The Chromebook's Effect on Student Achievement in World History 1

Ben W. Copeland

Lynchburg College

April 2018

THE CHROMEBOOK'S EFFECT ON STUDENT ACHIEVEMENT IN WORLD HISTORY I

A Dissertation

Presented to

The Faculty of Lynchburg College

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education (Ed.D.)

---

by

Benjamin W. Copeland

April 2018

Abstract

With the increased implementation of one-to-one computer programs in schools there is limited quantitative research concerning the effect on student achievement in the high poverty urban landscape. This paper examines the effect on student achievement for low socio-economic high school students of color in a one-to-one computer program using Chromebooks. The research utilizes a quasi-experimental longitudinal study encompassing four cohorts of ninth-grade students enrolled in World History 1 from 2013 to 2017. The study includes a background of the problem, methodology and research design, summary of quantitative results and discussion. The end of year standardized test scores for 1067 low SES students of color were analyzed via bivariate correlations to determine if the Chromebook had an effect on their test scores. A second research question focused on any difference in test scores between the two high schools is also contained in the study.

Dedication

This work is dedicated to my family. A very special thank you is extended to my wife Stephanie and my children, Jami and Sarah. A great deal of time was spent in class on Monday nights and in the basement studying or conducting research. I could not have completed this journey without your willingness to sacrifice family time. I hope my achievement will encourage my children to set lofty goals and work diligently to meet them. Your unwavering support assisted me more than words will ever express. Thank you for your understanding, patience, and continued support through all the challenging times.

To my parents thank you for challenging me, pushing me, and encouraging me to always reach for more in my life. You taught me early in life the value of an education and to always do things the right way the first time. Your love, expectations, and unwavering support helped propel me to this accomplishment.

Acknowledgements

My participation in the Lynchburg College doctoral cohort process has been an extremely challenging and fulfilling experience. I would like to express my appreciation and gratitude to the faculty at Lynchburg College. The coursework and guidance received on those long Monday nights were crucial to my success. I would like to specifically thank my committee members: Dr. Deanna Cash, Dr. John Walker, and Dr. Holly Gould. The expertise and guidance of my committee was instrumental in the completion of this research project.

I would like to thank Lynchburg City Schools for their willingness to support this study. Many people supported me during this journey by reviewing drafts, editing and providing honest feedback. I want to specifically thank Dr. April Bruce for her assistance with the data for this study. Lastly, to my classmates, thank you for your shared experiences, candid discussions, knowledge, laughter, and sometimes tears. I could not have completed this monumental achievement without the camaraderie we created and the support from each of you.

List of Tables

Table Page

List of Figures

TABLE OF CONTENTS

Page

Chapter One

Introduction

Every year more school systems opt to introduce one-to-one programs for their students and teachers. One-to-one initiatives create an environment in which every student is provided a laptop computer for use at school and at home. As school districts are confronted with the challenges of improving academic performance, they often look to technology as a potential solution. With any new program, the school board and district leadership must wrestle with a very important question: Is the potential reward worth the expense? Advancing a one-to-one program requires the investment of significant resources. To assess the educational benefits, decision makers first look to other school systems that already have one-to-one programs, but a review of the existing programs across the nation shows inconclusive and inconsistent results regarding their effectiveness on improving the quality of a public-school education. The data and research on one-to-one programs that are available to decision makers are limited. Given the constant struggle at the federal, state and local level to find successful programs and improve the performance of all public school children, it is concerning that achievement gaps between black and white students remain prevalent in the American education system (Bartz, 2016). A one-to-one program may take an important first step in the right direction by ensuring that all students have equal access to the tools and resources available in the consistent use of a computing device.

Definition of Terms

The following terms are defined to benefit the reader:

Chromebook	A laptop that runs Google's Chrome operating system and Chrome Web browser. Providing a total Web-based operating environment, designed to be used primarily while connected to the Internet, with most applications and data residing in "the cloud".
Desktop Computer	A personal computer that fits on or under a desk. They usually consist of multiple components; monitor, keyboard, mouse and computer processor unlike a laptop, which is portable, a desktop computer is meant to stay at one location.
High School	High school for this study will refer to students enrolled in grades 9-12 in a regular public school setting.
Laptop Computer	A laptop computer is a portable computer that functions via a rechargeable battery. It can be easily transported with a backpack or similar carrying bag.
Low Socioeconomic Status (SES)	For the purpose of this research, low socioeconomic status is determined by the student's receipt of free or reduced-price meals through the National School Lunch Program (also see definition of socioeconomic status below). Children from families with incomes at or below 130% of the poverty level are eligible for free meals. Those with incomes between 130% and 185% of the poverty level are eligible for reduced-price meals, for which students can be charged no more than 40 cents (National School Lunch Program, 2017).
Minority	The U. S. Department of Education defines a minority student as a student who is an Alaska Native, American Indian, Asian-American, Black (African-American), Hispanic American, Native Hawaiian, or Pacific Islander. Families report race and demographic information to their child's school at the beginning of each school year as part of the registration process. All information related to race of the study participants was derived from *Infinite Campus*, the school district's student information system.
One-to-one Program	A program where the school district or school provides to each student a device, normally a laptop computer or similar device (Chromebook or iPad), that can be used 24 hours a day during the school year.
Socioeconomic status (SES)	Measured as a combination of education, income and occupation. It is commonly conceptualized as the social standing or class of an individual or group (American Psychological Association, 2017).
Standards of	The Standards of Learning for Virginia Public Schools establish

Learning (SOL)	minimum expectations for what students should know and can do at the end of each grade or course in English, mathematics, science, history/social science and other subjects. SOL tests in reading, writing, mathematics, science and history/social science measure the success of students in meeting the Board of Education's expectations for learning and achievement (Virginia Department of Education, 2016).
Statistical Package for Social Sciences (SPSS)	A software package used for statistical analysis.
Student of Color	A student who is an Alaska Native, American Indian, Asian-American, Black (African-American), Hispanic American, Native Hawaiian, Pacific Islander or multi-racial.
21st Century learning and innovation skills	Learning and innovation skills to prepare students for increasingly complex life and work environments in the 21st century with a focus on creativity, critical thinking, communication, and collaboration to prepare students for the future (Partnership for 21st Century Learning, 2016).

Background of the Problem

Computer use in education has been ongoing for the past 50 years, spanning from the first use of Teletype connections in 1964 to the more recent use of laptops, netbooks and Chromebooks over the last decade in one-to-one programs (Bebell & Kay, 2010; Johnson, 2003; Warschauer, Zheng, Niiya, Cotton, & Farkas, 2014). During the 1980s and 1990s, schools in America opted to place computers in separate labs and not in the primary classroom because of the expense. As prices decreased and the Internet became more accessible, computers began to find a place in classrooms across the nation (Provenzo, Brett, & McCloskey, 2005). In their book, *Computers, Curriculum, and Cultural Change: An Introduction for Teachers,* Provenzo, Brett, & McCloskey (2005) state "the computer … is reshaping our social and economic systems, as well as our traditional approaches to teaching and learning" (p. 18).

Computers established a foothold in K-12 education during the end of the 20th century, and due to the rapid changes in technology, increased Internet access across all schools, and the

availability of wireless networks, there has been consistent and steady increase in the student-to-computer ratio in schools (Zheng, Arida, Niiya & Warschauer, 2014). When you couple the improving student-to-computer ratio with a desire by many in public K-12 education to ensure that students graduate from high school with 21st century skills of creativity, critical thinking, communication and collaboration, also known as the four C's, the logical next step is for educators to develop a vision focused on providing a computer for every student. As technology changed, and the economics of incorporating computers into classrooms became more advantageous, those in charge of education began putting an emphasis on developing a student's research skills and information literacy (Warschauer, 2007). A goal of many one-to-one programs is to create an environment that allows and inspires students to take ownership of their learning while increasing the individual motivation for learning (Warschauer, 2007). Research has shown that providing all students with a laptop creates an environment in schools that fosters competence, autonomy and student responsibility (Mouza, 2008). Some school officials think this autonomy and active participation in learning, on the part of students, equates to increased engagement, which will lead to better student achievement (Mouza, 2008).

Statement of the Problem

Educators today are faced with a never-ending struggle to improve the academic achievement of the students they serve. Gains in student achievement made during one school year must be eclipsed during the following year. Educators consistently look to data and research in hope of finding another program, instructional methodology, or tool to improve academic success. The research on student achievement in one-to-one laptop programs shows mixed results, and despite the increase in the quantity of one-to-one programs, the research has not reached a consensus that such programs bring improved educational outcomes (Harper &

Milman, 2016; Zheng, Warschauer, Lin, & Chang, 2016). This study seeks to determine if, between the year prior to the one-to-one program and the three years following its implementation, the achievement of low socioeconomic (SES) students of color has improved.

Purpose of the Study

The research may add to the body of knowledge concerning the changes in academic achievement for low SES high school students of color in one-to-one learning environments involving Chromebooks. Given the current state of public education with achievement gaps, underperforming students of color, and economically disadvantaged students, there is merit in a study of this type. The achievement gap in public education has persisted despite the integration of schools. The Coleman Report from 1966 is the seminal research relative to the achievement gap that exists between minority and majority students. One of the key points from the Coleman Report is that "the average minority pupil scores distinctly lower on these (achievement) tests at every level than the average white pupil" (p. 21). The Coleman Report showed that the 1st grade scores for minority students were as much as one standard deviation below the majority students. By the time of graduation in the 12th grade, the measures of student achievement showed the gap between minority and majority students had widened when compared to the 1st grade (Coleman, 1966). The Coleman report clearly stated a "combination of non-school factors poverty, community attitudes, low educational level of parents which put minority children at a disadvantage in verbal and nonverbal skills when they enter the first grade, the fact is the schools have not overcome it" (p. 21).

More recently, the Institute for Educational Policy at the City University of New York reported that "Black students on average score below White students by one standard deviation, which amounts to the difference between the performance of a 4th grader and an 8th grader"

(Miksic, 2014, p. 1). The socioeconomic status of students also impacts achievement, and Bartz asserts in his 2016 research that "for the income gap (between children for low SES families compared to children from high SES families) the achievement differences are even higher" (p. 3).

A secondary goal of the research was to provide school district leadership with a framework to make informed decisions about launching a one-to-one program. Lastly, this study may be significant for educators everywhere as there are an increasing number of students living in poverty and the instructional technology prevalent in education will continuously evolve and stay with us into the future.

Summary

Change is always challenging and in public education it seems that everything is constantly changing. An iterative cycle of new initiatives, evaluation and assessment leads to continuous change in accountability systems, teacher preparation programs, standards of learning, instructional delivery, technology and many other areas that affect the daily struggle in education (Duncan, 2012), and "too often people adopt technology in their schools without thinking through its potentials and limitations, they simply use it because it is the thing to do" (Provenzo, Brett, & McCloskey, 2005, p. 29). There is still much to learn about one-to-one initiatives and their effects on learning and student academic achievement. Zheng et al. (2016) wrote in their meta-analysis that 70 studies reported "positive changes in teaching and learning" (p. 17), while many of these studies cautioned that the change in pedagogy could not be brought about solely by technology. Educators, school administrators and school boards are responsible for making decisions that directly affect the policies within public education. Implementing additional technology in public education costs taxpayers more money and it is imperative that

the effects of any new implementation be evaluated. The money spent on these programs is important, and it is just as important to determine if the time spent teaching and learning in a one-to-one laptop environment is productive and has a positive effect on student achievement. The 1966 Coleman report showed that most students of color entered school performing lower than their white counterparts and they consistently fell further behind. In today's electronic world, 21st century skills are a requirement for all students, yet many students of color do not have access to computers and laptops outside of the school environment. Providing a one-to-one device to students of color ensures equal access to computing devices and will hopefully propel all students forward in the technologically advanced world.

Chapter Two

Literature Review

School districts dedicate significant resources to one-to-one programs, yet there is limited scientifically-based research and empirical evidence to measure the effect of these programs on student achievement (Bebell & O'Dwyer, 2010; Dunleavy & Heinecke, 2007; Penuel, 2006; Warschauer, 2006). In recent years, increased use of technology, and more specifically one-to-one programs, has become more attractive to education decision-makers as a model for educational change capable of enhancing student outcomes and improving the quality of education (Muir, 2007). These programs come with considerable costs and inadequate evidence related to improvements to teaching, learning and positive student outcomes. The need for additional research into the effectiveness, perceptions and effect on student achievement increases as additional school districts embark on one-to-one programs (Harper & Milman, 2016). Due to the rapid changes in laptop technology, increased Internet access across all schools, and the availability of wireless networks, a plethora of information is available regarding technology use in classrooms. However, much of the research on technology use in classrooms is not applicable to this literature review for several reasons. Some research was deemed not applicable due to a lack of rigor or limited information in the research about student achievement. Other research is not applicable due to the age and rapid changes in technology. Therefore, the scope of the research reviewed has been constrained to scholarly research and dissertations published since January 2001.

As technology has advanced, the computer platforms available for one-to-one programs improved. There are many reasons given by education organizations and educators for investing in these programs, ranging from improving teacher and students' technology skills, personalized

learning, better collaboration, increased student engagement and improvements in writing skills to name a few (e.g., Gravelle, 2003; Shapley, Sheehan, Maloney, Caranikas-Walker, & Texas Center for Education Research, 2009; Warschauer, 2007; Zucker & Light, 2009).

What is one-to-one?

As technology changed and the investment costs of incorporating computers into classrooms became more advantageous, those in charge of education began putting an emphasis on developing a student's research skills and information literacy (Warschauer, 2007). Desktop computers found a foothold in education in the 1990s and although "a national consensus is developing towards increased use of technology in the learning, there is no such consensus on how technology should be used" (Zheng, Arada, Niiya & Warschauer, 2014, p. 279). In 1983 the student-to-computer ratio in schools was 125:1 (Russell, Bebell & Higgins, 2004), in 1998 the student-to-computer ratio was 12:1, in 2000 it was 6.6:1 and by 2008 it had increased to 3.1:1 (National Center of Education Statistics, 2002; 2014). As the ratio of students-to-computer decreased, it became more feasible for school districts to consider a one-to-one program. One-to-one is a simple reference to the level of access to technology available to students and teachers. One computer laptop per individual student or teacher is the simple approach, but "it says nothing about actual educational practices" (Bebell & O'Dwyer, 2010, p. 6). Zheng et. al. (2016) broadly defined one-to-one programs as "all students in a class, grade level, school, or district are provided computers for use throughout the school day and, in some cases, at home" (p. 2). The majority of one-to-one programs are based around a laptop computer of some type. As laptop prices decreased from the $1300 to $1500 range seen in the late 1990's and early 2000's to the $200 to $300 range seen today, the ability to undertake one-to-one initiatives has become easier (Johnstone, 2003; Weston & Bain, 2010; Zucker & Light, 2009). The reason for

and goals of a one-to-one program can be very different. Improving academic achievement, improving access to technology, economic competitiveness, transforming teaching and instruction, and improving students' technology skills, and many others, are all used as justification for one-to-one programs (Penuel, 2006; Warschauer, 2007). The body of research clearly articulates the reasons school districts choose to launch a one-to-one program but seldom does the reason for a new program include a well-conceived and formulated evaluation plan. Topper and Lancaster (2013) found that only two of the five districts in their study had a formal evaluation plan for their one-to-one program, and that school districts struggled to show positive outcomes and an overall benefit from the program, if they had no means or plan to measure success.

Differing Approaches. As technology advanced, the laptop computer was adapted to function better in its environment. The early one-to-one programs used laptops and were not connected to the Internet or a network of any type. They functioned as stand-alone computers (Johnstone, 2003). With the advent of the Internet and wireless networks, the flexibility and options available have increased for one-to-one programs. Today one-to-one programs can flourish with low cost computers without hard drives, using only flash memory, and relying on network, or cloud storage (Zucker & Light, 2009). There are two other key areas where one-to-one programs differed in the early stages. First, some programs did not allow the students to take the device home, and some programs may have required students to lease or pay for their own computer (Penuel, 2006). If students are not allowed to take the device home, then the device could only be used during school hours which hindered the teacher's ability to assign homework that requires device usage. Programs that required students to lease or buy the device

are becoming few and far between as they are deemed not fair to all students and discriminatory against low SES students.

Early adopters. As technology advances, there are always a few organizations on the leading edge of experimentation. The early adopters of one-to-one programs include Microsoft Anytime Anywhere Learning Program; the Maine Learning and Technology Initiative; Henrico County, Virginia; and Texas Technology Immersion Pilot. These are all considered to be large scale efforts of early adoption. There is one instance of a small scale one-to-one program dating from 1988 in Australia that is worth mentioning due to the timeframe in which it was initiated.

Methodist Ladies College. One of the earliest instances of a one-to-one program was at the Methodist Ladies' College, located in Melbourne, Australia. Although it is referred to as a "college," it is a K-12 boarding school for girls. Their program began as a pilot with desktop computers for a seventh-grade class in November 1988 and within eight months was christened a success. The success of the pilot, coupled with the arrival of Toshiba laptops on the world computer market, led to the full-scale launch of the world's first one-to-one laptop program in February 1990. This milestone initiative involved three teachers and 82 students in the fifth grade at Methodist Ladies' College. The use of a laptop required a shift within the classroom for both teachers and students. No longer was most of the day spent doing the more traditional "chalk and talk" or "stand and deliver" style of instruction. Technology was incorporated into the classroom at every opportunity. The laptops produced several unexpected results. The students became more collaborative, risk-taking via technology became an everyday reality, self-esteem increased for underachieving students and teachers learned with their students (Johnstone, 2003). At the end of the school year, the students took their standardized tests, and

although specific data is not available, "the girls did wonderfully well, scoring way above average in both math and English" (Johnstone, 2003, p. 219).

Microsoft. In 1996, the Microsoft Corporation launched the "Anytime Anywhere Learning Project" at 52 schools as a partnership with Toshiba utilizing their Notebook computer system. An independent research group conducted multiple evaluations on the Microsoft program and published results that showed positive effects on student learning and curriculum delivery (Gulek & Demirtas, 2005). The student outcomes from the Microsoft Project are listed in Table 1.

Table 1

Anytime Anywhere Program Outcomes

Microsoft Project Outcomes
Laptop students spend more time engaging in collaborative work than non-laptop students
Laptop students participate in more project-based instruction
Laptops lead to more student writing and to writing of higher quality
Laptops increase access to information and improve research analysis skills
Laptop students become collaborators (interact with each other about their work)
Laptop students direct their own learning
Laptop students report a greater reliance on active learning strategies
Laptop students readily engage in problem solving and critical thinking
Laptop students consistently show deeper and more flexible uses of technology
Laptop students spend more time doing homework on computers

(Gulek & Demirtas, 2005, p. 5).

Like much of the research on technology programs, the evaluation of this early one-to-one program provides little insight into the effects on student achievement.

Maine. Another early program on the timeline of one-to-one programs was launched in Maine in 2001. The Maine Learning and Technology Initiative (MLTI) was the first statewide program providing laptops at a cost of $120 million and used Apple devices. The program was established as a state government initiative and viewed as an important component of Maine's economic development strategy (Bebell & Kay, 2010). Phase I of the program encompassed approximately 240 schools for grades seven and eight, including 32,500 students, and 2,330 teachers. After the initial phase was complete, numerous reports were published by the Maine Education Policy Research Institute. Silvernail and Lane (2004) found that the laptops were being used widely by teachers and students, and their use improved learning. The researchers found that both students and teachers reported improvements in the quality of students' work and increased understanding of the material the students were learning. They also found that students of all types were more motivated to learn and more engaged in the learning process (Silvernail & Lane, 2004). The data collection methods for these early evaluations of MLTI included surveys, self-reported evidence on student learning, site visits and observations. In another study on MLTI, Gravelle (2003) asserted that low socioeconomic students with access to tools and resources could improve their academic performance and that could possibly lead to better economic prosperity in the workforce. This finding by Gravelle (2003) directly aligns with one of the strategies of the MLTI program, "preparing youth for the future economy" (p. 2), by bridging the digital divide so all children have the opportunity to develop 21st century skills. Much of the early research on MLTI was qualitative in nature and focused on the use of the devices by students and teachers, the changes within the classroom and the effects on teaching and learning. Although they do make some broad generalizations, the researchers did not provide quantitative data to support the effects of the new program on increased student

achievement. In 2009, the MLTI program was expanded to include all high schools (About MLTI, 2009; Weston & Bain, 2010; Zucker & Light, 2009).

Henrico County, Virginia. In 2001, Apple and Henrico County Public Schools closed a deal to provide 23,000 iBooks to students and teachers at all high and middle schools throughout the district (Apple, 2001). In 2005, the school district transitioned from iBooks to traditional laptops. The first review of the program was published in 2008 with the help of Dr. D. Mann of Interactive, Inc. This technical report was published documenting outcomes after three years of laptop use from 2005 to 2008 (Interactive, Inc., 2008).

The Henrico report is over seventy pages in length with only seven pages dedicated to student outcomes. The data was collected from nine high schools and gathered in two major areas. "Students reported how often they used laptops ("every day", "once or twice a week", etc.) and we compared those amounts of use to their test scores using an analysis of variance (ANOVA) and post-hoc Bonferonni comparisons" (Interactive, Inc., 2008, p. 7). The three-year data analysis showed improvements in standardized test scores in all subject areas with computer use except Algebra 1 and Algebra 2. The test score improvement with computer use for all curriculum areas studied had a mean of +18.48 points across the three years of the study. Unfortunately, the student outcome data was not disaggregated at any level and leaves many questions unanswered. The standardized test score improvements reflect the only quantitative data contained in the report and the qualitative data was primarily gathered via self-report web surveys to students and teachers. The survey itself was lengthy as the students were required to complete an 82-item questionnaire while the teacher survey required responses to 140 items (Interactive, Inc., 2008). The significance of this survey composition to the discussion is that complexity and length of survey is a weakness as respondents tend to ignore the instrument.

Also, complexity and length brings into question the validity of the instrument, due to the time required to complete the survey (Bogen, 1996).

A unique point concerning the technical report published by Dr. Mann was that Interactive, Inc. was awarded a multiyear contract following a competitive proposal, or bidding process, on the behalf of Henrico County Public Schools. This type of evaluation based on a competitive bid contract is focused on the stakeholder perspectives and aids the future decision making of the school system relative to the one-to-one program. This type of evaluation for decision making may be interpreted as a way to justify the future merit of the program (Mathison, 2008). The report summary provided a brief description into the methodology; "This reports the results of a mixed methods longitudinal population study of students, teachers and building administrators with quantitative and qualitative data" (Interactive, Inc., 2008, p. 1).

Texas. In 2004, Texas began a program called the Technology Immersion Pilot (TIP) involving over forty schools at a cost of $20 million. The program was created by the Texas Legislature in 2003 and was funded by the Texas Education Agency through the use of federal Title II, Part D monies which are provided to enhance education through technology. The TIP schools were part of a four-year program comparing twenty technology immersion middle schools to twenty control (no technology) middle schools (Shapley et al., 2009). The TIP used a mix of Apple and Dell Computer wireless laptops, and the middle schools selected to participate in the program ranged in enrollment size from 83 to 1,447 students. A quasi-experimental research design was used to analyze the data over three cohorts in the fourth year of technology use. This allowed the researchers to look at cohorts with varying years of technology immersion ranging from two to four years (Shapley et al., 2009). The TIP analysis showed no statistically significant effect on reading achievement measured via standardized test scores when the data

was controlled for school and student poverty, but when looking at low socioeconomic immersion students only, the reading achievement grew "at significantly faster rates than their more affluent peers" (Shapley et al., 2009, p. vi) for the two cohorts with the longest immersion time. Similarly, the growth rates for mathematics scores on Texas standardized test scores in low socioeconomic immersion students were "significantly more positive that their control group counterparts" (Shapley et al., 2009, p. vii).

Views, Perceptions and Benefits

The body of research on one-to-one programs falls into two general focus areas of qualitative and quantitative data. Due to the resources required and time involved when launching a one-to-one program, a significant volume of research touched on the perceptions of those involved in the program. The following section examined some of the qualitative data that existed in the literature from the perspective of teachers, students, parents and school administrators. The qualitative data was collected via numerous methods including web surveys, paper surveys, classroom observations and interviews. The intent of this section of the review was to reveal the findings and generalizations of the qualitative data and research, while not delving into the composition, measurement scales and makeup of the tools used to collect the data.

Teachers. The success of any one-to-one program in K-12 schools was incumbent on the individual teacher. The teacher's attitudes towards technology, beliefs on the effects of a one-to-one program and overall views on teaching and learning in a technology environment were crucial points of data for any researcher (Bebell & Kay, 2010). Several studies (Bebell & O'Dwyer, 2010; Bebell & Kay, 2010; Grimes & Warschauer, 2008; Lowther, Inan, Ross, & Strahl, 2012) all supported the belief that teachers believed that one-to-one programs have a

positive impact on student learning, collaboration, interaction with other students, student engagement, motivation and achievement. In the Grimes and Warschauer (2008) research, the support of the one-to-one program was overwhelming in that 90% of teachers recommended the programs be permanent and 80% of teachers recommended other schools adopt similar programs. The Silvernail and Lane (2004) review of MLTI found that over 75% of the teachers believed the laptops helped them better meet Maine's statewide learning standards. Warschauer's (2007) research on information literacy in one-to-one programs found that 90% of teachers believed continuous online access allowed students to explore topics in more depth and get more involved in research. Teacher views and perspectives were the most prevalent qualitative data available in one-to-one program studies per the work compiled by Penuel (2006). His work was a meta-analysis of 30 separate studies on one-to-one programs and highlights another important teacher belief. Teachers thought students can accomplish more complex assignments due to the use of a laptop and via collaboration with peers (Penuel, 2006). Another important data point from the teacher's perspective was that they will use laptops more in daily classroom activities if they feel there is sufficient software and Internet-based resources. Likewise, if the teacher was concerned that there was not enough high-quality material, or that the students were using the laptops for playing games or recreational-Internet use, then the teacher was less apt to use laptops on a regular basis (Penuel, 2006).

Students. A goal of some one-to-one programs was increasing access to technology for all students and thus "reducing the digital divide" (Penuel, 2006, p. 335). An additive benefit of these programs for students was the development of technology skills or what some refer to as 21st Century skills (Gravelle, 2003; Penuel, 2006; Warschauer, 2007; Zheng et al., 2014). In qualitative studies students also reported a growth in research skills, easier access to information,

more interaction with peers and increased collaboration due to the accessibility of laptops (Bebell & Kay, 2010; Zheng et al., 2014). Qualitative studies also suggested that involvement in a one-to-one program brings an improvement in the student's literacy primarily due to the tools for better writing and overall writing skills increases (Peckham, 2008; Penuel, 2006; Zheng et al., 2014). Students reported that they preferred the laptop for written assignments and the most common use of the laptop was to write and edit papers (Grimes & Warschauer, 2008; Warschauer et al., 2014; Zheng et al., 2013).

Parents. The research accumulated for this review spanned several decades and covered varying types of one-to-one initiatives. The only instance of parent involvement or mention of parental input in the planning stages of the one-to-one program was with the program at the Methodists Ladies' College in Australia. Due to the $1500 price tag for Toshiba laptops in 1990, the school sought input from the parents on how families would fund the purchase or whether they would prefer to lease the devices (Johnson, 2003). Only one other source reviewed for this analysis contained information related to the parental viewpoint.

The technical report by Dr. Mann on the Henrico County one-to-one program contained one page, from the total 74, with parental related survey information from the 2006-07 school year. More than 3000 parents responded to the survey, and 80% of them believed the Henrico laptop program would help their child attain higher education or paid employment after high school. Fifty percent of the parents that responded felt that the technology focus in Henrico County had helped their child in school, and 23% thought the one-to-one program had helped with attendance. The Henrico County technical report covered a three-year period but only contained parent survey data for the 2006-07 school year (Interactive, Inc., 2008).

Administrators. Although qualitative data from school and district administrators were limited, there were a few studies with snapshots into their perspectives. In a study of school principals, it was found that they believed a one-to-one program had "dramatically improved student engagement" (Bebell & Kay, 2010, p. 22). The school leadership also felt that "students responded favorably to the laptop initiative and that the students' engagement, attentiveness, and motivation was improved (Bebell & Kay, 2010, p. 22). Topper and Lancaster (2013) did research on five school districts in Michigan that instituted one-to-one programs from 2005 to 2010 and found that school administrator support and belief in the program was crucial. It was the responsibility of the district leadership to set "a clear vision for the role of technology in supporting learning and a sustained commitment from administrators at all levels" (Topper & Lancaster, 2013, p. 352). The Bebell and Kay (2010) research on the Berkshire Wireless Learning Initiative in Massachusetts found that school leaders were very positive about student outcomes after three years of their one-to-one program. The leaders felt students created better products with computers and that computers helped students grasp difficult concepts and have a deeper understanding of material (Bebell & Kay, 2010).

Research on Student Achievement

The need for additional research related to student outcomes and achievement involved in one-to-one programs was mentioned numerous times in a variety of studies (Bebell & O'Dwyer, 2010; Crook, Sharma, & Wilson, 2015; Dunleavy & Heinecke, 2007; Grimes & Warschauer, 2008). The body of research on one-to-one laptop use showed a dearth of material related to low socioeconomic status (SES) high school students in an urban setting. Although there was a lack of specific research on low socioeconomic high school student's academic achievement, there were several studies that are worthy of mention. For the purposes of the discussion, the research

has been segregated into those studies that show mixed results and those that show improved academic outcomes.

Mixed results

Dunleavy and Heinecke (2007) investigated the effect of a one-to-one program on at risk middle school students' math and science outcomes. The research is rigorous with a pretest-posttest control group design, random assignment of students, and between groups analysis of covariance (ANCOVA). The population of the school was 87% students of color, and the school had a 60% poverty rate (Dunleavy & Heinecke, 2007). The researchers found that one-to-one laptops did enhance student achievement in science at this middle school while there was no significant change in student outcomes for math. Due to the lack of significant differences on math achievement there was no description of the statistical analysis conducted on the math posttest scores. Further analysis of the science scores revealed that only "2.9% of the variance in eighth-grade science achievement" could be attributed to the laptop (Dunleavy & Heinecke, 2007, p. 13). Additionally, the Cohen's *d* effect size was relatively small (*d* = .24), further supporting the magnitude of the effect not being related to laptop use. The research also reported a noticeable gender effect for eighth grade male science students with laptops resulting in large adjusted mean (M = 442.59), while males without laptops showed only a small adjusted mean (M = 426.70). Female adjusted means did not show significant differences with an adjusted mean (M = 422.37) for laptop students and (M = 420.68) for females without laptops. This led the researchers to conclude that "1:1 laptop instruction was more effective in increasing science achievement for male students than it is for female students" (Dunleavy & Heinecke, 2007, p. 15).

The Grimes and Warschauer (2008) research was a study of three schools in California from 2004 to 2006 with demographically diverse student populations and varying levels of socioeconomic status. The three schools were a junior high school, a K-8 school and an elementary school, and the state test scores were compared in the subject areas of math and English language arts (Grimes & Warschauer, 2008). The research contained both quantitative and qualitative data and "follows the same students for two school years (three annual tests), rather than a different group of students each year" (Grimes & Warschauer, 2008, p. 308). The researchers note "four positive changes that took place in the laptop classrooms, which we describe under the labels of writing, information literacy, multimedia skills, and autonomy" (Grimes & Warschauer, 2008, p. 314). The researchers presented self-reporting survey data on teacher and student opinions showing strong support for one-to-one laptops. Data was presented on the junior high school student state test scores and showed an unanticipated result in English language arts. Laptop student performance on state tests was lower than non-laptop students in the first year by 8.2 points. The laptop students performed better in year two for English language arts but only closed the test score gap. The decline in scores "may have been due to the complexity of introducing such a fundamental change in the basic tools of learning, rather than any inherent disadvantage of using laptops" (Grimes & Warschauer, 2008, p. 328). The laptop students did not outperform the non-laptop students during the two years of the study. In junior high math, the student test score changes were similar for both laptop and non-laptop students and "cannot be attributed to the laptop program because the laptops were used less in mathematics than in ELA" (Grimes & Warschauer, 2008, p. 326). The test score data from the elementary students showed no "statistically significant results and the effect sizes were small" (Grimes & Warschauer, 2008, p. 328). The researchers did compare 7th and 8th grade state test

score data between two schools "to investigate the possibility of a disparity in gains that might be related to socioeconomic status" (Grimes & Warschauer, 2008, p. 328). Over the two-year period for the low and high socioeconomic status schools "there was no significant difference in the mean gains in ELA scores" (Grimes & Warschauer, 2008, p. 328). In math, the scores decreased for the low socioeconomic students in the first year compared to the high socioeconomic students, but the low socioeconomic students showed significant gains over the high socioeconomic students in the second year with "$p < .001$, $t = 8.3$, $df = 1211$, effect size = -.59" (Grimes & Warschauer, 2008, p. 328). The researchers stated that their qualitative data analysis indicated the implementation during the first year of the one-to-one program was more challenging in a low-SES environment (Grimes & Warschauer, 2008).

The Berkshire Wireless Learning Initiative article by Bebell and Kay (2010) looked at five middle schools in western Massachusetts over three years during a one-to-one implementation from 2005 to 2008 involving 1800 students. They found "many positive educational impacts resulting from participation in the one-to-one computing program" (Bebell & Kay, 2010, p. 54). Seventh grade students in their second year of computer use wrote longer essays and scored higher on essays compared to traditional pencil and paper students. The net English and language arts scores for one-to-one students showed a gain after two years but so did the scores for the comparison group without access to computers. In math, the data on state standardized assessments were less promising with the one-to-one students having net lower scores after two years of computer use (Bebell & Kay, 2010). The conclusion of the Berkshire Wireless Learning Initiative study reads, "statistical analysis of student-level results revealed some positive, yet far from conclusive results on the impact of the one-to-one pilot program" (Bebell & Kay, 2010, p. 44).

Shapely et al. (2011) continued the analysis and research into the Texas Technology Immersion Pilot (TIP) looking for possible connections between increased use of technology and student achievement. The research utilized an experimental group design and specifically looked at middle school math achievement. Shapely et al. (2011) found that the one-to-one laptop usage and the change in student achievement was not statistically significant but could conclude that the effects on student achievement in one-to-one classrooms was consistently positive (Shapely et al., 2011).

Research by Lowther, Inan, Ross and Strahl (2012) investigated the overall effectiveness of Michigan's Freedom to Learn (FTL) one-to-one initiative. This statewide grant program provided 195 schools, both public and private, with laptops in both rural and urban settings. The research questions focused on teacher strategies for incorporating laptops into classrooms, teacher attitudes, student attitudes and student outcomes on state achievement tests (Lowther et al., 2012). Laptop use was started in the sixth grade and the analysis was conducted at the end of the seventh grade. The data was collected on seventh grade English, math, reading and writing state tests scores with 673 seventh grade students from eight schools in the experimental group (with laptops) and 715 seventh grade students in the control group (without laptops) from eight comparable schools. The schools were paired, test and control, for comparison to ensure similar demographics and key characteristics (Lowther et al., 2012). "A series of 2 x 2 chi-square frequency analyses were conducted comparing FTL and comparison schools" (Lowther et al., 2012, p. 17). The test scores were divided into two categories: meets or exceeds the standard and at or below the standard. Of the 32 possible comparisons with eight pairs of schools across four subject areas there is no evidence that laptops had an impact on student test scores (Lowther et al., 2012). Twenty-four of the 32 showed no difference in scores while four had the advantage

with laptops and four had the advantage without laptops (Lowther et al., 2012). "Although students from FTL schools had high interest, motivation, and belief in the benefits of using laptops, the examination of student performance did not show positive impact of laptops on students' state test scores" (Lowther et al., 2012, p. 25).

Improved outcomes

Research conducted by Gulek and Demirtas (2005) showed "substantial impact of laptop use on student learning outcomes" at a California middle school over a three-year period (p. 3). The researchers collected data on student grades, cumulative GPA, district writing assessments and scores of state standardized assessments. Students with laptops outperformed their peers without laptops in many areas measured and "laptop enrollment has a significant effect on mathematics and language scores" (Gulek & Demirtas, 2005, p. 28). The researchers used both cross sectional and longitudinal analysis across the domains of GPA, end of course grades and standardized test scores resulting in many points of comparison and data reporting. The cross-sectional analyses comparing means of standardized test scores in English language arts showed laptop students consistently scoring higher than non-laptop students with significant F statistic results across all three years. Unfortunately, the analysis of math standardized test scores did not yield any significant results. The comparison of laptop students' GPA scores were statistically significant in years one and two, but not year three. The longitudinal analyses revealed that involvement in the laptop program was "associated with an average per student gain of 16 points for mathematics scores and 13 points for language scores" on state required standardized tests (Gulek & Demirtas, 2005, p. 28). Laptop use in this study resulted in a 0.40 increase in math cumulative GPA and a 0.34 increase in overall cumulative GPA. Although this study shows benefits of laptop use on student achievement across several domains it was important to note

that the school was already a top performing school and located in a high-income area south of San Francisco with a 26% minority population and only four percent of the school considered to be low SES (Gulek & Demirtas, 2005).

Crook, Sharma and Wilson (2015) evaluated the impact of one-to-one on student outcomes in Sydney, Australia high school science courses. The opportunity to conduct the research was provided when a government funded program provided laptops to only half of the ninth-grade students from twelve high schools in Sydney. The result was seven schools had laptops and five schools did not. After three years of computer use, the twelfth-grade exams in all three sciences were analyzed. A multivariant correlation analysis was performed by gradually removing ($p > 0.05$) non-significant variables to reveal the optimal correlation. The unstandardized regression coefficient for one-to-one laptops in biology, physics and chemistry was $B = 0.33$, 0.42 and 0.56 respectively. This equates to an average test score increase between three and five points based on the standard deviation of test scores. Cohen's *d* effect sizes were also calculated with biology ($d = 0.26$), physics ($d = 0.38$) and chemistry ($d = 0.23$). The biology and chemistry impact due to one-to-one laptops was considered to be small while the impact in physics was medium. Socioeconomic status was a variable in the multivariant regression but did not show any significance ($B = 0.003$) (Crook, Sharma & Wilson, 2015).

Zheng, Warschauer, and Farkas (2013) "examined the effect of daily access to laptops on the writing outcomes and processes of 2,158 upper elementary students in two school districts, and the effect among diverse students" (p. 267). Zheng et al., (2013) studied two school districts, one in California and the other in Colorado. In the California school district, the analysis was done on fourth grade students over three years. Year one was without a laptop, while year two the students only had a laptop for part of the year, and the students had a laptop for the entire

time in year three. It is important to note that the California data was from three different cohorts of students, not one cohort over three years as seen in Grimes and Warschauer (2008) study. The Colorado school district data set contained 1,000 fifth grade students. The demographics of both school districts contained low socio-economic students, Hispanic students, English language learners, gifted and special education students (Zheng et al., 2013).

> To summarize, in the California school district all students benefited from the laptop program. In the Colorado school district, the laptop program had no overall effect; however, in both districts, at-risk students (i.e., Hispanics, free-lunch receivers) benefited from the laptop program more than their non-at-risk peers. (Zheng et al., 2013, p. 284)

Researchers Kposowa and Valdez (2013) conducted a study of fourth and fifth grade students with laptops in Palm Springs, California during the 2007-08 school year. As one of the few studies involving low SES populations, it is worth noting that the school had 76% of the students participating in the free or reduced lunch program. Although the analysis was limited to only one school, the research showed that students with laptops scored higher on state standardized assessments in language arts, mathematics and science, and "laptop use showed a consistent and statistically strong effect on student scores" (Kposowa & Valdez, 2013, p. 374). Students with laptops saw a mean increase of 54 points in language arts scores and a mean increase of 83 points in mathematics compared to students without laptops (Kposowa & Valdez, 2013). This study occurred during the first year of the one-to-one program, at one school within a large school division and it is not known if the effects of the one-to-one program were sustained over time.

Summary

Computer use in education has been ongoing for the past 50 years, spanning from the first use of Teletype connections in 1964 to the more recent use of laptops, netbooks and Chromebooks over the last decade in one-to-one programs (Bebell & Kay, 2010; Johnstone,

2003; Warschauer, et al., 2014). As the United States continues to spend more per pupil on education, we still have great disparities between high and low performers. Fullan (2010) asserts that these achievement gaps result from the unequal distribution of wealth in our society. Some research results suggest that one-to-one programs may widen the achievement gap between low and high performing students (Warschauer et al., 2014). The body of research from the previous fifteen years has consistently called for more research and analysis on the benefits of computer use in education classrooms. Researchers Harper and Milman (2016) conducted a meta-analysis of the literature related to one-to-one programs and concluded that "studies of student achievement indicated that schools facing achievement gaps related to ability or SES could benefit from 1:1 program" (Harper & Milman, 2016, p. 139). Still there is no definitive answer to the question. Do one-to-one programs improve student achievement?

With more school districts considering the adoption of one-to-one programs, the academic benefit must be determined to the individual student and more specifically to the low socioeconomic student of color. Bennett (2002) argued that schools are investing significant resources in technology programs without conducting the proper data analysis related to the improvements from these investments. Topper and Lancaster (2013) found that only two of the five districts in their study had a formal evaluation plan for their one-to-one program, and that school districts will struggle to show positive outcomes, and an overall benefit from the program, if they have no means or plan to measure success. Mark Warschauer of the University of California, Irvine wrote regarding information literacy; "laptops will not make bad schools good, but they will make good schools better" (Warschauer, 2007, p. 2537). Warschauer concluded that district leaders must effectively analyze expenditures and program outcomes of all initiatives to improve student learning.

The decision for this Central Virginia Public School District (CVAPS) to launch a one-to-one program was based on the belief that increased access and use of technology would have positive impacts for both students and teachers. The following statement was pulled from the question and answer portion of the CVAPS one-to-one program webpage: “Our goal is to improve student learning. To accomplish this, we use technology to increase student engagement in the classroom and encourage collaboration among students. This aligns with district efforts to create compelling student curriculum, build relationships that support learning, use project-based learning and ensure that students learn 21st century skills.” This study of the one-to-one program in CVAPS may contribute to the growing body of knowledge of one-to-one programs to improve student achievement.

Chapter Three

Methodology

Educators today are faced with a never-ending struggle to improve the academic achievement of the students they serve. Gains in student achievement made during one school year must be eclipsed during the following year. Educators consistently look to data and research in hope of finding another program, instructional methodology or tool to improve academic success. The review of literature on student achievement in one-to-one laptop programs showed mixed results, and despite the increase in the quantity of one-to-one programs, the research has not reached a consensus that one-to-one programs bring improved educational outcomes (Harper & Milman, 2016; Zheng et al., 2016). As school districts consider dedicating significant resources to one-to-one laptop initiatives, there was limited scientifically-based research and empirical evidence to measure the effect of these programs on student achievement (Bebell & O'Dwyer, 2010; Dunleavy & Heinecke, 2007). This research examined the impact of a one-to-one Chromebook on student achievement. This study sought to determine if one-to-one Chromebook use influenced low SES student of color achievement in World History I between the year prior to program launch and the three years following its implementation. Determining whether student achievement was changing for the low SES student of color was the driving force behind the methodology chosen for this study.

Research Questions and Hypothesis

The premise of this research was to determine if the one-to-one Chromebook program at CVAPS had an effect on student achievement. There are two research questions and an accompanying null hypothesis for each. The framework for the primary research question is contained in Figure 1.

Research Question 1 (RQ1): Does learning within a one-to-one Chromebook environment positively affect ninth grade World History 1 (WH1) Standard of Learning (SOL) scores for low SES students of color?

H1*null*: There will be no statistically significant difference in the WH1 SOL test scores for low SES students of color when provided a Chromebook compared to those without a laptop.

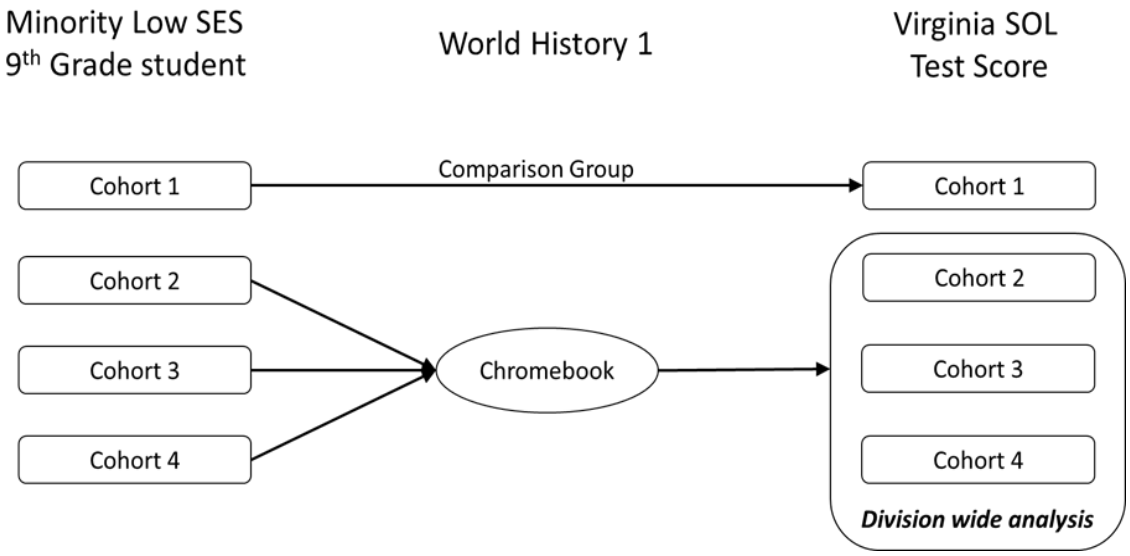


Figure 1. RQ1 Framework

Research Question 2: Is there a statistically significant difference between SOL scores on the WH1 test for low SES students of color between the two high schools in CVAPS involved in the one-to-one Chromebook program?

H2*null*: There will be no statistically significant difference in the WH1 SOL test scores for low SES students of color between the two high schools in CVAPS.

Research Design

The research was a quasi-experimental longitudinal study investigating the impact on student achievement in a one-to-one program involving Chromebooks. The research included four cohorts of students spanning the school years from August 2013 to June 2017. For the purposes of this research, a cohort was defined as all ninth-grade students enrolled in CVAPS during a traditional school year cycle. The research utilized a purposeful convenience sample containing all low SES ninth grade students of color taking World History I during the defined time. For this research, a convenience sample was warranted due to pre-existing data in the CVAPS student information system which was readily available to the researcher. The first cohort was the comparison group as they did not have the benefit of the Chromebook during the 2013-14 school year. The next three cohorts comprised the treatment group and did have the benefit of using the Chromebook throughout each school year. The World History I SOL test score was the dependent variable while the use of the Chromebook was the independent variable. With the research focus being the effect of the Chromebook on the low SES students of color, the parameters of low SES and students of color were viewed as mediating variables and helped explain the relationship between the dependent variable and the independent variable. CVAPS has two high schools and both participated in the one-to-one program. The research also investigated the difference, if any, in World History I SOL test scores between the two high schools for the low SES student of color. As the CVAPS one-to-one program was a district wide initiative, it was important to know if both high schools were seeing similar effects on student achievement due to the use of Chromebooks.

Research Setting

The setting for this research study was a city located in the state of Virginia with a population of approximately 80,000 residents and a demographic breakdown of 65% white and 35% people of color. Only 3.3% of the people of color population was classified as Asian in the city. The city has a single public-school district serving the entire municipality and referred to as Central Virginia Public Schools (CVAPS) throughout the research. To better understand the school district setting, Table 2 contains the total pre-kindergarten (Pre-K) to twelfth grade enrollment for CVAPS and other pertinent demographic data as recorded with the Virginia Department of Education. The school division is best described as a majority minority student population with high rates of urban poverty that are double the state average of 11.2%. The poverty rate in the city was 24.7% while the surrounding area was 11.9% (Weldon Cooper Center for Public Service, 2015). The column in Table 2 labeled Low SES is a sub category of the total and not linked in any way to the categories of white or students of color.

Table 2

CVAPS Enrollment

Cohort	Total	White	Students of Color	Low SES
2013-14	8,583	3,164	5,419	5,603
2014-15	8,577	3,104	5,473	4,928
2015-16	8,566	3,012	5,554	4,983
2016-17	8,477	2,868	5,609	4,577

Source: Virginia Dept. of Education, 2017

The primary study group for the research consists of the low SES ninth grade students of color enrolled in World History I between 2013 to 2017. The school district has two high

schools and the demographics for each of the ninth-grade cohorts by high school and district aggregate, as recorded by the Virginia Department of Education, are contained in Table 3.

Table 3

CVAPS Ninth Grade Students

Year	School Name	Total	Students of Color	Students of Color %	Low SES	Low SES %
2013-14	HS1	243	160	65.8%	162	66.7%
2013-14	HS2	358	209	58.4%	213	59.5%
2013-14	Total 9th Grade	601	369	61.4%	375	62.4%
2014-15	HS1	290	197	67.9%	166	57.2%
2014-15	HS2	357	190	53.2%	155	43.4%
2014-15	Total 9th Grade	647	387	59.8%	321	49.6%
2015-16	HS1	264	188	71.2%	171	64.8%
2015-16	HS2	350	197	56.3%	182	52.0%
2015-16	Total 9th grade	614	385	62.7%	353	57.5%
2016-17	HS1	274	202	73.7%	174	63.5%
2016-17	HS2	367	223	60.8%	182	49.6%
2016-17	Total 9th grade	641	425	66.3%	356	55.5%

Source: Virginia Dept. of Education, 2017

Participants and Data Collection

The participants in the study were selected through purposeful convenience sampling that includes all low SES ninth grade students of color enrolled in World History I at CVAPS prior to and following the launch of the one-to-one program. The one-to-one program in CVAPS began at the start of the 2014-15 school year with a rollout of Chromebooks to ninth grade students

only. All subsequent years of the one-to-one program, 2015-16 and 2016-17, included Chromebooks being provided to all high school students throughout CVAPS. It is important to note that during the time frame of this study, the Chromebooks were only used at the high school level within the school district, thus the ninth-grade year was the first year of use for one-to-one devices during the students K-12 educational experience.

Archival data containing standardized test scores existed for all years of the study, thus the Virginia Standard of Learning test scores for World History I were collected for all low SES ninth-grade students of color from the 2013-14 school year through the 2016-17 school year. Due to the use of archival data maintained by the school district, the identity of all students included in this research remained anonymous. All data was compiled from the school district's student information system and decoupled from the student's identity prior to the researcher's access to the data. The state testing identifier was used as the key field. The data was provided to the researcher by the school district's Director of Testing via an Excel spreadsheet file. The school name, test scores and test year were collected for all students that took the World History I SOL test in each year along with the following demographic data: Gender, Grade, Ethnicity, Race, and Economic Disadvantage. Prior to any data analysis the raw data was reviewed in spreadsheet form. As the data contained all students enrolled at CVAPS with a record of taking the World History I SOL test in each year, there was a need to remove some students from the data set. First, all students taking World History I in grades 10, 11 or 12 were removed from the data set. Second, as the data set also included students with a disability code, they were also removed. This field was purposely provided by CVAPS to identify all students in the population with a disability. The researcher determined early in the methodology formulation that students with disabilities should be removed from the sample due to the varying categories of 'disability'

assigned by the State Department of Education. The disability coded students were removed to avoid unintended effects on the results. The final sample contained only low SES students of color without disability codes in the ninth grade. The beginning cohort size and final size for each ninth-grade cohort enrolled in World History I along with the number of disability code students removed from the overall sample are provided in the Table 4.

Table 4

Ninth Grade Sample

Cohort	Ninth Grade Population	# of Disability Coded removed	Final Sample; Low-SES Students of color with disability students removed
2013-14	604	55	277
2014-15	666	72	278
2015-16	573	79	234
2016-17	648	88	278

Subject Area Selection.

With only ninth grade students involved in the first year of the one-to-one program the researcher restricted the potential subject matter for analysis to those courses which ninth grade students can enroll. There are several potential subject areas for analysis relative to ninth grade students in a one-to-one Chromebook environment; World Literature, Algebra I, Biology, Earth Science and World History I. After careful consideration of the courses available, World History I was selected as the subject area. The World History I course at CVAPS was the first social studies course offered to high school students. To graduate from high school, all students are required to have a minimum of three social studies credits. Two of those social studies credits are required by state code; (1) U.S. and Virginia History and (2) U.S. and Virginia Government

(CVAPS High School, program of studies, 2016). Of all courses, available to ninth grade students, the World History I course had the second highest enrollment in CVAPS behind World Literature.

Another consideration for selecting World History I was the curriculum and standardized test were established by the Virginia Department of Education in 2008. Due to the stability of the curriculum, and subsequent use of the test blueprint over the study timeframe, the researcher concluded that the World History I SOL test would be an acceptable area of analysis given the other choices of World Literature, Algebra I, Earth Science or Biology. The World History I course was designed to

> enable students to explore the historical development of people, places, and patterns of life from ancient times until 1500 A.D. (C.E.) in terms of the impact on Western civilization. The study of history rests on knowledge of dates, names, places, events, and ideas. Historical understanding, however, requires students to engage in historical thinking, raise questions, and marshal evidence in support of their answers (Virginia Department of Education, 2016).

The World History I curriculum framework with accompanying Standards of Learning and revised test blueprint were developed in 2008 and published in 2009. The 2010-11 school year was the first year the new standards were tested and in effect. The Standards of Learning World History 1 test was comprised of 70 questions. Sixty of the questions counted towards the score while 10 of the questions were field test questions and did not count. The test questions were broken down into six reporting categories:

1. Human Origins and Early Civilizations (11 questions)
2. Classical Civilizations (10 questions)
3. Postclassical Civilizations (9 questions)
4. Regional Interactions (13 questions)
5. Geography (10 questions)

6. Civics and Economics (7 questions)

(Virginia Department of Education, 2009)

The Standards of Learning tests in the state of Virginia are scored on a 0 to 600 scale. A score of 400 is the minimal level required to pass a test, and a score of 500 or above represents advanced proficiency (Virginia Department of Education, 2016).

Data Analysis

Statistical Package for the Social Science (SPSS) version 25 was used for all data analysis. The primary research question investigated the effect on student achievement for all low SES students of color in a one-to-one program across the school district. The secondary research question investigated the difference in achievement among sample students between the two high schools in the city. The introduction of the Chromebook served as the treatment to determine if the device influenced SOL test scores. The World History I SOL score was the dependent variable. The introduction of the Chromebook, or no use of the Chromebook as was the case with the comparison group, served as the independent variable.

The primary statistical analysis beyond descriptive statistics, was a bivariate correlation. The procedural steps included the collection and sorting of the data, followed by data analysis and interpretation of the results. During the analysis portion of the research the data was reviewed via descriptive statistics and inferential statistical methods.

For the purposes of this research, all minorities are grouped together as an aggregate group which will be further described in Chapter 4. During the analysis, the independent variable laptop was dummy coded 1 for having the Chromebook and 0 for no Chromebook in SPSS.

Summary

In recent years, one-to-one programs have become more attractive to education decision makers but come with considerable costs and inadequate evidence related to improvements in teaching and learning as well as positive student outcomes. The goal of this research was to provide decision makers and educators with additional information to guide choices around instruction, curriculum and the resources necessary to affect student achievement with a one-to-one program. The study may add to the knowledge base related to one-to-one programs and determine the effect of one-to-one programs on student achievement within the low SES students of color demographic; it may provide district administrators and school board members another tool to consider relative to improving the achievement of the traditionally underperforming sub-populations in public education.

Chapter Four

Results

The results of this quasi-experimental longitudinal study investigating the effect on student achievement in a one-to-one program involving Chromebooks are presented in chapter four. The findings related to the research questions and hypothesis, which were described in chapter three, will be discussed. This study seeks to determine if, between the year prior to the one-to-one Chromebook program and the three years following its implementation, the achievement of low socioeconomic ninth grade students of color has improved. All World History I SOL test scores were contained in archival databases and routinely collected school information. Permission from the appropriate school research personnel and superintendent was obtained before data was provided and analyzed. A copy of the letter can be found in the Appendix A.

Data Collection and Preparation

Archival data containing World History I standardized test scores, and specific demographic data for all years of the study, 2014 through 2017, was provided. The data set was uploaded into an Excel file with worksheets for each cohort and reviewed by the researcher. To prepare the raw data set for analysis in SPSS the following actions were taken:

- All 10^{th}, 11^{th}, and 12^{th} grade students were removed
- All special education students were removed
- All white students were removed
- All students without the free or reduced meals identifier were removed

The resulting data set contained 1072 students that matched the research criteria of low socioeconomic ninth grade students of color from 2014 – 2017. The data set was loaded into

SPSS and a frequency analysis was run for the 1072 SOL test scores. The frequency analysis revealed four SOL test scores of 991 and one test score of zero. The range of possible SOL test scores is from 0 to 600. The scores of 991 all fall outside of the acceptable possibilities. After reviewing the raw data provided by the school district and confirming the scores of 991 existed from the outset, the researcher determined the best course of action was to delete the four scores considered outliers. While conducting the preliminary analysis of the data via descriptive statistics, the researcher decided to delete the single score of zero to avoid skewing the data.

The race code frequency analysis in SPSS revealed several records in the data set that were combinations of two, three, four or more races. There were 33 race codes possible in the data set. The research is focused on low SES student of color and each cohort of students contained several race codes from combinations of races. The researcher used SPSS to group all combination of races codes with low representation in the data set, into a new race category of multiracial. This resulted in the following races being reflected in the student of color data set for further analysis: Hispanic, American Indian, Asian, Black, multiracial and multiracial excluding black and white.

To aid data analysis the final data set of 1067 records was further divided into files that contained student records by year and by school. After the initial correlation analysis was run, data sets were created for cross cohort comparisons for 2014 to 2015, 2014 to 2016, 2014 to 2017 and by school.

Demographic Characteristics

The demographic characteristics of the CVAPS data set are contained in the following descriptions and tables. As previously stated, the final data set of low SES students of color contained 1067 total records. The 2014 cohort is the control group with 277 records, as they did

not have the Chromebook, while the treatment group is comprised of 790 students with access to the Chromebook from the 2015, 2016 and 2017 cohorts. The gender composition of the entire data set is 500 males and 567 female students. There are 496 students from High School 1 (HS1) and 571 students from High School 2 (HS2). Table 5 contains the gender and school characteristics by cohort.

Table 5

Sample Size and Characteristics.

	2014	2015	2016	2017	Total
Sample (N)	277	278	234	278	1067
Male	133	130	106	131	500
Female	144	148	128	147	567
HS1	115	140	103	138	496
HS2	162	138	131	140	571

The racial composition of the sample by cohort is provided in Table 6. The determination of race is a self-reported requirement in CVAPS.

Table 6

Racial Composition

Race	2014	2015	2016	2017	Total

American Indian	1	2	2	2	7
Asian	8	7	4	7	26
Black	239	230	206	229	904
Multiracial	12	22	9	19	62
Hispanic	6	11	9	16	42
Multiracial (excluding Black and White)	11	6	4	5	26

Data Analysis

All World History I SOL test scores were contained in archival databases and routinely collected school information. Permission from the appropriate school research personnel was obtained before the data were collected and analyzed.

The initial descriptive statistics run in SPSS on the SOL test scores by cohort are contained in Table 7. The mean test scores for all cohorts were reviewed first and due

Table 7

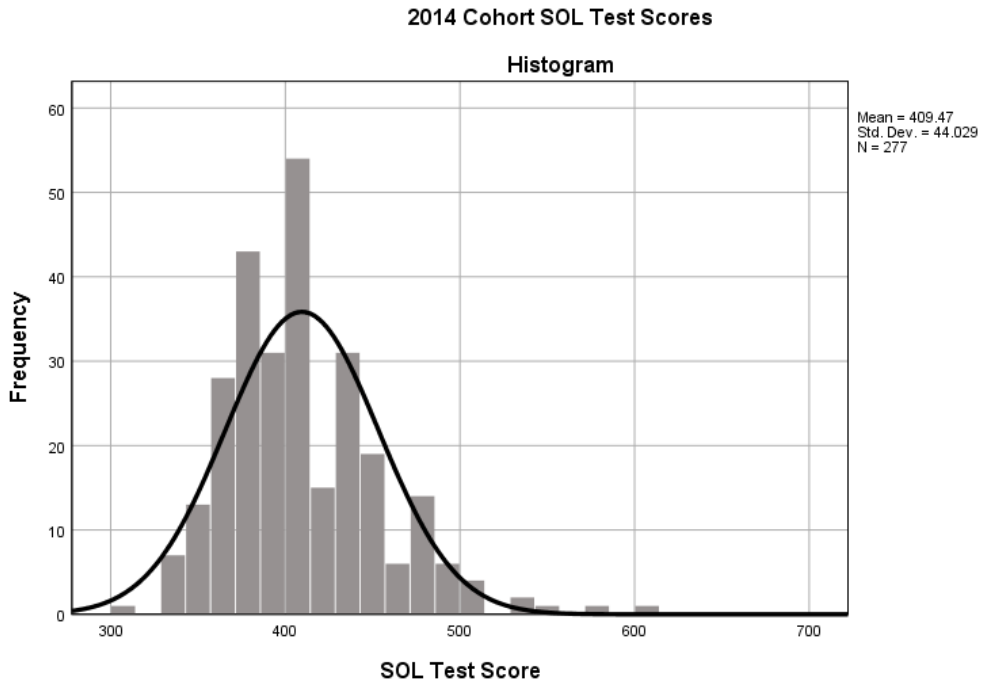
Test Score Descriptive Statistics

	2014	2015	2016	2017
Mean	409.47	414.65	407.27	411.73
Median	400	403	401	403
Standard deviation	44.03	49.28	49.99	48.28
Kurtosis	1.63	0.61	0.32	0.33
Skewness	0.98	0.85	0.69	0.75

to the relatively similar mean test scores the researcher looked at other measures of central tendency, as well as kurtosis and skewness to provide a richer understanding of the data. Although the test scores can range from 0 to 600, all scores in the sample data fall within a range from 300 to 600. With a range between 300 and 600, and means between 407 and 415, the kurtosis values point to long (heavy) tails in the data for scores above the mean and up to 600. Additionally, the test scores in the tails of the distribution and the positive skewness delineates the long right tails in the distribution. The standard deviations for the treatment group cohorts are 49.28, 49.99 and 48.28, while the control group standard deviation is 44.03. With the mean test scores all between 407 and 415, and the maximum score being 600, the distribution of scores is positively skewed but not significantly. The 2014 cohort SOL test scores histogram is contained in Figure 2.

Figure 2.

2014 SOL Test Scores



Although the scores are positively skewed it is important to note that the scores approximate a normal distribution when displayed in a histogram. The histograms for treatment cohort's SOL test scores are provided in Appendix B. Independent sample t-tests were run in SPSS to compare the mean SOL test scores of all cohorts contained in the sample, as well as a year to year comparison 2014 to 2015, 2014 to 2015 and 2014 to 2017. None of the independent sample t-test results were statistically significant.

Finally, before beginning further analysis via bivariate correlation, the assumptions for Pearson's correlation were reviewed. The only assumption that was not supported was the linear relationship between the two variables. As students either had, or did not have, a Chromebook, the test scores stack over the values representing each case related to the Chromebook and did not display linearly in a scatterplot. As stated in Chapter 3, the treatment cohorts with the

Chromebook were all coded as a 1 in SPSS while the comparison cohort without the Chromebook was coded as a 0 in SPSS.

Research Question 1.

For the benefit of the reader the research questions and accompanying null hypothesis are restated. Research Question 1 (RQ1): Does learning within a one-to-one Chromebook environment positively affect ninth grade World History 1 (WH1) Standard of Learning (SOL) scores for low SES students of color? H1*null*: There will be no statistically significant difference in the WH1 SOL test scores for low SES students of color when provided a Chromebook compared to those without a laptop.

The method of analysis utilized in SPSS was a bivariate correlation. A bivariate correlation focuses on explaining how one of the variable's characteristics is influenced by the other variable. This research specifically examined how student SOL test scores were affected by using the Chromebook. The traditional choices for confidence interval are 90%, 95% and 99%, with 95% being the most common. For the purposes of this research the confidence interval is 95% as it is considered the professional standard for social science research.

The first analysis performed related to RQ1 contained the 2014 cohort, that did not have a Chromebook, and all students with the Chromebook from the 2015, 2016 and 2017 cohorts. The overall bivariate correlation was not significant ($r (1067) = .018$, $p = .557$) yielding no effect size, thus we fail to reject the null hypothesis H1. There is no statistically significant difference in the WH1 SOL test scores for low SES students of color when provided a Chromebook.

As the initial bivariate correlation for RQ1 showed no justification for rejecting the null hypothesis the researcher conducted additional correlations comparing each treatment cohort to the control cohort by year; 2014 to 2015, 2014 to 2016 and 2014 to 2017.

- For the 2014 to 2015 analysis, the correlation was not significant (r (555) = .055, p = .192) yielding no effect size, thus we fail to reject the null hypothesis H1.
- For the 2014 to 2016 analysis, the correlation was not significant (r (511) = - .023, p = .597) yielding no effect size, thus we fail to reject the null hypothesis H1.
- For the 2014 to 2017 analysis, the correlation was not significant (r (555) = .024, p = .566) yielding no effect size, thus we fail to reject the null hypothesis H1.

Table 8 contains the values of all correlations and allows the reader to see there is no difference in the WH1 SOL test scores for low SES students of color when provided a Chromebook in a cohort to cohort analysis.

Table 8.

Consolidated Correlation Values

	RQ1 Correlation	2014 to 2015	2014 to 2016	2014 to 2017
N	1067	555	511	556
Pearson Correlation	.018	.055	-.023	.024
Sig (2-tailed)	.557	.192	.597	.566

Research Question 2.

CVAPS has two high schools and both schools were involved in the Chromebook program. The second research question was focused on any difference in test scores between those two high schools. RQ2 inquired if there was a statistically significant difference between SOL scores on the WH1 test for low SES students of color between the two high schools in CVAPS involved in the one-to-one Chromebook program, and thus the accompanying null is that there will be no statistically significant difference in the WH1 SOL test scores for low SES students of color between the two high schools.

The mean scores for each high school by cohort, and across the entire timeframe of the study are listed in Table 9. The mean test score at High School 1 is higher than the High School 2 in three of the four years, while the largest overall change in mean test score occurs at High School 2 beginning at 402.41 in 2014 increasing to 417.99 in 2017.

Table 9.

High School Means

	High School 1		High School 2	
Year	*N*	*Mean*	*N*	*Mean*
2014	115	419.43	162	402.41
2015	140	421.06	138	408.15
2016	103	409.73	131	405.34
2017	138	405.38	140	417.99
2015-17	381	412.32	409	410.62
All	496	413.97	571	408.29

A bivariate correlation analysis was run with the high schools as the independent variable and test scores as the dependent variable. The findings were not significant ($r(1067) = -.059$, $p = .053$) yielding no effect size, thus we fail to reject the null hypothesis H2.

Due to the varying means between the two high schools for each cohort and at the aggregate, the researcher believed that it was worthwhile to investigate the effect of the Chromebook within a single high school. This combination of both RQ1 and RQ2 was tested by running a bivariate correlation within each high school data set to determine any effect from the Chromebook on test scores. The bivariate correlation for High School 1 looking for effects from the Chromebook on test scores was not significant ($r(496) = -.056$, $p = .211$) yielding no effect

size. Thus, there is no statistical significant difference in test scores within High School 1 due to the Chromebook. A similar bivariate correlation was run for High School 2 and the correlation was significant ($r(571) = .087$, $p = .037$) yielding a small effect size of 8.7%. Thus, there is a statistical significant difference in test scores within High School 2 due to the Chromebook.

Summary

Bivariate correlation was the primary statistical test used to determine if there was a significant effect on the World History 1 SOL test score for ninth grade low socioeconomic students of color that were provided a Chromebook. There was no statistical significance identified for either of the primary research questions. It is important to note that the results of the correlation for RQ2 approached significance with a p value of .053 but with a moderate negative effect size of -.059.

The results contained within chapter four are best characterized as inconclusive or mixed results. In the literature review there was a lengthy discussion of one-to-one research where the research outcomes showed mixed results. The results of this research fall into the same category of mixed results similar to Dunleavy & Heinecke (2007), especially as it relates to the small effect size due to the laptop and small gains to mean test scores. It is worth noting that the mean test scores both at the division level and within each school did not decrease in the first year of Chromebook use as seen in the Grimes & Warschauer (2008) research of three schools in California.

This research examined the effect of the students' use of Chromebooks on World History 1 SOL test scores. During data analysis, the original research questions were expanded in two areas. The first research question was expanded to include an analysis of every treatment cohort to the control cohort at the district level. The resulting three additional correlations did not

produce any significant results. The second area of research expansion was a blend of both research questions and involved a bivariate correlation within each of the two high schools in CVAPS, based along the same premise of RQ1. The correlation looking for effects from the Chromebook on test scores for High School 1 was not statistically significant while the correlation for High School 2 was significant at the $p = .037$ level.

Chapter Five

Discussions and Conclusions

Educators consistently have looked to data and research in hope of finding another program, instructional methodology, or tool to improve academic success. This has become part of the never-ending struggle to improve the academic achievement of the students we serve each year. This study sought to determine if, between the year prior to the one-to-one Chromebook program and the three years following its implementation, the achievement of low socioeconomic students of color had improved.

Given the current state of public education with achievement gaps, underperforming students of color, and economically disadvantaged students, there is merit in a study of this type not only for educators but for policy makers, school boards, and the public. Programs that provide technology to every student require resources in the form of funding and personnel in the form of information technology expertise to manage and maintain the computers or Chromebooks. All programs are competing for these scarce resources and one-to-one programs require a significant investment.

Some of the previous research related to the impact of one-to-one programs on the achievement of students has shown mixed results. Both Grimes and Warschauer (2008) and Bebell and Kay (2010) claim some positive effects and some statistically significant results with small effect sizes. The literature review covered research by Gulek and Demirtas (2005) and Crook, Sharma and Wilson (2015) that made claims of a substantial impact on learning in English language arts as well as the sciences. Given the claims of positive effects and impacts to learning this research was optimistic similar effects would be seen in CVAPS.

For the benefit of the reader, the research question and null hypothesis will be restated at the beginning of each section for the ease of following the discussion.

Interpretations RQ1

RQ1: Does learning within a one-to-one Chromebook environment positively affect ninth grade WH 1 SOL scores for low SES students of color? H1*null*: There will be no statistically significant difference in the WH1 SOL test scores for low SES students of color when provided a Chromebook compared to those without a laptop.

The first research question followed a more traditional formulation of action research by looking at a control group containing 277 students and treatment group contain 790 students. The treatment group contained three cohorts of students spanning the years from 2015 to 2017, while the control group was the year prior to the Chromebook's introduction in 2014. The details related to the demographic characteristics of the sample are contained in Tables 5 and 6. The mean SOL test score for the control group was 409.47, while the mean test scores for the treatment cohorts were 414.65, 407.27 and 411.73 for each respective year. The range of the all four means relative to RQ1 was contained within 7.38 points, and it was immediately discernible via independent sample t-tests that there was little effect on SOL test scores due to the use of the Chromebook at the district level. With little variation in the mean test scores, it was safe to postulate that there would be no statistical significance when the bivariate correlation for RQ1 was run in SPSS. The bivariate correlation results confirmed there was no statistically significant difference in the SOL test scores when low SES students of color were provided a Chromebook at the division level. The research was further expanded to analyze a single treatment cohort with each control cohort. Thus, a series of year-to-year bivariate correlations were run in SPSS. This cohort to cohort analysis yielded no statistically significantly results and

we failed to reject the null hypothesis H1 for every case. The lowest p value encountered in all correlations related to RQ1 was .192 in the 2014 to 2015 analysis which also yielded the highest Pearson's Correlation value .055 for the same analysis. Table 8 contains all bivariate correlation results for RQ1 and supports the conclusion that the use of the Chromebook had no effect on the sample population's World History I SOL test scores at the district level.

Interpretations RQ2

RQ2: Is there a statistically significant difference between SOL scores on the WH1 test for low SES students of color between the two high schools in CVAPS involved in the one-to-one Chromebook program? H2*null*: There will be no statistically significant difference in the WH1 SOL test scores for low SES students of color between the two high schools in CVAPS.

The second research question investigated any difference between the two high schools and the mean test scores by cohort within each high school. The mean test scores, seen in Table 9, contained several unexpected values relative to the mean scores seen at the district level in Table 7. In the year prior to the Chromebook program, the 2014 control cohort at High School 1 outscored their counterparts at High School 2 by 17.02 points. Additionally, within High School 1, the first treatment cohort in 2015 saw a mean test score increase of 1.63 points over the control group while the High School 2 students saw a mean test score increase of 5.74 points. The mean for the all treatment cohorts, 2015-17, at High School 1 was 1.7 points higher than High School 2, with High School 1 having its best year in 2015 with a mean test score of 421.06, while High School 2 had its best year in 2017 with a mean test score of 417.99. The High School 1 mean test scores during the three years of the treatment, were declining from a high of 421.06 to a low of 405.38 while at High School 2 the mean scores were increasing from a low of 405.34 to a high of 417.99. The bivariate correlation for RQ2 did approach significance with a p value of .053

and Pearson's Correlation of -.059. At this point in the analysis, the p value of .053 was the best result for significance while the Pearson's Correlation value indicated a moderate negative relationship for the variables of high school and test scores. The Pearson's Correlation value of -.059 supported the data seen in Table 9 relative to mean test score changes at each high school and confirmed the test scores were declining for High School 1 at a greater rate relative to the increase at High School 2.

Other Results

Due to the varying test score means between the two high schools for each cohort, the combined treatment cohorts and at the aggregate across all four years, the effect of the Chromebook within a single high school was investigated. A bivariate correlation was run for each high school. The results within High School 1 were not significant with a p value of .211 and a Pearson's Correlation of - .056. The bivariate correlation for this additional area of investigation did reveal a statistically significant result for High School 2, with a p value of .037 and yielded a small effect size of 8.7%.

It is important to note that if this research had been focused solely on HS2, it could be concluded that the one-to-one program had a statistically significant small effect on test scores and saw mean test scores rise from 402.41 in the control cohort to a high of 417.99 in the third year of the one-to-one program.

Much of the research covered in the literature review highlighted the positive effects resulting from one-to-one programs. The lack of rigor in some of the reviewed research contributed to the research methodology for this study by including two schools within the same district across multiple years of a one-to-one program. Several less rigorous studies encountered during the literature review directly influenced the methodology. Both Gulek & Demirtas (2005)

and Kposowa & Valdez (2013) showed positive effects of one-to-one programs from a limited perspective by sampling at only one high preforming school for three years or by studying only the first year of the one-to-one program at a single school.

Limitations

To establish validity for any research the setting, timeframe and sample must be considered. This study analyzed assessment data in one ninth grade subject area collected over a period of four years. Over that length of time many variables and environmental changes may have also affected SOL test scores. New teachers, new administrators, or social studies department heads joined the two schools and other school initiatives were implemented at Central Virginia Public School District (CVAPS) during the timeframe of this study. It is impossible in an educational environment to hold all things constant while a single new program is initiated. Public education constantly sees changes in school personnel and fluctuation within classroom enrollment. While this study has contributed information regarding the one-to-one program involving Chromebooks in World History, this research did not examine or investigate the nature and evaluation of teacher effectiveness, curriculum changes, or other content areas. The scope of this research also did not review or analyze any of the professional development provided for staff prior to the fielding of Chromebooks or during the research timeline. Given the state of constant change within public education, this research attempted to isolate the Chromebook's effect by focusing on a World History I curriculum and test blueprint that had been stable since 2008.

A known threat to these results is a nuance contained within the extraction of the data from the student information system. The nature of the convenience sample data set does not allow the researcher to determine how many instances of repeat ninth grade students there may

be in any cohort. All personally identifiable information that would aid in determining repeat ninth grade students was withheld from the researcher. Any students that repeated the World History I course while they were still characterized as ninth grade students was assumed to be small in number. In CVAPS, a student must have a passing grade in five high school courses to be promoted to the tenth grade. This passing grade is not incumbent on passing the SOL test, so a student could have a high school credit for making a letter grade of C while not passing the SOL test. Most students are eligible to receive high school credit as early as the eighth grade, so it is assumed that the number of repeat ninth graders, having less than five credits and retaking World History I, would be small.

This research was quasi-experimental and quantitative in nature. There was no survey undertaken, so it is impossible for the researcher to know the students or the teachers familiarity and skill with using a Chromebook. It is important to note that High School 1 remained accredited in Social Studies for the 2017 school year even with their declining mean test scores over the four-year period. Another point to acknowledge relative to High School 1 is that they moved in to a new building in August 2016, so the 2016-17 cohort had the benefit of a new building and enhanced access to technology compared to the old building. Although not a component of this research, it is also worth noting a steep learning curve the first nine weeks of the 2016-17 school year for some teachers relative to the classroom support technology in the new building. The impact of the learning curve relative to the classroom support technology is unknown.

Implications for Practice, Policy and Research

These findings were meaningful because public schools are required to educate all students, despite the socioeconomic barriers that may impact student achievement and the

students' lack of access to technology. One-to-one programs are crucial in many locations because they provide equal and consistent access to computing devices for all students. These findings were important for CVAPS as it provided data analysis at the third year of implementation. There was benefit in knowing the impact this initiative has had upon the World History I SOL test scores, especially at High School 2. The school district may want to consider an in-depth review into the teaching strategies utilized at High School 2 in comparison to the strategies at High School 1. Further, it may be worth investigating why the teachers at High School 2 seem to be more effective with the Chromebook in teaching the World History 1 curriculum. The results of this study provide some evidence on how the school district has implemented the digital conversion and whether it has impacted the achievement gap for the low SES student of color. Alternatively, since the research shows that the achievement gaps have not been significantly impacted, new strategies for positively impacting the achievement gaps can and should be considered.

The conclusion of this research may assist the school district in evaluating the Chromebook program and determining what adjustments to consider for the future. A secondary goal of this research was to provide a framework for those considering one-to-one programs. The items contained in the framework are derived from this research study, the literature review and the researcher's experience as a school district administrator. For ease of understanding the framework annotations of (R) for research, (L) for literature and (E) for experience will be listed to show the origination of the item. The framework considerations are:

- *Determining the goals and objectives for a one-to-one program early in the planning phase. (E)* Goals and measurable objectives are the cornerstone of good teaching, and

they are also crucial steps in project management. They help establish a road map for the effort and help determine success.

- *Acknowledging that funding and network capacity will always be an issue. (E), (L)* Funding in education is a scarce resource and one-to-one programs require a budgetary commitment. The one-to-one program will increase the burden on the network with additional devices and in most instances require additional network infrastructure and increased bandwidth.
- *Staffing the technology department appropriately to support the program. (E)* The increased number of devices and traffic on the network will require additional technicians to maintain an acceptable service response time. Additionally, a school district may benefit from instructional technology specialist to assist teachers with new strategies and adapting the curriculum to a one-to-one environment.
- *Having a robust professional development and training curriculum for staff. (L), (E)* Professional development must be provided prior to initiating the one-to-one program so teachers can incorporate technology into the curriculum.
- *Developing a testing and evaluation plan for the program at key milestones based on goals and objectives. (L), (R)* Sound project management relies on evaluation at key milestones to confirm intermediate goals and objectives are being met. In many instances, key decision points must be attained before proceeding to the next project phase.
- *Revising the test and evaluation plan after key milestones. (E)* Lessons learned within an evaluation may necessitate updates to goals, objectives or program implementation. The future test and evaluation plan will need to be updated and flexible.

- *Understanding that not all students have access to the Internet at home. (R), (L), (E)* When all students do not have access to the Internet, the school district may need to limit assignments reliant on the Internet and consider allowing students to access the school network outside of normal school hours.
- *Acknowledging that some high school courses may not benefit from one-to-one technology. (L)* Existing curriculum and teaching strategies may limit the effectiveness of one-to-one devices. Math is a good example of a content area that has been studied by several researchers and continues to show limited or no effect on student achievement due to one-to-one devices.
- *Accepting the premise that a computing device may distract a student from school work and time on task. (E), (L)* Classroom management takes on a different dynamic when a student has access to the Internet. For low SES students that traditionally have not had access to computers outside of school, there is higher distraction factor and may affect time on task.
- *Planning for rigorous evaluation of your program; consider a third party to limit bias. (L), (R)* A third party researcher will provide a more objective review of the data and be better positioned to ensure research bias is limited and not brought into consideration.
- *Developing an exit strategy if the program does not produce the intended results and does not meet expectations. (E)* Continuing any program when it is not having the intended impact will strain resources and affect operation of the organization. If the desired change is not being realized, move on to the next program or strategy.
- *Celebrating the successes. (E)* The existence of goals, objectives, milestones and evaluation present many opportunities to acknowledge and celebrate successes. Although

they may be small in nature, it is beneficial for the organization to reward gains and recognize forward progress.

Future Research

The body of research from the previous fifteen years has consistently called for more research and analysis on the benefits of computer use in education classrooms. The results from this study continues to support the need for additional research relative to computers in the classroom and more specifically to one-to-one programs' impact on student achievement relative to the historical achievement gaps for low SES students and students of color. There are dissenting conclusions concerning the impact of one-to-one programs ability to impact achievement gaps and low SES students. Researchers Harper and Milman (2016) concluded that schools with achievement gaps due to SES and ability may benefit from ono-to-one programs while Warschauer et al. (2014) suggested one-to-one programs may widen the achievement gap between low and high performing students. The results from this analysis fall in the middle of the Harper and Milman (2016) and Warschauer et al. (2014) viewpoints and justly support the need for additional research relative to the effect on student achievement from one-to-one programs for the low SES student of color. As this study focused on a high school World History I course, it highlighted the lack of existing literature and research related to content area of social studies. The field of research could benefit from additional study of student achievement within social studies courses. There are several areas for additional research that may enhance the understanding of one-to-one program effectiveness within this school district:

- Teacher effectiveness within World History 1 and between the two high schools.
- Teaching strategies within World History 1 differences between schools.
- Replication of this study for other content areas of math, science or literature.

Conclusions

The literature review led the researcher to contemplate the conclusion that most one-to-one programs produced positive effects (Bebell & Kay, 2010; Crook, Sharma & Wilson, 2015; Gulek & Demirtas, 2005; Kposowa & Valdez, 2013; Shapely et. al., 2011) and that the students in CVAPS would be able to maintain consistent test scores and possibly show SOL test score improvement in a one-to-one program. With only one statistically significant finding, the results of this research did not support a positive effect resulting from the Chromebook at the district level but did show small improvement in test scores at High School 2. It is worth noting there were some negative effects within High School 1. Whether there was a negative or positive effect, all effect sizes were small, and it must be acknowledged that the mean SOL test scores varied little after the Chromebook initiative began. This research does not indicate there was a positive effect for low SES students of color across the school district. The achievement gap, based on no appreciable increase in World History I SOL test scores, has not narrowed for these students in CVAPS. A commendable accomplishment and positive outcome for the program in CVAPS was that by providing a device for every student, the district has ensured Chromebook access to every student especially when considering the alternative that many low SES students would not have access to computing devices outside of school.

The preponderance of the existing literature and research on one-to-one programs has been focused on the core content areas of English, math and science. This study is unique in that it used the high school social studies course of World History 1 as the content area for analysis. The curriculum stability and large ninth grade population presented an acceptable combination of parameters for action research relative to student achievement during the implementation of a one-to-one program involving Chromebooks. It was the researcher's hope that this study may

inform administrators and school boards by providing a review of previous research connected to one-to-one programs, while continuing to explore the relationship between technology implementation in schools and the effect on low SES student of color achievement.

References

About MLTI. (2009). Retrieved from http://maine.gov/mlti/about/index.shtml.

American Psychological Association (2017). *Education and Socioeconomic Status*. Retrieved from http://www.apa.org/pi/ses/resources/publications/factsheet-education.pdf

Apple Press Info. (2001, May 1). *Apple to supply 23,000 iBook's to Henrico County Public Schools.* Retrieved from https://www.apple.com/pr/library/2001/05/01Apple-to-Supply-23-000-iBooks-to-Henrico-County-Public-Schools.html.

Bayraktar, S. (2001). A Meta-analysis of the effectiveness of computer-assisted instruction in science education. *Journal of Research on Technology in Education, 34*(2), 173-188.

Bartz, D. E. (2016). Revisiting James Coleman's epic study entitled equality of educational opportunity. *National Forum of Educational Administration and Supervision Journal, 34*(4), 1-10.

Bebell, D., & Kay, R. (2010). One to one computing: A summary of the quantitative results from the Berkshire wireless learning initiative. *Journal of Technology, Learning, and Assessment, 9*(2), 5-58.

Bebell, D., & O'Dwyer, L. M. (2010). Educational outcomes and research from one-to-one computing settings. *Journal of Technology, Learning, and Assessment, 9*(1), 4-15.

Beckman, K., Bennett, S., & Lockyer, L. (2014). Understanding students' use and value of technology for learning. *Learning, Media and Technology, 39*, 346-367.

Bennett, F. (2002). The future of computer technology in K-12 education. *Phi Delta Kappan, 83*(8), 621-625.

Bogen, K. (1996). *The effect of questionnaire length on response rate – A review of the literature.* U.S. Bureau of the Census. Retrieved from https://www.census.gov/srd/papers/pdf/kb9601.pdf

Coleman, J. S., Campbell, E. Q., Hobson, C. J., McPartland, J., Mood, A. M., Weinfeld, F. D., & York, R. L. (1966). *Equality of educational opportunity*. Washington, DC: U.S. Government Printing Office.

Crook, S. J., Sharma, M. D., & Wilson, R. (2015). An evaluation of the impact of one-to-one laptops on student attainment in senior high school sciences. *International Journal of Science Education, 37*, 272-293.

Duncan, A. (August 2012). *Change is Hard*. Remarks of U.S. Secretary of Education Arne Duncan at Baltimore County Teachers Convening. Retrieved from https://www.ed.gov/news/speeches/change-hard

Dunleavy, M., & Heinecke, W. F. (2007). The impact of one-to-one laptop use on middle school math and science standardized test scores. *Computers in the Schools, 24*(3), 7-22. doi:10.1300/J025v24n03-02

Fullan, M. (2010). *All systems go: The change imperative for whole system reform*. Thousand Oaks: Corwin.

Gay, L.R., Mills, G.E., & Airasian, P. (2006). *Educational research: Competencies for analysis and applications* (8th ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Gravelle, P. B. (2003). *Early Evidence from the Field the Maine Learning Technology Initiative: Impact on the Digital Divide.* Center for Education Policy, Applied Research, and Evaluation; University of Southern Maine.

Grimes, D., & Warschauer, M. (2008). Learning with laptops: A multi-method case study. *Journal of Educational Computing Research, 38*, 305-332.

Gulek, J., & Demirtas, H. (2005). Learning with technology: The impact of laptop use on student achievement. *The Journal of Technology, Learning, and Assessment 3*(2), 1-32.

Harper, B., & Milman, N. B. (2016). One-to-One Technology in K–12 Classrooms: A Review of the Literature From 2004 Through 2014. *Journal of Research on Technology in Education, 48*(2), 129-142. doi:10.1080/15391523.2016.1146564

Interactive, Inc. (2008, November 24). *Documenting outcomes from Henrico County Public School's laptop computing initiative: 2005-06 through 2007-08*. Ashland, VA: Mann, D.

Jing, L. E. I., & Zhao, Y. (2008). One-to-one computing: What does it bring to schools? *Journal of Educational Computing Research, 39*(2), 97-122. doi:10.2190/EC.39.2.a

Johnstone, B. (2003). *Never mind the laptops: Kids, computers, and the transformation of learning.* New York, NY: iUniverse, Inc., 2003.

Kposowa, A., & Valdez, A. (2013). Student laptop use and scores on standardized tests. *Journal of Educational Computing Research 48*(3), 345-379.

Lowther, D. L., Inan, F. A., Ross, S. M., & Strahl, J. D. (2012). Do one-to-one initiatives bridge the way to 21st century knowledge and skills? *Journal of Educational Computing Research, 46*(1), 1-30.

Mathison, S. (2008) What is the difference between evaluation and research and why do we care. In N. L. Smith, & P. R. Brandon, P. R. (Eds.), *Fundamental issues in evaluation* (pp. 183-196). New York, NY: Guilford Press.

Miksic, M. (2014). *The persistent achievement gaps in American education*. CUNY Institute for Education Policy. Retrieved from http://edpolicy.education.jhu.edu/the-persistent-achievement-gaps-in-american-education/.

Mouza, C. (2008). Learning with laptops: Implementation and outcomes in an urban, under-privileged school. *Journal of Research on Technology in Education, 40*(4), 447-472.

Muir, M. (2007). *NMSA Research summary: Technology and pedagogy.* Retrieved from http://www.amle.org/Portals/0/pdf/research_summaries/Technology_Pedagogy.pdf

National School Lunch Program. (2017). Retrieved from https://www.fns.usda.gov/sites/default/files/NSLPFactSheet.pdf

Partnership for 21st Century Learning. (2016). *Framework for 21st Century Learning*. Retrieved from http://www.p21.org/about-us/p21-framework

Peckham, S. (2008). Middle school laptop program improves writing skills. *The Education Digest, 73*(6), 75-76.

Penuel, W. R. (2006). Implementation and effects of one-to-one computing initiatives: A research synthesis. *Journal of Research on Technology in Education, 38*, 329-348.

Provenzo, E. F., Brett, A., & McCloskey, G. N. (2005). *Computers, Curriculum, and Cultural Change: An Introduction for Teachers*. Mahwah, N.J.: Routledge.

Russell, M., Bebell, D., & Higgins, J. (2004). Laptop learning: A comparison of teaching and learning in upper elementary equipped with shared carts of laptops and permanent 1:1 laptops. *Journal of Educational Computing Research. 30*(3), 313-330.

Shapley, K., Sheehan, D., Maloney, C., Caranikas-Walker, F., & Texas Center for Educational Research. (2009). *Evaluation of the Texas technology immersion pilot: Final outcomes for a four-year study (2004-05 to 2007-08).* Austin, TX: Texas Center for Educational Research.

Shapley, K., Sheehan, D., Maloney, C., & Caranikas-Walker, F. (2011). Effects of technology immersion on middle school students' learning opportunities and achievement. *Journal of Educational Research, 104*(5), 299-315.

Silvernail, D., & Lane, D. (2004). *The Impact of Maine's One-to-One Laptop Program on Middle School Teachers and Students.* Maine Education Policy Research Institute University of Southern Maine Office.

Topper, A., & Lancaster, S. (2013). Common challenges and experiences of school districts that are implementing one-to-one computing initiatives. *Computers in the Schools, 30*, 346-358. doi:10.1080/07380569.2013.844640

Virginia Department of Education. (2009). World History and Geography to 1500 A.D. (C.E.) Standards of Learning Test Blueprint. Retrieved from http://www.doe.virginia.gov/testing/sol/blueprints/history_socialscience_blueprints/2008/blueprints_worldhistory_geo_to1500.pdf

Virginia Department of Education. (2017). *Fall Membership for the Commonwealth of Virginia*. Retrieved from http://bi.vita.virginia.gov/doe_bi/rdPage.aspx?rdReport=Main&subRptName=Fallmembership

Virginia Department of Education. (2016a). *Standards of learning (SOL) & testing*. Retrieved from http://www.doe.virginia.gov/testing

Warschauer, M. (2006). Learning in a digital age: Going one-to-one. *Educational Leadership, 63*(4), 34-38.

Warschauer, M. (2007). Information literacy in the laptop classroom. *Teachers College Record, 109*, 2511-2540.

Warschauer, M., Zheng, B., Niiya, M., Cotten, S., & Farkas, G. (2014). Balancing the one-to-one equation: Equity and access in three laptop programs. *Equity & Excellence in Education, 47*(1), 46-62.

Weldon Cooper Center for Public Service. (2015). *Poverty in Lynchburg, Virginia.* Retrieved from http://lynchburg.granicus.com/MetaViewer.php?view_id=4&clip_id=2246&meta_id=27454

Weston, M. E., & Bain, A. (2010). The end of techno-critique: The naked truth about one-to-one laptop initiatives and educational change. *Journal of Technology, Learning, and Assessment, 9*(6), 5-25.

Zheng, B., Arada, K., Niiya, M., & Warschauer, M. (2014). One-to-one laptops in K-12 classrooms: Voices of students. *Pedagogies, 9*, 279-299. doi:10.1080/1554480X.2014.955499

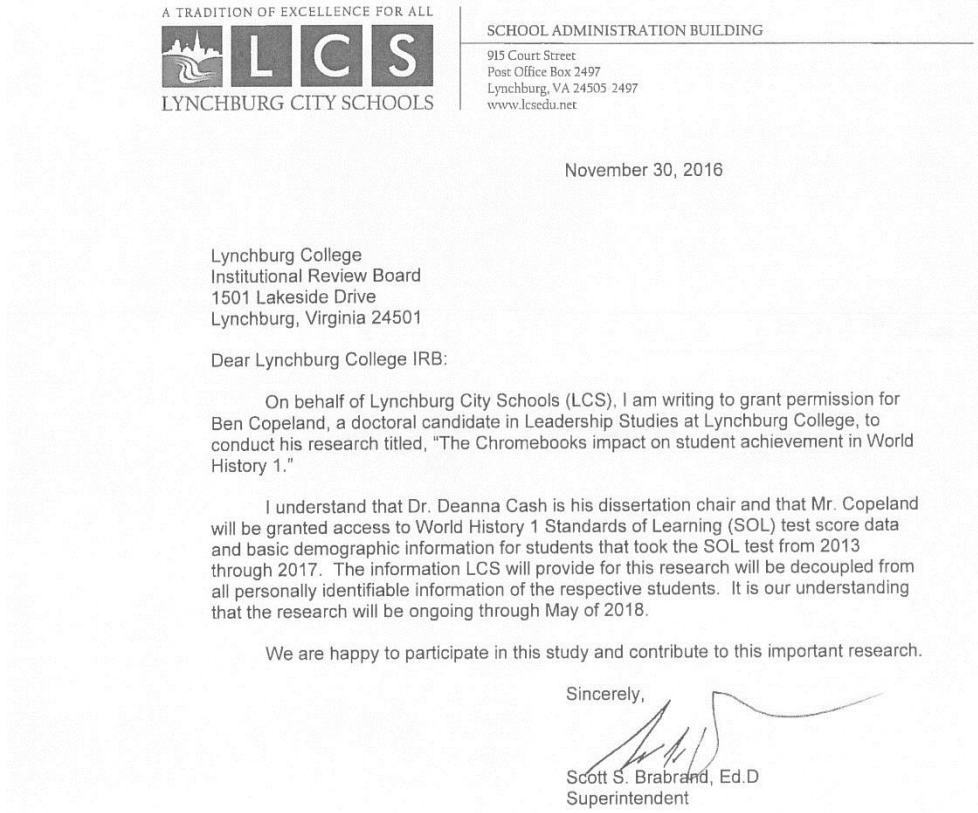
Zheng, B., Warschauer, M., & Farkas, G. (2013). Digital writing and diversity: The effects of school laptop programs on literacy processes and outcomes. *Journal of Educational Computing Research, 48*, 267-299. doi:10.2190/EC.48.3.a

Zheng, B., Warschauer, M., Lin, C. H., & Chang, C. (2016). Learning in one-to-one laptop environments a meta-analysis and research synthesis. *Review of Educational Research*, Published online before print February 5, 2016. doi: 10.3102/0034654316628645

Zucker, A. A., & Light, D. (2009, January 2). Laptop programs for students. *Science, 323*, 82-85.

Appendix A

Permission to use Data



A TRADITION OF EXCELLENCE FOR ALL

LCS

LYNCHBURG CITY SCHOOLS

SCHOOL ADMINISTRATION BUILDING

915 Court Street
Post Office Box 2497
Lynchburg, VA 24505 2497
www.lcsedu.net

November 30, 2016

Lynchburg College
Institutional Review Board
1501 Lakeside Drive
Lynchburg, Virginia 24501

Dear Lynchburg College IRB:

On behalf of Lynchburg City Schools (LCS), I am writing to grant permission for Ben Copeland, a doctoral candidate in Leadership Studies at Lynchburg College, to conduct his research titled, "The Chromebooks impact on student achievement in World History 1."

I understand that Dr. Deanna Cash is his dissertation chair and that Mr. Copeland will be granted access to World History 1 Standards of Learning (SOL) test score data and basic demographic information for students that took the SOL test from 2013 through 2017. The information LCS will provide for this research will be decoupled from all personally identifiable information of the respective students. It is our understanding that the research will be ongoing through May of 2018.

We are happy to participate in this study and contribute to this important research.

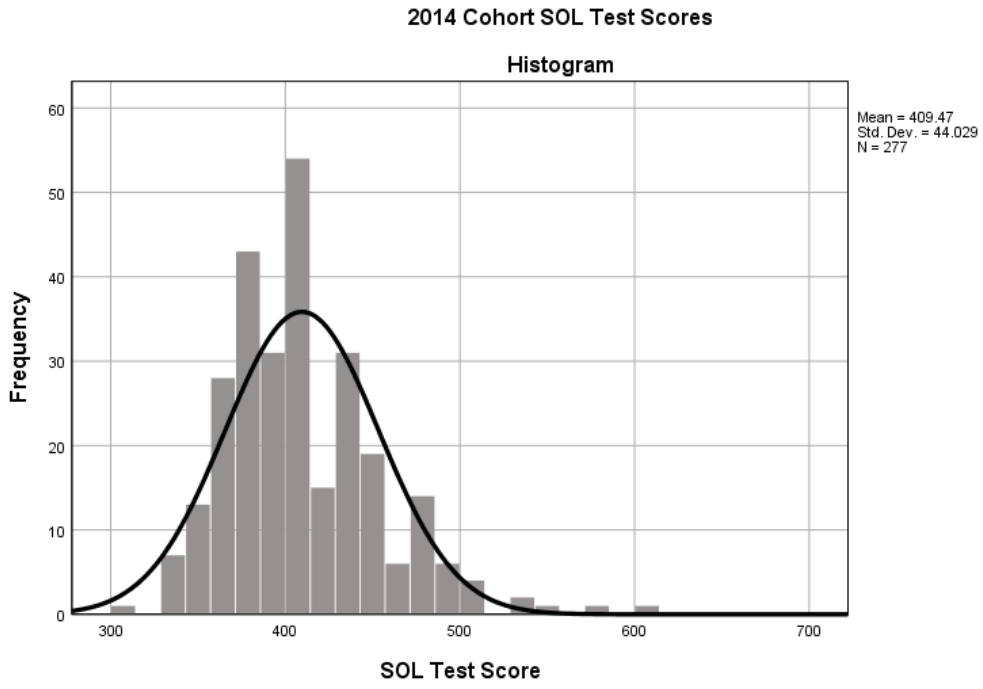
Sincerely,

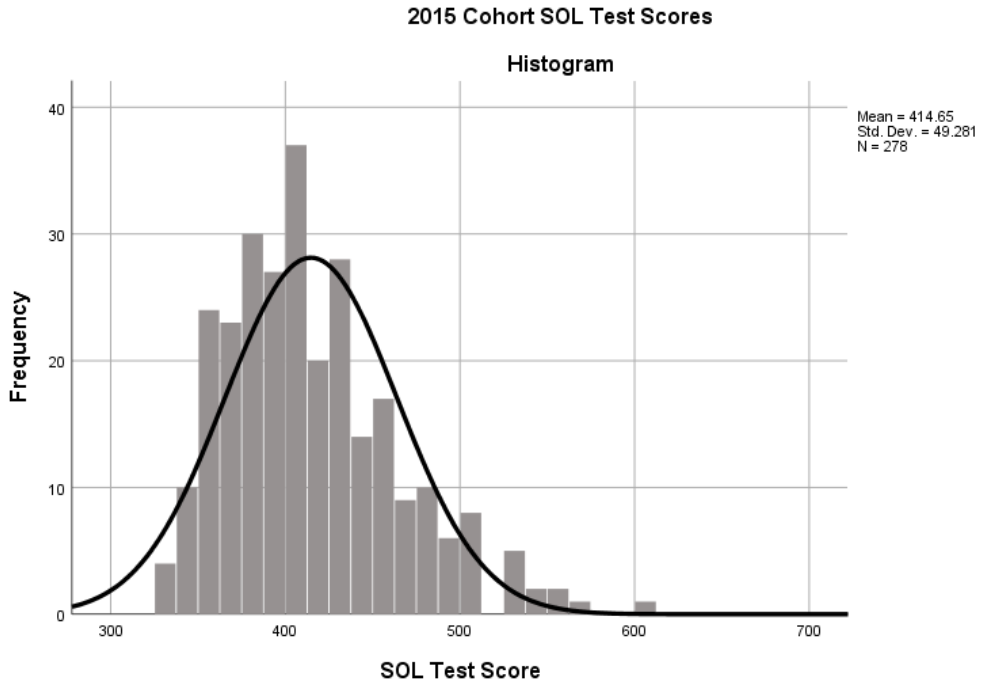
Scott S. Brabrand, Ed.D
Superintendent

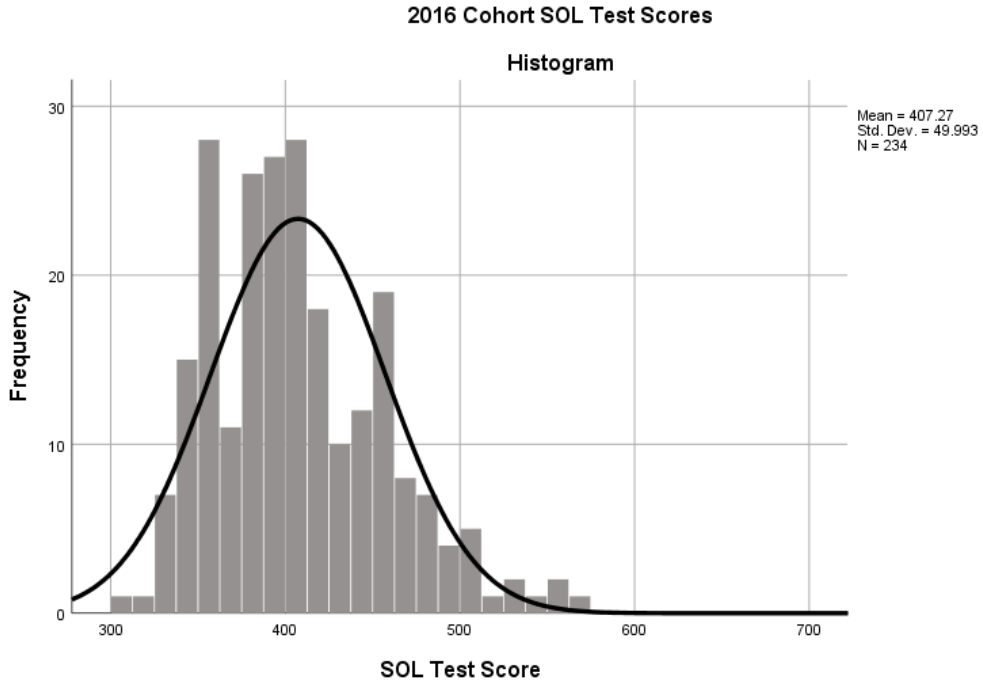
Letter

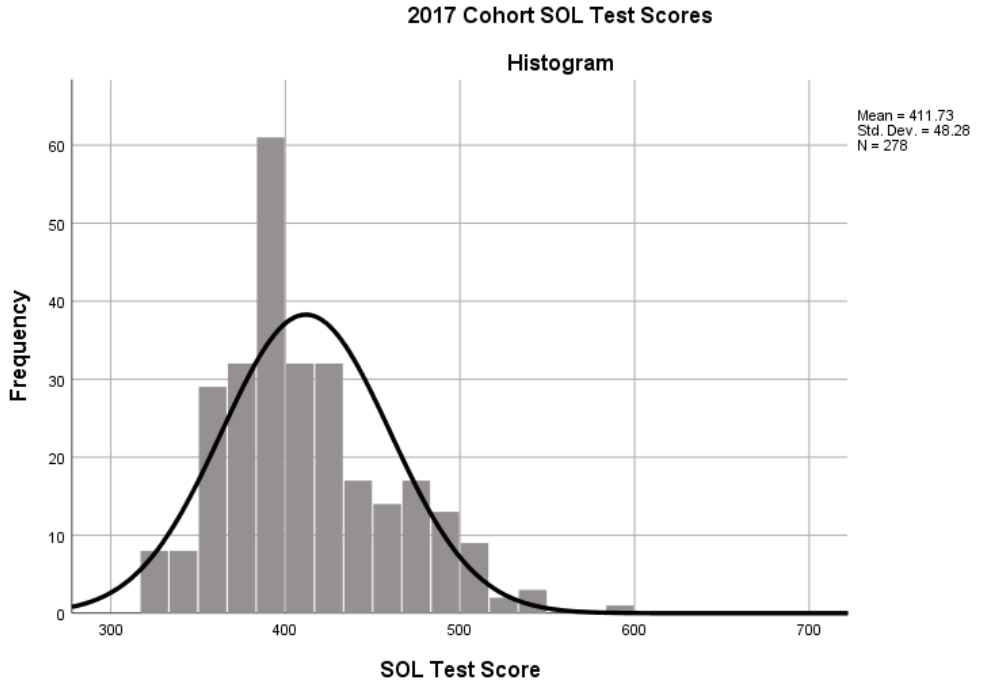
Appendix B

Histograms






2016 Cohort SOL Test Scores
Histogram
Mean = 407.27
Std. Dev. = 49.993
N = 234
Frequency
SOL Test Score
0
10
20
30
300
400
500
600
700


2017 Cohort SOL Test Scores
Histogram
Mean = 411.73
Std. Dev. = 48.28
N = 278
Frequency
SOL Test Score
0
10
20
30
40
50
60
300
400
500
600
700