the language development skills of ELLs through hearing, reading, speaking, and writing English (Nomass, 2013). In some cases, educators have realized the benefits of personalized and virtual learning that allow ELLs and all students to progress at a pace that is comfortable and appropriate for them (Van Beek, 2011). Nomass (2013) found that 98% of ELLs responded that they felt as though their use of a personal computer could improve their English vocabulary, and 96% believed that using a computer would help to improve their writing skills in English. Perhaps, the most important finding for those considering implementing a 1:1 initiative as a part of ELL instruction was that 66% of ELLs surveyed preferred using a form of technology to learn the English language.

The way in which school districts use the technology is the key to reaching ELLs and increasing their language fluency. In one middle school in Maine, educators focused on a rich technology- and inquiry-based curriculum that focused on meeting the needs of both low socioeconomic students and ELLs. When compared to the state as a whole, the middle school's achievement scores outpaced the state averages in mathematics (80% to 69%) and reading (79% to 59%) despite the high populations of typically underachieving students (Warschauer et al., 2014). After conducting a study involving four-year-old ELLs in which some were given iPads as part of their daily instruction while some were

taught with traditional methods, Vasquez-Dewein (2017) concluded, “In an effort to increase student achievement in ELLs, technology should be integrated more via small and/or large group, one-on-one teachings, learning centers and literacy times” (p. 15). In the Saugus Union School District in California, a district where 20% of the students are classified as ELLs, Warschauer et al. (2014) found that students classified as both *ELLs* and *low socioeconomic* used their computers significantly more often than their peers, and ELLs used their computers more often for learning activities such as finding information and writing papers. Data also suggested that Saugus students especially benefitted by lessons that were collaborative. Teachers also expressed that the 1:1 initiative allowed their ELLs more time to practice communicating through writing and online discussion and through other language supports such as text-to-speech applications and online bilingual dictionaries.

Instructional Benefits

Even the staunchest supporters of 1:1 initiatives acknowledge that adding computers to classrooms does not guarantee increases in student achievement or the other areas so important to today’s classrooms. As Zheng noted, providing a laptop to every student will not automatically lead to an increase in student achievement, but providing the technology is a good first step (as cited in Molnar, 2015). Schwallier (2016) remarked something very similar when he warned educators that they must be careful with their assumptions about technology leading automatically to an increase in learning. In order for students to realize the full effect of a 1:1 initiative, teachers must learn to not only accommodate the new devices within their classrooms but also to embrace them as an integral and meaningful piece of their instruction. Doing so, according to Windschitl and

Sahl (2002), often causes teachers to change their classroom practices while adopting a more student-centered approach to teaching and learning.

Embracing the new technology can involve allowing students to assume the role of the teacher in some situations, organizing multiple, simultaneous activities, giving students complex assignments and projects requiring the use of their laptop and the Internet, and allowing students to have a choice in the learning tasks (Windschitl & Sahl, 2002). Multiple studies pointed to a shift in instruction from classrooms being teacher-centered to having a more student-centered focus (Bebell, 2005; Stanley, 2015; Windschitl & Sahl, 2002). Windschitl and Sahl (2002) noted that there was a tendency for teachers to view themselves as learning facilitators as opposed to the traditional role of classroom teachers. Similarly, Garthwait and Weller (2005) noted after surveying teachers that one of the major changes was the change in the behavior and mindset of teachers to that of facilitator of the learning.

Many teachers report that one of the greatest advantages of teaching in a 1:1 initiative was the increased communication between teachers and students and the communication among students regarding assignments and projects. Rosen and Beck-Hill (2012) found that interactions between students and teachers were significantly higher in classrooms using 1:1 initiatives (40 interactions per class) versus those classrooms without similar technology (17 interactions per class). Similar results were noted by Bebell (2005) where teachers who were part of a 1:1 initiative in Maine reported that having laptops allowed their students, especially those students with disabilities, to interact more with other students and teachers. This increased means of communication leads to a variety of benefits for students who tend to be marginalized by other classroom

innovations. These teachers reported that at-risk and low-achieving students were more likely and better able to work in groups with instances of low-achieving students and students with special needs teaching other students about technology. Having the 1:1 technology also gave students with special needs a more equitable platform that allowed them to produce work that was more in line with the work of their non-disabled peers, according to teachers. Along the lines of increase avenues for communication, research by The Abell Foundation (2008) indicated that the collaboration among teachers and students increased when participating in a 1:1 initiative.

Perhaps as a result of the increased communication and collaboration, Rosen and Beck-Hill (2012) found that teachers working in a 1:1 initiative engaged their students in lessons designed to elicit higher order thinking from their students in ways that exceeded teachers in control groups without 1:1 technology. By the end of the first year of implementation, teachers in a 1:1 environment explored independent learning (defined as giving opportunities to increase independence, responsibility, and self-management for students) at a higher rate (84%) compared to 14% of teachers in the control group. The experimental group also challenged their students' intellectually at a higher rate (63% to 29%), modeled lessons at a higher rate (84% to 63%), and adjusted instruction based on students' progress and interests at a rate double that of their peers in the control group (42% to 21%). The researchers noted that the teachers in the experimental group differentiated their instruction significantly more than the teachers in the control group. In addition, the teachers within the experimental group commented that their differentiation was made easier because the 1:1 initiative provided a curriculum that was already differentiated. Garthwait and Weller (2005) found similar results concerning

curriculum and instruction that was richer and more individualized as a result of the introduction of a 1:1 initiative. They found that teachers in a 1:1 environment taught using more inquiry-based strategies (opposed to memorization), cooperative learning activities, and differentiated learning tasks. Thompson (2014) also found that technology use made it easier for teachers to individualize instruction based on their students' needs. As Rosen and Beck-Hill (2012) noted, students are at the center of the learning process when teachers are able to differentiate their instruction.

Summary

Results from previous studies indicated that the addition of each new piece of relevant educational technology brought changes in education that, despite any controversy or cost associated with its initial implementation, made education better, more efficient, or more engaging. When educators received appropriate training before implementation and ongoing support during the process, the benefits of providing 1:1 access to students and teachers are worth considering. When coupled with the findings of the benefits associated with the students' ability to take their laptops home to a family who in many cases rely on the technology as their sole avenue of accessing the Internet, it is no wonder that so many school and district leaders have turned to 1:1 initiatives as the chosen tools to facilitate and enhance learning for all students.

Proponents of 1:1 initiatives have long said that if educational leaders choose to ignore the benefits to instruction and the advantages to students as a result of using a 1:1 initiative, leaders equally ignore the changes to education made possible through technology. As a result, leaders also disregard their position to act as change agents for the students' families through increased exposure to technology. As Schwallier (2016)

noted, “It has become evident that teaching, learning, and technology work synergistically to provide effective and efficient knowledge transfer because educational technology helps teachers create learning contexts that were not previously possible with traditional teaching models” (p. 9). With the proliferation of 1:1 resources and as teachers become more proficient with 1:1 technology, researchers at The Abell Foundation (2008) argued that students would reap the benefits through increased productivity and increased student academic performance.

CHAPTER III

METHODOLOGY

In the review of the literature, I presented evidence that participation in a 1:1 initiative generally had a positive influence on academic performance. Although some early research indicated that 1:1 initiatives led to no changes or even declines in academic performance, the same research generally pointed to increases in student engagement, autonomy, satisfaction, and even attendance (Argueta et al., 2011; Holcomb, 2009; Hu, 2007; Silvernail & Gritter, 2007; Topper & Lancaster, 2013). In addition, the 1:1 initiatives led to greater levels of collaboration among teachers and students, improved means of providing feedback to students, and a greater comfort level for both teachers and students when participating in a 1:1 initiative (Corn et al., 2011; Holcomb, 2009). Later research, conducted as technology had begun to infiltrate the lives of students and teachers to a much greater level (Stanley, 2015), typically outlined those same positive outcomes coupled with an increase in academic performance when measured by a variety of indicators (Gulek & Demirtas, 2005; Rosen & Beck-Hill, 2012).

From the three purposes for this study, I generated the following null hypotheses:

1. No significant differences will exist by socioeconomic status of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as

measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools.

2. No significant differences will exist by gender of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools.
3. No significant differences will exist by native language of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools.

The objectives of this chapter are to explain the research design, identify the sample and sampling process, describe the instrument, explain the process of data collection, examine the process of statistical analysis, and discuss the limitations in the study.

Research Design

A quantitative, non-experimental, causal-comparative design was used in this study. The participants were scores provided by 11th-grade students in seven high schools in Southwest Arkansas who were categorized by participation status in a 1:1 initiative, socioeconomic status, gender, and native language (ELL program participation status). Because participation was determined prior to the beginning of this study, manipulation of the independent variable was not possible, and a causal-comparative strategy was determined to be appropriate. A 2 x 2 between-groups factorial design

strategy was used to analyze the interaction effect and main effects of socioeconomic status and participation in a 1:1 initiative, gender and participation in a 1:1 initiative, and native language and participation in a 1:1 initiative on a single dependent variable. The independent variables for Hypothesis 1 were socioeconomic status defined by school lunch status (participation in the free and reduced school lunch program versus no participation) and participation status in a 1:1 initiative (participation versus no participation). The independent variables for Hypothesis 2 were gender (male versus female) and participation status in a 1:1 initiative (participation versus no participation). The independent variables for Hypothesis 3 were native language of students defined by English Language Learner status (participation in an ELL program versus no participation) and participation status in a 1:1 initiative (participation versus no participation). The dependent variable for Hypotheses 1-3 was academic performance as measured by ACT composite scores.

Sample

Scores chosen for this study were from 2017 and 2018 11th-grade students in seven high schools in Southwest Arkansas. The samples were chosen from the two main accessible populations, which included scores from students in schools participating in a 1:1 initiative and scores from students in schools not participating in a 1:1 initiative. In the first populations, students in four schools participated in a 1:1 initiative, and the Arkansas Activities Association (2018) classified those schools as 1A-3A. The 11th-grade student populations of the four schools ranged from 42 to 137 students with a total of 294 students. This population of students was primarily males (54.4%), consisted of 11.9% non-native English speakers, and included 63.6% classified as low socioeconomic.

In the second population, students in three schools did not participate in a 1:1 initiative. The Arkansas Activities Association (2018) classified those schools as 2A-5A. The 11th-grade student populations of the four schools ranged from 61 to 315 students with a total of 478 students. This population of students was split exactly between males and females. It consisted of 21.3% non-native English speakers and included 68.2% classified as low socioeconomic.

The combined populations consisted of 772 students' scores from a rural area with 17.7% classified as non-native English speakers and 66.5% classified as low socioeconomic. Each school principal and counselor gave approval for the collection of data. In the data collection process, all students' scores were classified according to socioeconomic status, gender, native language, and participation in a 1:1 initiative. Scores were placed in a spreadsheet, and four samples were selected for each hypothesis using the randomization formula in Microsoft Excel.

Instrumentation

ACT composite scores were used to provide the academic performance data for the dependent variable used in each hypothesis. The ACT is a battery of four multiple-choice tests that measure content knowledge in English, reading, mathematics, and science. Composite scores for each student are formulated by averaging the scores of the individual content area test scores. The average composite score for the students in this study was 18.2 compared to the 2017 statewide average of 18.8 for 11th-grade students (ACT, 2017). The ACT has a reliability score in English of .92, in Mathematics of .91, in Reading of .87, and in Science of .85. A reliability score of .94 was reported for the overall composite score (ACT, 2017).

Beginning in 2016, the Arkansas Department of Education began offering the ACT to all 11th-grade students at no cost to the students or schools (Arkansas State Senate, 2017). Since that time, 93,418 students have taken the exam (Arkansas Department of Education, 2017). Each year, the Arkansas Department of Education (2017) determines an overall testing window, and principals and counselors then decide the exact testing date for their students. Principals and counselors also determine whether to administer the test using computers or pencil and paper. Permission to use the composite scores was granted by the principals and counselors of the seven high schools selected in this study.

Data Collection Procedures

After receiving approval from the Institutional Review Board, I obtained the existing data from the high school counselors of the seven schools within this study. These data included ACT composite scores categorized by participation status in a 1:1 initiative, socioeconomic status, gender, and native language. During the spring semesters of 2017 and 2018, the ACT was administered to 11th-grade students across the state of Arkansas including students from the seven high schools in Southwest Arkansas. The results of the ACT and the students' demographic data were electronically collected from each of the seven schools in the study. Each school was assigned an identification number, which was used to identify each school's students in order to link demographic data with ACT composite scores in a manner that maintained confidentiality. The student data were reviewed to verify that all categories were complete. Data found not to be complete were not used in the statistical analysis. All data, demographic and ACT composite scores, were manually typed in a Microsoft Excel spreadsheet. Paper copies of

the data were used and then shredded thereby maintaining student confidentiality. Student names were not placed on the demographic data or the ACT data.

Data for Hypothesis 1 were coded according to socioeconomic status defined by school lunch status (participation in the free and reduced school lunch program versus no participation) and participation status in a 1:1 initiative (participation versus no participation). Data for Hypothesis 2 were coded according to gender (male versus female) and participation status in a 1:1 initiative (participation versus no participation). Data for Hypothesis 3 were coded according to native language defined by English Language Learner status (participation in an ELL program versus no participation) and participation status in a 1:1 initiative (participation versus no participation). Academic performance based on ACT composite scores was used as the dependent variable for all three hypotheses.

Analytical Methods

Scores from this study were analyzed statistically using *IBM Statistical Package for the Social Sciences Version 24* (Morgan, Leech, Gloeckner, & Barrett, 2012). A 2-tailed test with a .05 level of significance was used for statistical analysis to test the three hypotheses. The three hypotheses were analyzed with three 2 x 2 factorial between-groups ANOVAs. The data were examined before statistical analysis for socioeconomic status, gender, native language, and participation status in a 1:1 initiative to ensure the sample collected appropriately represented the population. Further analysis was used to check for outliers, and homogeneity of variances was checked using the Levene's statistic.

Hypothesis 1 was statistically analyzed with a 2 x 2 factorial between-groups ANOVA using participation status in a 1:1 initiative (participation versus no participation) by socioeconomic status (participation in the free and reduced school lunch program versus no participation) as the independent variables and academic performance as measured by ACT composite scores as the dependent variable. Hypothesis 2 was statistically analyzed with a 2 x 2 factorial between-groups ANOVA using participation status in a 1:1 initiative (participation versus no participation) by gender (male versus female) as the independent variables and academic performance as measured by ACT composite scores as the dependent variable. Hypothesis 3 was statistically analyzed with a 2 x 2 factorial between-groups ANOVA using participation status in a 1:1 initiative (participation versus no participation) by native language defined by English Language Learner status (participation in an ELL program versus no participation) as the independent variables and academic performance as measured by ACT composite scores as the dependent variable.

Limitations

Although I sought to minimize them, there are limitations in all research studies. The limitations are outlined to assist readers in interpreting the results of this study. First, although it was possible to determine the length of time a 1:1 initiative had been in place, it was not possible to determine several other aspects regarding the schools that had 1:1 initiatives in place. For example, some schools, and even the teachers within the schools, implemented their 1:1 initiatives with greater fidelity compared to other schools and teachers. The amount of professional development provided to teachers, the teachers' comfort levels with the technology, the frequency in which the teachers taught lessons

using the 1:1 technology, the support the teachers received from administrators and technology support personnel, and the attitudes of the teachers within the schools were among the many variables not examined as part of this study. Additionally, the types of hardware, software, and peripherals and the stability, strength, and reliability of the Wi-Fi within the 1:1 initiatives were not examined. These variables should be controlled in future research to generalize the results for greater reliability.

Second, although three schools in this study were not classified as having implemented a 1:1 initiative, the designation did not imply that those schools had no technology available to its students. In fact, it is possible that those schools classified as not participating in a 1:1 initiative could have a more robust and reliable infrastructure to support *bring your own devices* than the 1:1 schools. The classification also did not imply that the teachers within a school without a 1:1 initiative could have in place classroom sets of computers or other 1:1 devices to serve students. In reality, the opposite could also be true in each of these situations, and a measure would need to be put in place to control for these variables.

Third, there was a lack of overall diversity within the population of students used for this study. Among the 772 total students providing scores for this study, the vast majority (82.3%) were native English speakers, and 66.5% were considered low socioeconomic based on their participation in the free and reduced school lunch programs in their schools. Therefore, before generalizing these findings to a larger population, subsequent studies should involve students with a broader scope of attributes.

Fourth, I did not control for other academic programs within the schools that could serve to affect the dependent variable of ACT composite scores. Some of the

schools within this study might have provided extra resources or instruction to their students in hopes of raising ACT scores. ACT prep courses, boot camps, tutoring, and even levels of teacher familiarity with the ACT could increase students' scores, and those resources were not examined within the scope of this study. Efforts should be made to control for extraneous variables that could affect the study's results and thus affect the study's validity and generalizability. Readers should not view participation in a 1:1 initiative as being the sole or even the most significant variable in academic performance.

Fifth, the mode in which the ACT was administered was not examined. School personnel chose whether to administer the test by computers or with paper and pencil. Additionally, there was no requirement that schools who participate in a 1:1 initiative give the ACT by computer. There was also the possibility that a school that did not participate in a 1:1 initiative might have administered the test by computer in a lab setting. This could be avoided in subsequent research by controlling for modes of test administration.

Finally, I was an administrator at one of the schools selected for this study. Procedures were implemented to avoid undue bias. Participants were identified holistically by each school as to whether they participated in a 1:1 initiative. Otherwise, individual students were only identified by socioeconomic status, gender, and native language. This study provides readers with information that allows them to make decisions regarding 1:1 initiative implementation within their schools given consideration of similar demographics.

CHAPTER IV

RESULTS

This study was a quantitative, causal-comparative analysis of three 2 x 2 between-group designs. The independent variables for Hypothesis 1 were socioeconomic status defined by school lunch status (participation in the free and reduced school lunch program versus no participation) and participation status in a 1:1 initiative (participation versus no participation). The independent variables for Hypothesis 2 were gender (male versus female) and participation status in a 1:1 initiative. The independent variables for Hypothesis 3 were native language of students defined by English Language Learner status (participation in an ELL program versus no participation) and participation status in a 1:1 initiative. The dependent variable for Hypotheses 1-3 was overall academic performance as measured by ACT composite scores for 11th-grade students.

Analytical Methods

The three hypotheses were analyzed using *IBM Statistical Packages for the Social Sciences Version 24* (Morgan et al., 2012). Data for Hypothesis 1 were coded according to socioeconomic status defined by school lunch status (0 = participation in the free and reduced school lunch program and 1 = no participation) and participation status in a 1:1 initiative (0 = no participation and 1 = participation). Data for Hypothesis 2 were coded according to gender (0 = male and 1 = female) and participation status in a 1:1 initiative (0 = no participation and 1 = participation). Data for Hypothesis 3 were coded according

to native language defined by English Language Learner status (0 = no participation in an ELL program and 1 = participation) and participation status in a 1:1 initiative (0 = no participation and 1 = participation). Academic performance based on ACT composite scores was used as the dependent variable for all three hypotheses, which were analyzed using three 2 x 2 factorial ANOVAs. Two-tailed tests with significance levels of .05 were used to test the null hypotheses. I assessed assumptions of normality and homogeneity of variances prior to statistical analysis of the hypotheses. Information, including demographical data and test scores, was collected from students in seven Southwest Arkansas high schools. From that accessible population of 772 students, a stratified sample of 140 students was chosen for each hypothesis, which resulted in a total sample of 420 students.

Hypothesis 1

Hypothesis 1 stated that no significant difference will exist by socioeconomic status of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools. Homogeneity of variances and normality of distributions were tested. Skewness was less than 1, and kurtosis was less than 1. Table 1 displays the group means and standard deviations.

Table 1

Descriptive Statistics for Participation in a 1:1 Initiative by Socioeconomic Status on Overall Academic Performance

SES	1:1 Initiative Participation	*M*	*SD*	*N*
F/R Lunch	1:1 Initiative	17.23	3.41	35
	No 1:1 Initiative	16.54	3.10	35
	Total	16.89	3.25	70
No F/R Lunch	1:1 Initiative	19.51	4.48	35
	No 1:1 Initiative	20.34	4.75	35
	Total	19.93	4.60	70
Total	1:1 Initiative	18.37	4.12	70
	No 1:1 Initiative	18.44	4.41	70
	Total	18.41	4.25	140

Screening for extreme outliers was conducted, and no outlier was noted. The Shapiro-Wilk test was used to test for normality with $p < .05$ for each group, indicating that the data were normally distributed across all groups. Levene's test of equality of variances was conducted within ANOVA and indicated the assumption of homogeneity of variances was violated across groups, $F(3, 136) = 2.67$, $p = .050$. Even though the assumption was violated, the ANOVA was a robust test and could still be used for this statistical analysis (Morgan et al., 2012). A line plot did not indicate an interaction between gender and 1:1 initiative participation. To test this hypothesis, a 2 x 2 factorial ANOVA was conducted to evaluate the effects of participation in a 1:1 initiative by

socioeconomic status on overall academic performance as measured by ACT composite scores for 11th-grade students. The results of the ANOVA are displayed in Table 2.

Table 2

Factorial ANOVA Results for Participation in a 1:1 Initiative by Socioeconomic Status on Overall Academic Performance

Source	*SS*	*df*	*MS*	*F*	*p*	*ES*
SES	324.06	1	324.06	20.30	.000	0.130
1:1 Initiative	0.18	1	0.18	0.01	.916	0.000
SES*1:1 Initiative	20.06	1	20.06	1.26	.264	0.009
Error	2171.49	136	15.97			
Total	49951.00	140				

Insufficient evidence existed based on the interaction of the variables to reject the null hypothesis, $F(1, 136) = 1.26$, $p = .264$, $ES = 0.009$. Given there was no significant interaction between the variables of participation in a 1:1 initiative and socioeconomic status, the main effect of each variable was examined separately. The main effect for 1:1 initiative participation on academic performance was not significant with a small effect size, $F(1, 136) = 0.01$, $p = .916$, $ES = 0.000$. However, the main effect for socioeconomic status on academic performance was significant, $F(1, 136) = 20.30$, $p = .000$, $ES = 0.130$. Figure 1 displays the means for overall academic performance as a function of 1:1 initiative participation and socioeconomic status.

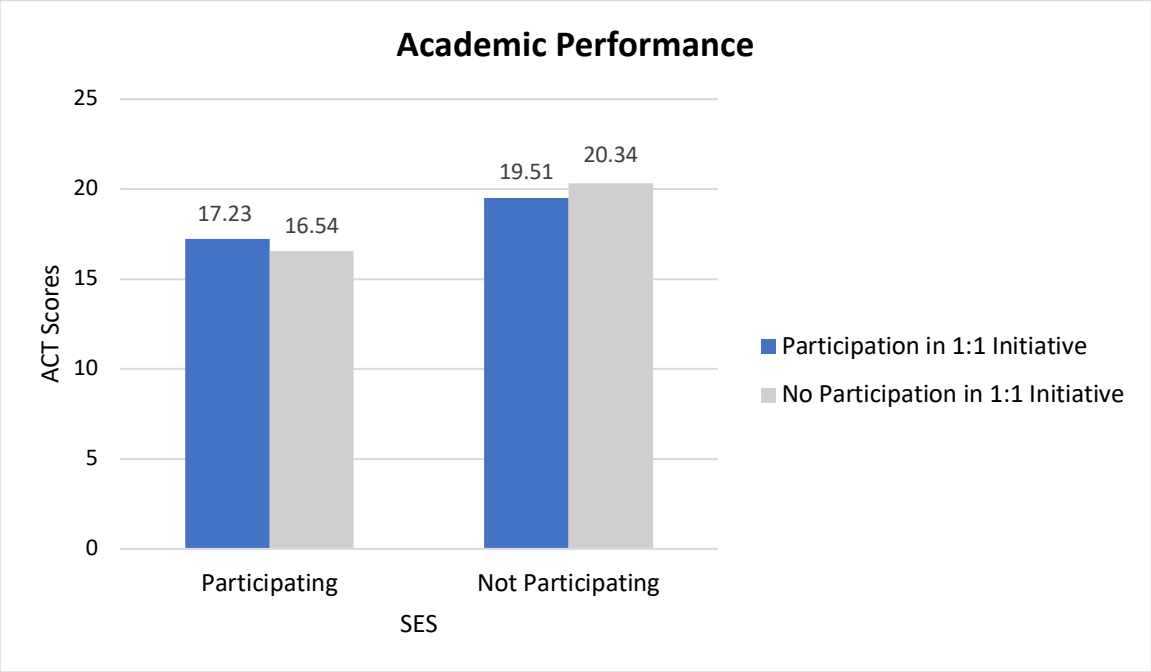

Figure 1. Means for academic performance as a function of 1:1 initiative participation by socioeconomic status.

Even though the mean of ACT scores for the group not participating in a 1:1 initiative ($M = 18.44$, $SD = 4.42$) was slightly higher compared to the mean of the group that participated in a 1:1 initiative ($M = 18.37$, $SD = 4.12$), the difference was not significant. In contrast, the mean of the ACT scores of students participating in the free and reduced school lunch program ($M = 16.89$, $SD = 3.26$) was significantly lower compared to the mean of students not participating in the free and reduced school lunch program ($M = 19.93$, $SD = 4.60$). Overall, the results indicated no combined significant effect of 1:1 initiative participation and socioeconomic status on academic performance. Similarly, there was no significant difference from the main effect of 1:1 initiative participation. However, socioeconomic status, when considered independently, appeared

to exert a significant influence on students' academic performance regardless of 1:1 initiative participation.

Hypothesis 2

Hypothesis 2 stated that no significant difference will exist by gender of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools. Homogeneity of variances and normality of distributions were tested. Skewness was greater than 1 for males who participated in a 1:1 initiative. Table 3 displays the group means and standard deviations.

Table 3

Descriptive Statistics for Participation in a 1:1 Initiative by Gender on Overall Academic Performance

Gender	1:1 Initiative Participation	*M*	*SD*	*N*
Male	1:1 Initiative	18.34	3.88	35
	No 1:1 Initiative	16.97	3.35	35
	Total	17.66	3.66	70
Female	1:1 Initiative	18.26	4.30	35
	No 1:1 Initiative	18.86	3.77	35
	Total	18.56	4.02	70
Total	1:1 Initiative	18.30	4.07	70
	No 1:1 Initiative	17.91	3.66	70
	Total	18.11	3.86	140

Screening for extreme outliers was conducted, and no outlier was noted. The Shapiro-Wilk test was used to test for normality with $p < .05$ for each group. For males in each group, those participating in a 1:1 initiative and those not participating in a 1:1 initiative, the assumption of normality was violated. Even though the assumption was violated, the ANOVA was a robust test and could still be used for this statistical analysis (Morgan et al., 2012). Levene's test of equality of variances was conducted within ANOVA and indicated there was homogeneity of variance across groups, $F(3, 136) = 0.32$, $p = .811$. Therefore, the assumption of normality was met. A line plot indicated an interaction between gender and 1:1 initiative participation, but the interaction was not significant. To test this hypothesis, a 2 x 2 factorial ANOVA was conducted to evaluate the effects of participation in a 1:1 initiative by gender on overall academic performance as measured by ACT composite scores for 11th-grade students. The results of the ANOVA are displayed in Table 4.

Table 4

Factorial ANOVA Results for Participation in a 1:1 Initiative by Gender on Overall Academic Performance

Source	*SS*	*df*	*MS*	*F*	*p*	*ES*
Gender	28.35	1	28.35	1.92	.168	0.014
1:1 Initiative	5.21	1	5.21	0.35	.553	0.003
Gender*1:1 Initiative	34.01	1	34.01	2.31	.131	0.017
Error	2003.83	136	14.73			
Total	47973.00	140				

Insufficient evidence existed based on the interaction of the variables to reject the null hypothesis, $F(1, 136) = 2.31$, $p = .131$, $ES = 0.017$. Given there was no significant interaction between the variables of participation in a 1:1 initiative and gender, the main effect of each variable was examined separately. The main effect for 1:1 initiative participation on academic performance was not significant, $F(1, 136) = 0.35$, $p = .553$, $ES = 0.003$. In addition, the main effect for gender on academic performance was not significant, $F(1, 136) = 1.92$, $p = .168$, $ES = 0.014$. Figure 2 displays the means for 1:1 initiative participation and gender.

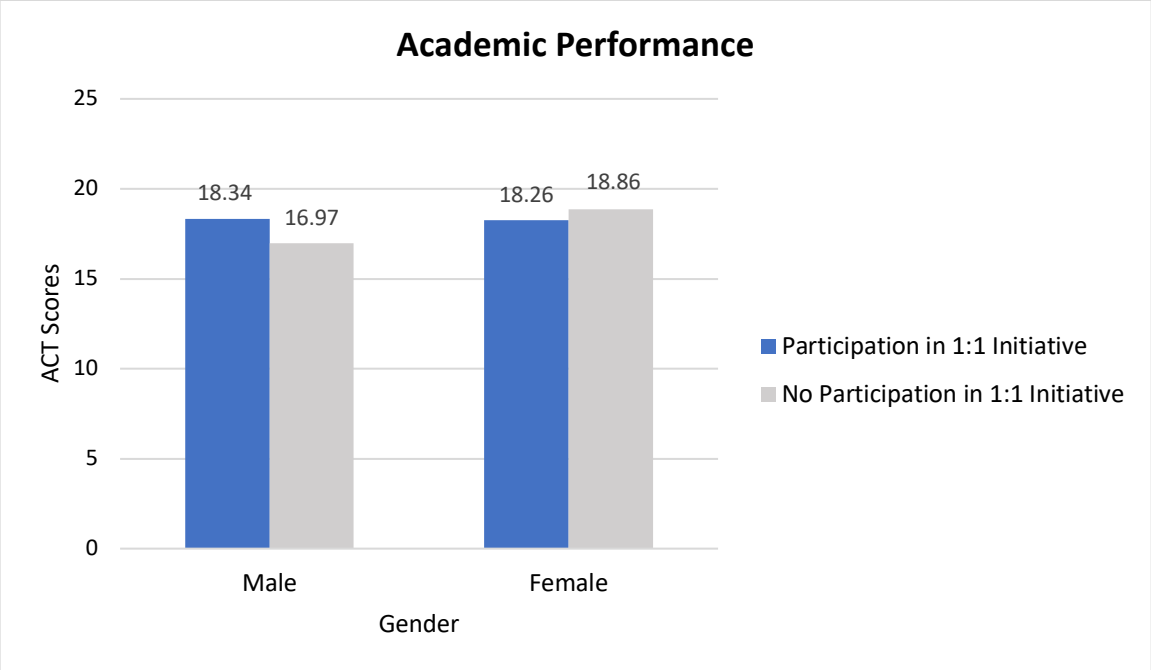

Figure 2. Means for overall academic performance as a function of 1:1 initiative participation by gender.

Even though the mean of ACT scores for the group not participating in a 1:1 initiative ($M = 17.91$, $SD = 3.66$) was slightly lower compared to the mean of the group

that participated in a 1:1 initiative (M = 18.30, SD = 4.07), the difference was not significant. Similarly, even though the mean of the ACT scores of females (M = 18.56, SD = 4.02) was higher compared to the mean of the males (M = 17.66, SD = 3.66), the difference was not significant. Overall, the results indicated no significant combined effect of 1:1 initiative participation and gender on overall academic achievement. Additionally, there were no significant main effect differences for gender or for 1:1 initiative participation when considered independently of one another.

Hypothesis 3

Hypothesis 3 stated that no significant difference will exist by native language of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools. Homogeneity of variances and normality of distributions were tested. Skewness was less than 1, and kurtosis was less than 1. Table 5 displays the group means and standard deviations.

Table 5

Descriptive Statistics for Participation in a 1:1 Initiative by Native Language on Overall Academic Performance

ELL Program Participation	Participation	*M*	*SD*	*N*
Yes	1:1 Initiative	16.46	3.11	35
	No 1:1 Initiative	16.69	3.53	35
	Total	16.57	3.30	70
No	1:1 Initiative	19.14	4.73	35
	No 1:1 Initiative	18.40	3.61	35
	Total	18.77	4.19	70
Total	1:1 Initiative	17.80	4.20	70
	No 1:1 Initiative	17.54	3.65	70
	Total	17.67	3.92	140

Screening for extreme outliers was conducted, and no outlier was noted. The Shapiro-Wilk test was used to test for normality with two groups showing significance (not ELL and not 1:1 tech; ELL and not 1:1 tech), indicating that the data were not normally distributed across all groups. Even though the assumption was violated, the ANOVA was a robust test and could still be used for this statistical analysis (Morgan et al., 2012). Levene's test of equality of variances was conducted within ANOVA and indicated there was homogeneity of variance across groups, $F(3, 136) = 2.44$, $p = .067$. Therefore, the assumption was met. A line plot did not indicate an interaction between native language and 1:1 initiative participation. To test this hypothesis, a 2 x 2 factorial

ANOVA was conducted to evaluate the effects of participation in a 1:1 initiative by native language (participation in an ELL program versus no participation) on overall academic performance as measured by ACT composite scores for 11th-grade students. The results of the ANOVA are displayed in Table 6.

Table 6

Factorial ANOVA Results for Participation in a 1:1 Initiative by Native Language on Overall Academic Performance

Source	*SS*	*df*	*MS*	*F*	*p*	*ES*
ELL Program Part	169.40	1	169.40	11.79	.001	0.080
1:1 Initiative	2.31	1	2.31	0.16	.689	0.001
ELL Prog*1:1 Initiative	8.26	1	8.26	0.57	.450	0.004
Error	1954.91	136	14.37			
Total	45854.00	140				

Insufficient evidence existed based on the interaction of the variables to reject the null hypothesis, $F(1, 136) = 0.57$, $p = .450$, $ES = 0.004$. Given there was no significant interaction between the variables of participation in a 1:1 initiative and native language, the main effect of each variable was examined separately. The main effect for 1:1 initiative participation on overall academic performance was not significant, $F(1, 136) = 0.16$, $p = .689$, $ES = 0.001$. However, the main effect for native language on academic performance was significant, $F(1, 136) = 11.79$, $p = .001$, $ES = 0.080$. Figure 3 shows the

means for 1:1 initiative participation and native language based on participation in an ELL program versus no participation.

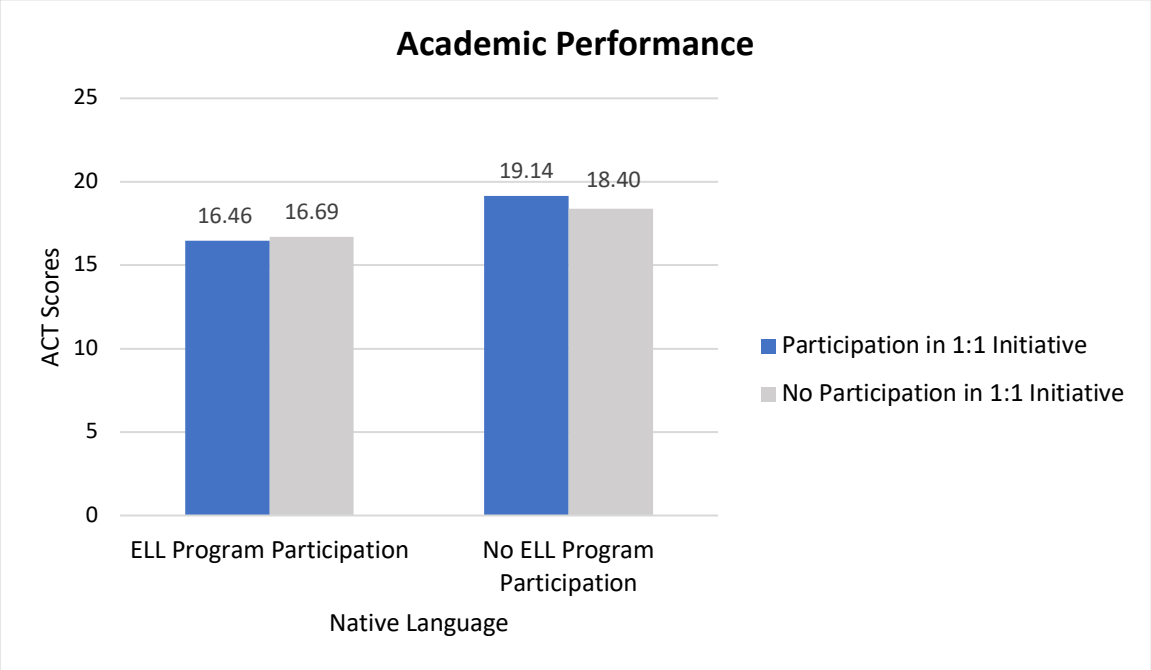

Figure 3. Means for overall academic performance as a function of 1:1 initiative participation by native language.

Even though the mean of ACT scores for the group not participating in a 1:1 initiative (M = 17.54, SD = 3.65) was slightly lower compared to the mean of the group that participated in a 1:1 initiative (M = 17.80, SD = 4.20), the difference was not significant. However, the mean of the ACT scores of students participating in an ELL program (M = 16.57, SD = 3.30) was statistically lower compared to the mean of students not participating in an ELL program (M = 18.77, SD = 4.19). Overall, the results indicated no significant difference for the combined effect of 1:1 initiative participation and native language or for the main effect of 1:1 initiative participation. However, native

language, when considered independently, appeared to exert a significant influence on students' overall academic performance regardless of 1:1 initiative participation.

Summary

The purpose of this study was to determine the effects by socioeconomic status, gender, and native language of students on overall academic performance as measured by ACT composite scores for 11th-grade students in seven high schools in Southwest Arkansas. This study contained three hypotheses, all of which were 2 x 2 between-group designs. The independent variables for Hypothesis 1 were socioeconomic status (lunch status) and 1:1 initiative participation. The independent variables for Hypothesis 2 were gender and 1:1 initiative participation. The independent variables for Hypothesis 3 were native language (ELL program participation status) and 1:1 initiative participation. The dependent variable for the three hypotheses was overall academic achievement measured by ACT composite scores. A summary of the three hypotheses is presented in Table 7.

Table 7

Summary of Statistical Significance of SES, Gender, Native Language, & 1:1 Initiative Participation on Overall Academic Performance by Hypothesis

Variables by H_o	H1	H2	H3
SES	.000		
Gender		.168	
Language			.001
1:1 Tech Participation	.916	.553	.689
SES*1:1 Tech Part.	.264		
Gender*1:1 Tech Part.		.131	
Lang.*1:1 Tech Part.			.450

Note: Significance = $p \leq .05$.

For the three hypotheses, none displayed a significant interaction between 1:1 initiative participation and its moderator variable. Additionally, the main effect for 1:1 initiative participation was not significant for the three hypotheses. Similarly, the main effect for gender was not significant for Hypothesis 2. However, the main effects of socioeconomic status in Hypothesis 1 and native language in Hypothesis 3 were significant, regardless of their 1:1 initiative participation.

CHAPTER V

DISCUSSION

Technology has facilitated incredible advancements in surgical procedures, automobile and aircraft design, disease research, agricultural innovations, political campaigning, and product marketing. Although the experts using these advancements in technology are appreciative, the focus always remains on the task and not on the technology itself. Even though the business sector generally views technology as a way to make tasks more efficient, accurate, or focused, the true beauty of technological advances is that they make possible those things that were once inconceivable.

In this chapter, conclusions, recommendations, and implications are presented. First, this chapter includes the conclusions that resulted from the data collection and analysis within this study. Second, in this chapter, I offer implications based on the results of this study within the context of the review of related literature. Third, in this chapter, I present recommendations that may assist school administrators with similar student populations when implementing or considering implementation of 1:1 initiatives.

Conclusions

The study used the composite scores from the state-mandated ACT, which was first required for all 11th-grade students across the state of Arkansas in 2016 (Arkansas State Senate, 2017). The test measures content knowledge in four key core academic content areas: English, reading, mathematics, and science. An optional writing test was

added in 2015 (Fletcher, 2009), but the state of Arkansas does not require students to complete it as part of the testing requirements (Arkansas Department of Education, 2017). The scores used in this study were from tests administered in spring 2017 and spring 2018. The study used results from 772 students in seven high schools in Southwest Arkansas. Results were analyzed to determine the effects of socioeconomic status, gender, and native language on academic performance.

To address the three hypotheses, between-groups ANOVAs were run using socioeconomic status, gender, native language, and participation in a 1:1 initiative (participation versus no participation). The hypotheses were tested, and the respective conclusions were formulated. I used a .05 level of significance. Interactions and main effects were examined in all three hypotheses.

Hypothesis 1

Hypothesis 1 stated that no significant differences will exist by socioeconomic status of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools. Of the four groups created by the two independent variables in the first hypothesis (Yes SES/Yes 1:1 initiative program participation; Yes SES/No 1:1 initiative participation; No SES/Yes 1:1 initiative participation; and No SES/No 1:1 initiative participation), students identified as not participating in the free and reduced school lunch program and not participating in a 1:1 initiative had the highest mean. The group identified as participating in the free and reduced school lunch program and not participating in a 1:1 initiative had the lowest mean. However, the interaction between

socioeconomic status and program participation was not significant. Together, socioeconomic status and program participation did not combine to affect academic performance as measured by ACT composite scores significantly. Based on these results, there was not enough evidence to reject the null hypothesis for the interaction effect. The main effect for program participation on academic performance was also not significant. When considering 1:1 initiative participation alone, the combined group that did not participate in the 1:1 initiative had a slightly higher mean than the combined group that participated in a 1:1 initiative. Yet, evidence was not sufficient to reject the null hypothesis for the main effect of program participation. However, when analyzing the main effect for socioeconomic status on academic performance, the mean of the group not participating in the free and reduced lunch program was significantly higher compared to the mean of the group participating in the program. Therefore, the main effect null hypothesis for socioeconomic status was rejected.

Hypothesis 2

Hypothesis 2 stated that no significant differences will exist by gender of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools. Of the four groups created by the two independent variables in the second hypothesis (Male/Yes 1:1 initiative participation; Male/No 1:1 initiative participation; Female/Yes 1:1 initiative participation; and Female/No 1:1 initiative participation), students identified as female and not participating in a 1:1 initiative had the highest mean. The group identified as male and not participating in a 1:1 initiative had the lowest mean. However,

the interaction between gender and program participation was not significant. Together, gender and program participation did not combine to affect academic performance as measured by ACT composite scores significantly. Based on these results, there was not enough evidence to reject the null hypothesis for the interaction effect. Regarding the independent variables independently, the main effect for gender on academic performance was not significant. Even though the females, on average, scored higher compared to the males regardless of program participation, the difference was not significant. In addition, the main effect for program participation on academic performance was not significant even though the mean of the group participating in a 1:1 initiative was slightly higher compared to the mean of the group not participating in a 1:1 initiative. Therefore, evidence was not sufficient to reject the null hypothesis for the main effects of gender or 1:1 initiative program participation.

Hypothesis 3

Hypothesis 3 stated that no significant differences will exist by native language of students who participated in a 1:1 initiative (provided a personal computer) versus those students who did not participate in a 1:1 initiative on academic performance as measured by ACT composite scores for 11th-grade students in seven Southwest Arkansas high schools. Of the four groups created by the two independent variables in the third hypothesis (Yes ELL program participation/Yes 1:1 initiative participation; Yes ELL program participation/No 1:1 initiative participation; No ELL program participation/Yes 1:1 initiative participation; and No ELL program participation/No 1:1 initiative participation), the results indicated that the group that did participate in an ELL program but who did participate in a 1:1 initiative had the highest mean. The group identified as

participating in the ELL program and participating in a 1:1 initiative had the lowest mean. However, the interaction between ELL program participation and program participation was not significant. Together, native language program participation and 1:1 initiative participation did not combine to affect academic performance as measured by ACT composite scores significantly. Based on these results, there was not enough evidence to reject the null hypothesis for the interaction effect. The main effect for program participation on academic performance was also not significant even though the mean of the group participating in a 1:1 initiative was slightly higher compared to the mean of the group not participating in a 1:1 initiative. Therefore, evidence was not sufficient to reject the null hypothesis for the main effect of program participation. However, when analyzing the main effect for ELL program participation on academic performance, the mean of the group not participating in an ELL program was significantly higher compared to the mean of the group participating in an ELL program. Therefore, the main effect null hypothesis for native language was rejected.

Implications

The results of this study were mixed. Of the three interaction effects, none was found to have a significant effect on academic performance. In fact, the main effects of socioeconomic status and native language were the only two independent variables that had significant effects on academic performance regardless of their 1:1 technology participation. Although dependent upon a unique set of traits within a population of 11th-grade students in seven high schools in Southwest Arkansas, the results of this study are applicable for educational leaders including those charged with overseeing curriculum, technology, purchasing, and professional development. The findings are also uniquely

applicable to those schools with significant populations of low socioeconomic students or ELLs. The variables are discussed in relation to the connections between this research and the research reviewed from previous studies.

The first important implication of this study is whether 1:1 initiatives result in increased academic performance for low socioeconomic students. In Hypothesis 1, the main effect for socioeconomic status on academic performance was found to be statistically significant regardless of the students' 1:1 technology participation. Findings in studies by The Abell Foundation (2008), the Hanover Research Council (2010), and Warschauer et al. (2014) indicated that the implementation of a 1:1 initiative had significant effects on the academic performance of students even when those students were limited by factors associated with being raised in a low socioeconomic household. In contrast to the findings in this study, studies have indicated that schools with populations of low socioeconomic status students of 75-90% have seen significant increases in academic performance in Nevada, Wisconsin, and Texas, respectively (The Abell Foundation, 2008; Hanover Research Council, 2010; Warschauer et al., 2014). However, the results of this study indicated that neither the interaction between socioeconomic status and 1:1 initiative participation nor 1:1 initiative participation considered alone had a significant effect on academic performance of students. When considered separately, socioeconomic status had a significant effect on academic performance regardless of 1:1 initiative participation.

Second, although much has been written about the disparity in gender and the lack of a female presence in technology-centric careers such as engineering and computer science, virtually no research exists on the interaction between 1:1 initiative participation

and gender or their effects on academic performance. Earlier research indicated, however, that gender plays no role in a child's tendency to be better or worse at using or embracing technology. Instead, students' environment and the general expectations of those around them influence the choices that children make concerning technology (Bateman, 2017). The results of this study indicated that neither gender nor the interaction between gender and 1:1 initiative participation had a significant effect on academic performance.

The third major implication of this study concerns the effects of a 1:1 initiative on ELLs. As noted in Hypothesis 3, the main effect for native language on academic performance was found to be statistically significant regardless of 1:1 technological participation. However, the interaction effect between 1:1 initiative and native language and the main effect for program participation on academic performance were not significant. Because so many students who are classified as ELLs are also simultaneously classified as low socioeconomic, it is not surprising to find that those variables were the only two variables in the study that indicated a significant effect on academic performance. Students within these groups typically suffer from the digital divide at a greater rate compared to their peers, which was referenced in numerous studies including those by Gulick (2012), the Hanover Research Council (2010), Moseley (2015), and Rideout and Katz (2016). Rideout and Katz (2016) noted that Hispanic students are almost twice as likely to reside in a home that has no form of a computer compared to all other ethnic groups, and they are less likely to have access to the Internet through even a cell phone. In addition to the digital divide, these students possess prohibiting factors caused by a general lack of money and resources within the household, but in some studies, 1:1 initiatives have shown to have significant effects on the ELL students'

academic performance. When given access to 1:1 technology, Warschauer et al. (2014) found the middle school in Maine had higher mean scores when compared to the state as a whole in mathematics (80% to 69%) and reading (79% to 59%) even though the school had a significant population of ELLs. Although not examined as part of this study, in addition to increases in test scores, Nomass (2013) and Van Beek (2011) found that ELLs overwhelmingly acknowledged they felt having access to a personal computer through a 1:1 initiative led to improved English vocabulary and improved writing skills, and they preferred technology as a way to better learn English. However, ELL students' perceptions do not always translate into practice as evidenced by the results of this study that indicated students' participation in a 1:1 initiative did not have a significant effect on their academic performance.

Recommendations

Potential for Practice/Policy

This study examined the effects of socioeconomic status, gender, native language, and 1:1 initiative program participation on academic performance. The study was conducted with a sample of 11th-grade students from seven high schools in Southwest Arkansas. The population in the study had a heterogeneous mix of students by socioeconomic status, gender, and native language with majority populations of students participating in the free and reduced school lunch program (66.5%), males (51.7%), and students not participating in an ELL program (82.3%). The findings of this study could assist school leaders with similar populations in similar grade levels in other Southwest Arkansas high schools or similar rural areas.

When considering the implementation of a 1:1 initiative, school leaders must first consider the goals of adding such a program. If too singularly focused, there is a risk of ignoring many of the benefits provided by giving every student a computer. All areas of benefit must be considered including engagement, attendance, satisfaction with school, and technology access. The technology skills required of today's high school students as they enter the workforce or college and the role a 1:1 initiative plays in providing those skills should be considered as well as the value of what a high school diploma signifies. When local businesses and colleges consider graduates for hiring or admissions purposes, do they consider the graduates from a specific school to be at the same level as graduates from other schools regarding the technological skills needed for today's work environment?

Second, school leaders should strive to empower their schools to be change agents within the broader context of the communities they serve. To that end, leaders must carefully consider the demographics and the needs within their communities and attempt to meet those needs, when possible, through the responsible allocation of resources. Several studies indicated that some of the most important benefits to a 1:1 initiative were the changes that took place within the home well outside the confines of the school day (Hanover Research Council, 2010; Rideout & Katz, 2016; Schawllier, 2016). Providing a computer to a family who has previously been without access has the potential to change the course of the entire family. As noted by Rideout and Katz (2016), once a computer is introduced into a low-income home, many times, the relationship between parent and child becomes reciprocal regarding technology usage and the interaction surrounding it. Although difficult to measure in most cases, those aspects of a 1:1 initiative should not be

ignored or dismissed. Because of these benefits, school leaders who do not allow students to take computers home as part of their technology initiative should explore that possibility.

Third, school leaders should not be dismissive of teachers' concerns when implementing a 1:1 initiative, nor should they place too much emphasis on the initial reactions of teachers who may be hesitant to embrace the new technology because of their own perceived limitations or lack of experience. Despite the importance of quality professional development both at the time of implementation and throughout the life of the initiative, Owen et al. (2005-2006) found that the implementation itself was a considerable motivating factor for teachers to take ownership of *their* learning so that they could have full use of the tools provided through a 1:1 initiative. Once they assumed this ownership, teachers rated themselves as more comfortable with the technology usage as the initiative progressed. Owen and his fellow researchers noted that full adjustment by the faculty to the nuances of a 1:1 initiative generally takes three years.

Fourth, school leaders must consider the holistic change that takes place when a 1:1 initiative is given sufficient time to effect change throughout the faculty, the student body, and the community. Downes and Bishop (2015), Herman (2015), Herold (2014), and Topper and Lancaster (2013) noted the problems with failing to consider all of the challenges that would be faced throughout implementation and the subsequent fallout for their failure. When implemented correctly, however, 1:1 initiatives have the potential to change the educational landscape through increased levels of participation, collaboration, engagement, writing, organizational skills, project-based learning, community support, flexibility with assignments, research skills, editing skills, ownership of student learning,

overall knowledge, and digital literacy. In addition to those student skills, 1:1 initiatives were shown to increase the skills of teachers and enable them to become more innovative, their classrooms to become more student-centered with increased levels of higher order thinking skills being implemented, and their instruction to become more engaging and differentiated. Bebell (2005) even found that these benefits were more pronounced with students with disabilities.

Future Research Considerations

Educational technology, considered within the scope of 1:1 initiatives, changes quickly regarding both availability and need. Because of this, school leaders must be willing to remain current in their understanding of the available technology and be able to actively participate in discussions regarding all aspects of 1:1 initiatives including funding, hardware, software, teacher training, Wi-Fi accessibility, support for students and teachers, and maintenance and replacement schedules of devices. To ignore any one area of the discussion has the potential to doom an otherwise sound plan or derail an already-successful initiative. When those aspects are considered alongside the more abstract aspects including teacher attitudes toward technology, student comfort levels and backgrounds of their technology usage, and quality of professional development and training for teachers, it reveals a complicated decision for educational leaders concerning when and how to implement a 1:1 initiative.

In order to strengthen the body of research about educational technology and 1:1 initiatives, in particular, I recommend further examination of the following:

1. Researchers should examine the long-term effects of 1:1 initiatives on academic performance, especially regarding the academic performance of students of low socioeconomic status and students classified as ELLs.
2. Researchers should examine teachers' attitudes toward professional development and training provided as part of a school's or district's transition to a 1:1 initiative and the effect that teachers' attitudes have on the success of the initiative.
3. Researchers should examine the effect teacher education programs have on novice teachers' comfort levels using technology compared to veteran teachers whose teacher education programs did not focus on educational technology.
4. A replication of this study could include additional variables such as students' perceptions about technology, learning styles of students, and the comparison of programs that allow students to take their computers home with them versus programs that require the computers to remain at school.
5. A replication of this study could include different measurements of academic performance such as ACT Aspire, high school graduation rates, college remediation rates, and student discipline rates.
6. Researchers should examine the effect gender has on technology proficiency levels, their satisfaction levels with the technology, and the effect those variables have on students' enrollment in technology-related courses or college majors.

7. Researchers should examine the effect taking computers home makes on parents' perceptions of the school and to what degree the relationship between the parents and the children becomes reciprocal regarding technology usage and the interaction surrounding it.

With the student population of American schools becoming increasingly more diverse, educators will need to become more creative in their efforts to reach and engage those learners and ensure that they have access to the tools that put them on equal footing with their peers. Implementing a 1:1 initiative has in many cases facilitated the engagement of students through an education that is embedded with 21st-century learning skills such as problem-solving, thinking critically, collaborating, communicating, and creating. Further, the development of these skills is often linked to increasing student attendance, student satisfaction, student engagement in school, writing frequency, and academic performance while at the same time decreasing negative student behaviors. Additionally, the benefits to teachers and the skills promoted through 1:1 initiative implantation suggests that all school and district leaders should at least consider such an endeavor.

Summary

Throughout this study, it became apparent that the changes brought about through educational technology are not solely rooted in the implementation of the 1:1 initiatives themselves. Instead, in almost all cases, the changes have been realized because of a change in focus and a change in mindset about teaching and learning *through* 1:1 initiatives. When educators consider the needs of today's learners, acknowledge those needs are different from the needs of past generations, and view technology as a way to

enhance the good work they are already doing, the benefits of 1:1 initiatives are truly realized. When those same educators see the technology as a way to redefine tasks required of students and as a way to create new tasks that were previously beyond the scope of anything they thought possible, 1:1 initiatives become indispensable. Regarding a hypothetical school transformed, not by technology, but by a change in mindset about technology as a whole, Weston and Baine (2010) observed, "Laptop computers are not technological tools; rather, they are cognitive tools that are holistically integrated into the teaching and learning processes of their school" (p. 11). In this school, the focus is on the learning, not on the technology.

This change in mindset about technology and how it is implemented as a way to enhance instruction, engage students, and increase teacher and student collaboration is changing classrooms and schools across the country in a way that an initiative focused solely on the available technology could never do alone (Weston & Baine, 2010). Never before have so many computers been connected so easily and reliably to one another, and never have so many students reaped the benefits of such an enormously powerful tool. In addition, never before have educators been so engaged in research about pedagogy and how to meet the needs of their students. As a result of these two phenomena, real and relevant change is taking place in regard to the way teachers teach and assess students and the way students learn, process, and retain information. Perhaps, no other testimony is more powerful or more summative of this thought than that offered by a teacher in Garthwait and Weller's (2005) study. The teacher said:

> One of the greatest changes I've experienced since the arrival of the laptops has been my increased opportunity to act spontaneously. Every educator realizes that

> when a teachable moment presents itself, one must act accordingly. Nevertheless, in most cases (before the implementation of his school's 1:1 initiative), if that moment involves the use of technology, one must make sure that the computer lab is free and, if it is not, beg for its use from another teacher. Having one lab for an entire school forces teachers to plan way in advance. From my experience, teaching this way tends to make me hurry through things in order to maximize the use of the lab when I want it. (p. 4)

Anyone who has stood in front of a group of students even a few times realizes what the teacher means when s/he discusses a *teachable moment*. Those moments, precious and rare in many cases, come from nowhere, and teachers must be able to capitalize on them or risk losing them forever. This teacher's focus was not on the technology. It was on learning made possible through the availability and use of technology. Although technology does not necessarily increase these teachable moments, as the teacher said, educators can take advantage of them more easily through technology when they do appear.

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