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The Impact of High-Speed Internet Connectivity at Home on Eighth-Grade Student Achievement

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By

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Abstract

THE IMPACT OF HIGH-SPEED INTERNET CONNECTIVITY AT HOME ON EIGHTH-GRADE STUDENT ACHIEVEMENT

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In the fall of 2008 Westside Community Schools – District 66, in Omaha, Nebraska implemented a one-to-one notebook computer take home model for all eighth-grade students. The purpose of this study was to determine the effect of a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school on (a) English, (b) math, (c) reading, (d) science, and (e) composite score norm-referenced EXPLORE achievement test scores, District's Criterion-Referenced Descriptive Writing Assessment scores, and classroom performance grade point average (GPA) scores for the core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores of eighth-grade students who do not have high-speed Internet connectivity at home (n = 19) compared to eighth-grade students eligible (n = 19) and not eligible (n = 19) for free and reduced price lunch program participation who do have high-speed Internet connectivity at home. The results of this study support the implementation of a one-to-one notebook computer program as a systematic intervention to improve student achievement. Furthermore, all within group pretest-posttest gains and between group posttest-posttest equipoise demonstrated that the achievement gap between students eligible and students not eligible for free or reduced price lunch participation with or without high-speed Internet connectivity at home had been mitigated

through participation in the school-wide one-to-one notebook computer program. While the one-to-one notebook eighth-grade computer program in this study may not be singled out solely for between group posttest equipoise causality, its inclusion as a fundamental academic programmatic component of this middle school's curriculum should be considered as a contributing factor.

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CHAPTER ONE

Introduction

During the greatest economic downturn in our country's history, the Great Depression, a technological divide loomed large in this country. That divide was on the electrical power grid that provided countless benefits to those lucky enough to be connected and have homes and work places with electric lights. During the 1930's nine out of ten urban dwellers had electricity compared to only one out of ten rural Americans ("TVA: Electricity for All," n.d.). Electricity improved the economic health and well being for those fortunate to be connected to the grid. Rural electrification was based on the belief that affordable electricity would improve the standard of living and the economic competitiveness of the family farm ("TVA: Electricity for All," n.d.).

History Repeats Itself—The New Divide in America

This rural and urban divide exists today even though both have a similar percentage of households connected to the Internet. However the rate of high-speed penetration for rural areas lags behind those in urban and suburban areas (Cooper & Gallagher, 2004). During this current economic downturn of the twenty-first century a new technological divide is again hampering those in the lowest income brackets and in rural areas—connectivity to broadband Internet. Just over 200 million Americans have high-speed, wired Internet access at home while millions of other Americans are completely offline (Crawford, 2011). Families reporting incomes of $75,000 or more have wired high-speed Internet access in 90% of their homes compared to only 40% of homes with annual incomes below $25,000 (Crawford, 2011). This new digital divide puts at risk the quality of life for many Americans in a world where quick, easy access to vital information is necessary to compete and survive. Many scholars and policy makers hypothesize that high-speed Internet users are better able to make use of the Internet and therefore gain more value when performing critical day-to-day activities, as opposed to those with dial-up access who are left behind in terms of efficiency and capability (Dewan & Riggins, 2005).

The late 1990s were a time of rapid increase in Internet and computer use across all levels of American society (Martin, 2003). Young adults today may represent the harshest legacy of the digital divide as they lived out their childhoods during the 1980s to 1990s, an era when personal computers were available for home purchase yet were far too expensive for most people below upper-middle-class income levels (Ching, Basham, & Jang, 2005). When computers entered the educational landscape they were almost impossible to deploy for underfunded schools, and when the Internet opened its doors to vast stores of knowledge it remained prohibitive to access without costly school equipment and infrastructure improvements (Ching et al., 2005). However, as the country moved forward more homes were being wired yet the increase in Internet connectivity was more pronounced among individuals and families in the highest income levels in our country.

After a decade of debate by experts in public policy, communications, philosophy, social sciences, and economics, there is still no consensus on the definition, extent or impact of the digital divide (Dewan & Riggins, 2005). Yet, computer and Internet users in this country are divided along demographic and socioeconomic lines, as the use of both technologies is higher among Whites than among Blacks and Hispanics (Rainie, 2010). Students living with more highly educated parents are more likely to use these technologies than those living with less well educated parents, and those living in households with higher family incomes are more likely to use computers and the Internet than those living in lower income households (DeBell & Chapman, 2006). But studies show that those students who do not have a parent with a bachelor's degree seem more likely to agree that having a notebook computer has improved their grades than are students who have a parent with a bachelor's or graduate degree ("One-to-One Laptops in a High School Environment," 2004).

The digital divide can be categorizes into two types---a first-order digital divide or a second-order digital divide (Kim, Lee, & Menon, 2009). First-order refers to the inequality of access to Internet and communications technology, and second-order refers to the inequality in the user ability to interact in meaningful ways with the Internet and communications technology (Dewan & Riggins, 2005). The implication of this divide impacts all socio-economic groups because if members of the society must make a collective choice among a set of extreme alternatives, that society must make an effort to inform the digitally challenged so they have the right information too when making a decision that benefits the welfare of the society at large (Kim et al., 2009).

Students and the Digital Divide

Ninety-eight percent of all schools own computers with the current student-to-computer rate below 10 to 1 (Coley, Cradler, & Engel, 1997). While the effectiveness of educational technology can be debated the fact remains that nearly all schools today are wired for high-speed Internet connectivity. However, many disadvantaged students only use the Internet while at school because they do not have this technology at home that requires the expenditure of discretionary dollars. Income, education, and ethnicity are strong predictors of whether or not children have access to a home computer, as well as strong predictors of the quality of access (Becker, 2000). Among groups of students who access the Internet from only one location, 60% of these students come from families in poverty and 63% come from families whose parents have not earned a least a high school diploma (DeBell & Chapman, 2006). Low socio-economic status continues to distinguish between the "haves" and the "have-nots" with technology access at home, which have a positive influence on reading achievement of students even when socio-economic differences are accounted for (Espinosa, Laffey, Whittaker, & Sheng, 2006).

Because what students do with technology ultimately determines the effectiveness of their education experience, it is key that they have access to meaningful, high-quality, interactive educational content online (Solomon, 2002). If technological inequalities are allowed to persist then they will exacerbate other forms of social and economic inequalities for students most at risk in this country (Martin, 2003). Today, more and more students use creative online simulations and web applications to learn, they consult experts, exchange ideas with peers around the world, take virtual field trips to distant places, and do research using vast databases of information all via high-speed Internet access (Solomon, 2002).

In a truly equitable digital environment, every student would have access to this kind of online learning twenty-four hours a day, seven days a week. Data from a study of eighth-grade students computer usage revealed that those in low-income groups more often use computers for lower-order skills, such as drill and practice, meanwhile their peers who are considered more economically advantaged get more opportunities to use technology for higher-order activities, which are positively related to gains in academic performance (Solomon, 2002). Several researchers in the United States and the United Kingdom examined home use of computers and found that the use of technology at home is aligned with positive academic achievement for students (Espinosa et al., 2006).

Schools Try to Fill the Void

Using a computer at school and at home affect economic outcomes in at least two ways. First, computer skills - knowing how to use a computer - may have direct effects on productivity and wages. Second, computers can be used as means for learning other skills, such as math, reading, and science that in turn may give rise to positive labor-market outcomes (Woessmann & Fuchs, 2005). In recent years, governmental funding programs such as Goals 2000 and Preparing Tomorrow's Teachers to Use Technology, which provide federal dollars for such necessities as purchasing equipment, wiring classrooms, and training teachers, have been somewhat successful at building bridges across the digital divide for the current generation of K-12 students (Ching et al., 2005).

The state of Maine decided to improve equity of opportunity towards their digital divide by giving all secondary students a computing device to take home. More than 70% of teachers in one Maine school reported that the laptop program has improved student interaction with teachers, and that it has improved interaction among students they define as traditional, at-risk, or low achieving ("One-to-One Laptops in a High School Environment," 2004). More than two-thirds of teachers in a one-to-one notebook computer school indicated that, for at-risk or low-achieving students, notebook computers have improved student engagement/level of interest, motivation, participation in class, ability to work in groups, ability to work independently, interaction with teachers and with other students, and quality of work ("One-to-One Laptops in a High School

Environment," 2004). During this time of high unemployment and underemployment research studies on broadband and economic growth have found a positive correlation between broadband Internet availability, home computer use and local employment opportunities (Kolko, 2012). For society the cost of delivering services to meet the needs of a shrinking minority of people who either do not have access to broadband or lack the skills to use it will put added financial strain on already limited resources (Horrigan, 2011). Having a computer at home and using it at school will almost certainly raise some computer skills that have implications for the society at large (Woessmann & Fuchs, 2005).

As the current economic crisis lingers, we may see only modest gains in the proportion of poorer households with computers or Internet access (Martin, 2003). While the digital divide debate should not abandon equity arguments, it should also consider the cost to individuals, and more importantly to society, of having a sizable portion of the population offline (Horrigan, 2011). This exclusion makes a lack of Internet access more disadvantages today than a decade ago and could cause the digital divide to easily persist for a generation or two longer than anticipated (Martin, 2003).

For individuals without access to broadband, they either miss out on information all together or they must use more costly means to accomplish certain daily tasks (Horrigan, 2011). Internet users with broadband at home are more likely than those with dial-up or no home Internet to engage in searches related to health services, news, weather, government agency information, and recreational opportunities (Cooper & Gallagher, 2004). There is hope on the horizon, if you have people together in structured environments, such as public schools, where individuals have assured access at school and at home, the digital divide seems to dissipate in many of the traditional ways that we think about the digital divide (Cotten & Jelenewicz, 2006). If we intend to have an impact on our students for their entire life, school experiences with computers must take place in an environment where technology is important and enjoyable, the learning activities should be personally meaningful, and all students should be guaranteed these powerful experiences (Ching et al., 2005). Then perhaps we can hope that after another span of years, with the next generation of young adults, we will see a waning legacy of the digital divide.

Purpose of Study

The purpose of this study was to determine the effect of a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school on the norm-referenced achievement test scores, writing assessment scores, and grade point average scores of eighth-grade students who do not have high-speed Internet connectivity at home compared to eighth-grade students eligible and not eligible for free and reduced price lunch program participation who do have high-speed Internet connectivity at home.

Research Questions

The following research questions were used to analyze the Norm-referenced EXPLORE Test scores for eighth-grade students who completed a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school who do not have high-speed Internet connectivity at home compared to eighth-grade students eligible and not eligible for free and reduced price lunch program participation who do have high-speed Internet connectivity at home.

Overarching Pretest-Posttest EXPLORE Test Research Question #1. Do eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program participation lose, maintain, or improve their pretest beginning eight-grade compared to their posttest ending eighth-grade Norm-referenced EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent Scores?

Sub-Question 1a. Is there a statistically significant difference between eighth-grade students who do not have high-speed Internet connectivity at home pretest beginning eighth-grade compared to their posttest ending eighth-grade Norm-referenced EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent Scores?

Sub-Question 1b. Is there a statistically significant difference between eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation pretest beginning eighth-grade compared to their posttest ending eighth-grade Norm-referenced EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent Scores?

Sub-Question 1c. Is there a statistically significant difference between eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation pretest beginning eighth-grade compared to their posttest ending eighth-grade Norm-referenced EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent Scores?

Overarching Posttest-Posttest EXPLORE Test Research Question #2. Do eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program participation have congruent or different posttest compared to posttest ending eighth-grade EXPLORE Test (a) English, (b) reading, (c) math, (d) science, and (e) composite Normal Curve Equivalent scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school?

Overarching Pretest-Posttest Criterion-Referenced District Descriptive Writing Assessment Research Question #3. Do eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program participation lose, maintain, or improve their pretest beginning eighth-grade compared to their posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores?

Sub-Question 3a. Is there a statistically significant difference between eighth-grade students who do not have high-speed Internet connectivity at home pretest beginning eighth-grade compared to their posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores?

Sub-Question 3b. Is there a statistically significant difference between eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation pretest beginning eighth-grade compared to their posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores?

Sub-Question 3c. Is there a statistically significant difference between eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation pretest beginning eighth-grade compared to their posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores?

Overarching Posttest-Posttest Criterion-Referenced District Descriptive Writing Assessment Research Question #4. Do eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program participation have congruent or different posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school?

Overarching Pretest-Posttest Classroom Performance Research Question #5. Do eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home lose, maintain, or improve their pretest ending seventh-grade compared to their posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores?

Sub-Question 5a. Is there a statistically significant difference between eighth-grade students who do not have high-speed Internet connectivity at home pretest ending seventh-grade compared to their posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores?

Sub-Question 5b. Is there a statistically significant difference between eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation pretest ending seventh-grade compared to their posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores?

Sub-Question 5c. Is there a statistically significant difference between eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation pretest ending seventh-grade compared to their posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores?

Overarching Posttest-Posttest Classroom Performance Research Question #6. Do eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home have congruent or different posttest ending eighth-grade, grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school?

Data Collection Procedures

All study achievement data were retrospective, archival, and routinely collected school information. Permission from the appropriate school research personnel was obtained. Study participants in arm one (n = 19) were a naturally formed group of eighth-grade students who do not have high-speed Internet connectivity at home. Study participants in arm two (n = 19) were randomly selected eighth-grade students who have high-speed Internet connectivity at home who qualify for free or reduced lunch program participation. Study participants in arm three (n = 19) were randomly selected eighth-grade students who have high-speed Internet connectivity at home who do not qualify for free or reduced lunch program participation. Non-coded numbers were used to display individual de-identified achievement data. Aggregated group data, descriptive statistics, and parametric statistical analysis were utilized and reported with means and standard deviations on tables.

Performance site. The research was conducted in the public school setting through normal educational practices. The study procedures did not interfere with the normal educational practices of the public school and did not involve coercion or discomfort of any kind. Data were stored on spreadsheets and computer flash drives for statistical analysis in the office of the primary researcher and the dissertation chair. Data and computer files were kept in locked file cabinets. No individual identifiers were attached to the data.

Assumptions

The study has several strong points including: (a) that having access to a notebook computer 24-7 advantageous in increasing student academic performance, (b) all subjects were enrolled in the same school district during both their seventh-grade and eighth-grade school years (c) student without access to high-speed Internet at home may be at a disadvantage to peers with such access, and (d) all students were assessed by the same standardized prognosis test.

Delimitations of the Study

This study was delimited to the incoming eighth-grade students of one middle school in a suburban school district who were in attendance from the fall of 2007 to the spring of 2009. A small number of students were excluded from this pool because they did not attend this school as seventh-graders. Study findings were delimited to the students participating yearlong one-to-one notebook computer program.

Limitations of the Study

This exploratory study was confined to eighth-grade students (*N* = 57) participating in yearlong one-to-one notebook computer program. Study participants in arm one (*n* = 19) were a naturally formed group of eighth-grade students who do not have high-speed Internet connectivity at home. Study participants in arm two (*n* = 19) were randomly selected eighth-grade students who have high-speed Internet connectivity at home who qualify for free or reduced lunch program participation. Study participants in arm three (*n* = 19) were randomly selected eighth-grade students who have high-speed Internet connectivity at home who do not qualify for free or reduced lunch program participation.

The small number of study subjects could limit the utility and generalizability of the study results and findings.

Definition of Terms

Broadband. For the purpose of this study broadband will be synonymous with high-speed Internet access. Relating to, or being a high-speed communications network and especially one in which a frequency range is divided into multiple independent channels for simultaneous transmission of signals (as voice, data, or video).

Internet. For the purpose of this study Internet will be an electronic communications network that connects computer networks and organizational computer facilities around the world.

21st century skills. 21st century skills are the skills students need to succeed in work, school, and life. They include but are not limited to the following: (1) 21st Century Core Subjects and the 21st Century Themes: global awareness; financial, economic, business and entrepreneurial literacy; civic literacy and health literacy, and environmental literacy. (2) Learning and Innovation Skills: creativity and innovation, critical thinking and problem solving skills, communication and collaboration skills. (3) Information Media and Technology skills: information literacy and media literacy (Partnership for 21st Century Skills, 2011).

Academic achievement data. For this study academic achievement data includes performance on five separate assessment measures: The norm-referenced EXPLORE (*i*) Reading total subtest, (*ii*) English total subtest normal curve equivalent (NCE) scores, first and fourth quarter English grades, the district developed fall and spring Writing Assessment, grades in core subject areas (i.e., English, social studies, & science) and the students' grade point average (GPA).

Blogs. For this study blogs are interactive websites where an individual or group creates a running log of entries or comments that can be read by other users, such as in an online journal.

Broadband. Broadband, short for broadband Internet access refers to a high rate data connection to the Internet. Broadband technologies provide download data transfers faster than typical dial-up speeds. Broadband connections provide faster transfer of data from the user to the Internet and from the Internet to the user. For the purpose of this study this term is synonymous with high-speed Internet.

Digital divide. For the purpose of this paper the divide between people with access to high-speed Internet compared to those without access to high-speed Internet.

Digital equity. Digital equity in education means ensuring that every student, regardless of socioeconomic status, language, race, geography, physical restrictions, cultural background, gender, or other attribute historically associated with inequities, has equitable access to advanced technologies, communication and information resources, and the learning experiences they provide (Soloman, Allen, & Resta, 2003).

Digital immigrants. Digital immigrants are defined as students or adults who have not grown up with digital technology such as computers, the Internet, mobile phones and other mobile devices. They often come from home environments where there is no Internet access and/or no personal home computer.

Digital natives. Digital natives are students or adults who have grown up with digital technology such as computers, the Internet, mobile phones, and other mobile devices. They often come from home environments where there is Internet access and a personal home computer.

District Writing Assessment. For this study, the District Writing Assessment refers to a writing assessment administered each fall and spring to eighth-grade students in the Westside Community Schools. Students write a descriptive essay that is scored holistically by trained raters from the district.

First-order digital divide. People without physical access to the Internet because of hardware or infrastructure limitations or both.

Free and reduced priced lunch. Children from families with incomes at or below 130% of the poverty level ($28,665 for a family of four) are eligible for free lunch program participation. Those with incomes between 130% and up to 185% of the poverty level ($40,793 for a family of four) are eligible for reduced-price lunch program participation, for which students can be charged no more than 40 cents. Free and reduced priced lunch program participation is commonly referred to in educational literature as a standard poverty level of which to draw conclusions about socioeconomic status compared to their peers who do not qualify for participation in this program (United State Department of Agriculture, 2011).

Globalization. For this study and in the literature review, globalization refers to the process by which economies, societies, and cultures have become integrated through a global network of communication, technology, transportation, and trade.

Grade point average (GPA). GPA provides a value of a student's overall academic performance across content areas. GPA is typically expressed in either total GPA on a four-point scale or individually for separate subject areas on a four-point scale. GPA may also be reflected as cumulative GPA in which the GPA accumulates across time.

Internet. The Internet refers to an interconnected worldwide network of technology systems and computer pathways for which data and information is shared for a variety of purposes by a variety of users.

Local area network. A local area network (LAN) is a computer network that connects computers and devices in an identified and specific geographical area such as home, school, computer laboratory, or office. They usually have high data-transfer rates, smaller geographic area and do not require telecommunication lines.

Laptop Computer. For this study, a laptop computer refers to small mobile personal computer. Laptops contain various software and tools used by students and are often networked so that students may connect wirelessly to a Local Area Network (LAN). For this study this term is synonymous with notebook computer.

One-to-one laptop computer program. For this study, a one-to-one laptop computer program refers to providing each student with a laptop computer for both school and home 24/7 ubiquitous use and access. One-to-one laptop computer programs may be either school district provided, individual student provided, or a combination.

Paid lunch students. Children from families with incomes above 130% of the poverty level ($28,665 for a family of four), which are not eligible for free, lunch program participation. Those with incomes between 130% and up to 185% of the poverty level ($40,793 for a family of four) are not eligible for reduced-price program participation, for which students can be charged no more than 40 cents. These students would commonly be referred to in educational literature as students not in poverty, which sometimes is used to draw conclusions against their peers who qualify for free/reduced lunch program participation (United State Department of Agriculture, 2011).

Pilot Program. For this study, a pilot program refers to a temporary, experimental program or project intended to test an educational theory or assumption. Pilot programs cited in this study and literature review usually contain a limited number of students, schools, teachers, and/or classrooms (Bird, 2008).

Second-order Digital Divide. People with physical access to the Internet but lacking a skill-set that allows them to gather and use the necessary information to make informed decisions.

Social networking websites. For this study, social networking websites refer to Internet social websites in which communities of people share information, interests and activities (e.g., Facebook, MySpace).

Socioeconomic status. For this study, socioeconomic status refers to an individual or family's economic and social position relative to others, based on income, education, and occupation. Socioeconomic status is generally divided into three categories (high, middle, and low) to describe the three areas a family or an individual may fall into.

Technology. For this study, technology refers in general to any information technology device such as computers, mobile wireless devices, systems of networks (e.g., Internet, local networks), and computer software.

Technology integration. Technology Integration is the use of technology tools in content subject areas in education thus allowing students to apply computer and technology skills to learning, problem solving, and communication.

Wide area network. A wide area network (WAN) is a computer network that connects multiple buildings or sites within an organization. They have high data-transfer rates and require the use of telecommunication lines (i.e., fiber, T1, T3 lines), high throughput radio transmitters, or high throughput lasers.

Wi-Fi. For this study, WI-FI refers to a process for wirelessly connecting electronic devices. A device enabled with Wi-Fi, such as a computer, gaming device, smart phone, or digital audio player, that connects to the Internet via a wireless Internet access point.

Wikis. For this study wikis are referred to as collaborative websites that allow users to freely create and edit web page content (e.g., Wikipedia).

Significance of the Study

This study has the potential to contribute to research, practice, and policy. It is of significant interest to educators seeking ways to help student achievement by providing 24-7 access to technology tools.

Contribution to research. There is a great deal of research in the area of school technology but little research on what happens when that technology goes home. This study could help to inform those that worry about the achievement of those students without high-speed Internet access at home

Contribution to practice. This study has the potential of contributing to educational practice by examining technology processes and practices used at the research school, as well as other middle schools. The findings of this study will inform the research school about its technology processes and the need to continue the existing process or change the process to better meet the needs of students.

Contribution to policy. The results of this study could inform the research school district to make policy changes in the technology integration. It could further assist other school districts in developing a technology implementation plan to be used in placing technology in the hands of their students for home use.

Organization of the Study

The literature review relevant to this study is presented in Chapter 2. This chapter reviews professional literature on the digital divide and the expansion of digital tools in schools. Chapter 3 describes the research design, methodology, and procedures used to gather and analyze the data of the study.

CHAPTER TWO

Introduction

Use of Instructional Technology

From birth, today's students have always lived in a digital world. Many in this generation will never know a phone that hung on a wall or what a cassette or VHS tape looks like, these students live in a world where they carry their entire music collection with them everywhere they go (Pitler, Flynn, & Gaddy, 2004). While some might question the expense of a one-to-one notebook computer initiative, both in human and monetary capital, school officials see this as an opportunity to reshape the very nature of teaching and learning (Pitler et al., 2004). Schools have always used technology to support instruction. Prior to computers we saw a number of other forms of technology in our classrooms—film, radio, and television (Koschmann, 1996). With Micro-processers many schools and teachers started requiring that students bring to school specific makes and models of graphing calculators (Campbell & Pargas, 2003). The use of what would later be known as Instructional Technology was being widely used and advocated for by educators even though it was a daunting task (Campbell & Pargas, 2003).

With the invention of the personal computer and its use in schools the term instructional technology came into its own broad area of study and analysis by educational researchers (Koschmann, 1996). The early use of instructional technology lumped all forms of computer use into a paradigm known as Computer-Assisted Instruction (Koschmann, 1996). This was highlighted by the use of such things as IBM's Coursewriter I authoring tools in schools in the early 1990's (Koschmann, 1996). This type of learning strategy required a passive learner that receives content from the teacher via a technology tool (Koschmann, 1996).

The one-to-one computer access movement began in the 1980's with the Apple Classrooms of Tomorrow (ACOT) project (Donovan, Hartley, & Strudler, 2007). This was the first large-scale one-to-one computer access project for K-12 educators and students (Donovan et al., 2007). This was followed in the 1990's by Microsoft Corporation Anytime Anywhere Learning (AAL) project (Gulek & Demirtas, 2005). One of the first large-scale portable one-to-one notebook computer initiatives was done by Henrico County Public Schools, Henrico, Virginia; in 2002 they deployed over 25,000 laptops to teachers and students in grades 6 through 12 (Donovan et al., 2007). Students, teachers, and families of the Henrico system considered the notebook computer to be a positive addition to the teaching and learning experience (Donovan et al., 2007). In addition, families felt that it also improved school to home communication, while at the same time increasing student motivation to be more self-directed learners (Donovan et al., 2007). Today many parents, educators, and students view notebook computers not as technology tools but rather as cognitive tools that are holistically integrated into the teaching and learning frameworks of their school (Weston & Bain, 2010).

By 2003, the United States and Australia were tied for first in the world on having the lowest computer to student ratio of 5 computers to every one student (Gulek & Demirtas, 2005). Also in 2003 the Texas Legislature created the Technology Immersion Pilot (TIP) with the hope of "immersing" schools in technology rather than by introducing technology resources in a cyclical fashion over time (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010). They invested more than $20 million to high-need secondary schools through completive grants for one-to-one notebook pilots to wireless Internet access through an entire school campus (Shapley et al., 2010). Not only was there progress in number of devices per students available at U.S. schools but also a new paradigm was emerging because of the development of programs that used artificial intelligence (Koschmann, 1996). These types of software programs now allowed the computer to be a student's personal tutor (Koschmann, 1996). This was followed by the current technology paradigm that knowledge should be acquired through a process of students actively constructing their own learning (Koschmann, 1996). Technology transforms classrooms into more collaborative, engaging, dynamic and student-centered learning environments (Jeroski, 2003). The use of technology in the classroom allows teachers to more easily shift towards a constructivist teaching pedagogy (Windschitl & Sahl, 2002). This in turn allows teachers to use more student-centered strategies for student learning that marries well with the integration of technology tools within their classroom (Koschmann, 1996). When teachers use technology in this way their classroom is transformed from being one with a teacher that is an authority figure that imparts knowledge to a classroom in which the teacher becomes the facilitator or guide on the side for student learning (Windschitl & Sahl, 2002).

A goal of many one-to-one notebook computer programs is to create a learning environment that inspires students to take more ownership of their learning while at the same time increasing their intrinsic motivation for learning (Warschauer, 2008). One-to-one programs can provide an environment which include more student centered strategies, project-based learning opportunities, cooperative or collaborative learning activities, while the teacher serves as a facilitator for learning (Warschauer, 2008).

Unfortunately, many educators even today think that implementation of a one-to-one notebook computer program automatically results in student centered learning. However, a true theoretical explanation would be that moving to a one-to-one notebook-computing model requires a school to first shift toward student-centered practices within the learning environment prior to implementation of any one-to-one computer program model (Donovan et al., 2007). In the main, one-to-one notebook computer immersion programs require a comprehensive approach that transforms the school culture, changes the nature of teaching and learning, and expands the educational boundaries of the school and the classrooms in anticipation of distributing the laptop computers (Shapley et al., 2010). While there still may be some critics of one-to-one notebook computer programs, particularly given their expense and the expenditure of scarce tax dollars, few educational initiatives have resulted so completely in positively transforming the teaching, learning, and evaluation process of so many schools in so many states in so many countries that now are connected in so many ways. The result is now known and this new standard for opening up worlds of knowledge to all students irrespective of their economic advantages or disadvantages in our schools is getting the positive media coverage it deserves (Weston & Bain, 2010).

Also, for states with struggling economies, quality schools with low computer to student ratios or even a one-to-one notebook computer program may be a way for a state to repair, maintain, or improve their economic status for their citizens (Pitler et al., 2004). These type of technology programs level the playing field for low socio-economic students while at the same time preparing them for the very tools that they will find in today's military, workplace, or schools of higher-learning (Pitler et al., 2004). Digital equity is established by ensuring that all students have the same tools coupled with high teacher expectations (Lemke & Martin, 2003). This creates "equity of opportunity" for all students within a learning system and has the potential to impact in a positive way achievement for those most at risk who normally would not have access to these type of tools within their domicile (Lemke & Martin, 2003).

Educators began to ask could we do a better job of educating our students if they were provided a portable notebook computer with a wireless Internet connection that was available to them 24 hours a day, seven days a week (Campbell & Pargas, 2003)? They began experimenting with providing students online resources that reinforced, brought forth prior knowledge and/or presented new knowledge to their students (Campbell & Pargas, 2003). A one-to-one notebook computer setting can bridge the digital divide that currently exists among some of our students (Mouza, 2008). Educators at both the K-12 and at higher education institutions have realized that providing online resources that were carefully selected by the instructor allows students to be better prepared when they entered that day's classroom (Campbell & Pargas, 2003).

The emergence of handheld devices and computers that have low acquisition price points began to gain traction in school districts across the United States (Carter, 2001). These smaller handheld devices are all Internet ready, have longer battery life and have short learning curves for the end user (Crichton, Stuewe, Pegler, & White, 2011). While handhelds may be more portable and cheaper than laptops they are not comparable to a fully loaded notebook-computing platform that includes a robust chip set and large storage capabilities (Carter, 2001). It can be agreed among computer aficionados of either handhelds or portable-computing devices that the increasing use of wireless networking coupled with access to the Internet is transforming teaching and learning worldwide (Wambach, 2006). With the expansion of wireless Internet access learning places have the fluidity of truly becoming anytime, anywhere, educational spaces (Windschitl & Sahl, 2002). These technology rich, connected learning environments provide a collaborative learning experience that allows students to think through and solve real-world problems (Campbell & Pargas, 2003). This real world experience also applies to the social mores of our society when using electronic devices. When students are working at school to complete assignments using computer technology they are also learning real world electronic etiquette (Campbell & Pargas, 2003).

Student Achievement

Back in 1996 Microsoft Corporation launched the "Anytime Anywhere Learning Project" at selected schools (Gulek & Demirtas, 2005). Key findings from a study of that program resulted in increases by students in the following areas; engaging in collaborative work, participation in project-based learning, writing quantity, writing quality, directing their own learning, problem-solving and critical thinking, and increased time on homework (Gulek & Demirtas, 2005). The Crossriver School District also found that their one-to-one notebook computer program increased peer-to-peer collaboration among their students finding that 91% of students who had one-to-one computers collaborated at least one time per week with a peer, while 76% of the control group students who did not use one-to-one computers collaborated with another peer once per week (Lowther, Ross, & Morrison, 2003). The Crossriver study also mirrored the Microsoft study in that students participated in more project-based activities, increased the quantity of writing, and used higher level thinking skills (Lowther et al., 2003).

Schools participating in one-to-one programs have come to be associated with more regular school attendance with students staying in school longer, both of these things can be keys to student achievement (Carter, 2001).

Since 1996, state and district level agencies have invested over ten billion dollars to acquire and integrate computer-based technologies into American schools (O'Dwyer, Russell, Bebell, & Tucker-Seeley, 2005). More and more schools are embracing one-to-one notebook computer initiatives, in which students of every grade at participating schools have access to a laptop throughout the day to level the playing field for all of their students. Some one-to-one initiatives begin and end with the school day, while others aim to ensure student access to computers and Internet access twenty-four hours a day, seven days a week. As we examine the impact of one-to-one technology use on student learning, it is critical that the measures actually assess the types of learning that may occur as a result of technology use and that those measures are sensitive enough to detect potential changes in learning that may occur (O’Dwyer et al., 2005). Given that students within a classroom are likely to influence the attitudes and instructional practices of their teachers and that these practices in turn affect all of the students in the classroom, it is important to examine the classroom as a hierarchical organization within which technology use occurs, it is a tool rather than a means to an end (O’Dwyer, et al., 2005).

The Crossriver School District showed that students with laptops acquired computer skills in more diverse and real world connected ways than those students who only used computers in school lab settings (Lowther et al., 2003). Ubiquitous access to technology tools in conjunction with well-prepared teachers can ensure equity of opportunity in today’s digital world for our most socio-economic disadvantaged students

(Mouza, 2008). At the heart of studies on Instructional Technology is the desire to learn the answer to the question "What are the instructional benefits of introducing technology into the classroom" (Koschmann, 1996)? With mandates in the No Child Left Behind (NCLB) Act, schools have felt an increased pressure to provide every child with access to high-quality instruction and tools to close any achievement gaps (Mouza, 2008).

There is also a sense of urgency to insure that all students leave school equipped with 21st century skills and knowledge to compete in a global market (Mouza, 2008). Research has shown that providing all students with a one-to-one notebook computer creates a supportive school environment that fosters student responsibility, competence, and autonomy (Mouza, 2008). This fostered autonomy and ownership of learning can be leveraged by school officials to increase academic engagement, which can lead to increased student achievement on academic measures (Mouza, 2008).

The Enhancing Missouri's Instructional Networked Teaching Strategies (eMINTS) student cohort initiated in 2004 found that integrating multimedia technology into an inquiry-based learning environment earned higher scores on the Missouri's Assessment Program in mathematics and social studies than students who were not in the cohort (Pitler et al., 2004). Henrico County, Virginia, began a one-to-one notebook computer program in 2001 (Pitler et al., 2004). When they started their one-to-one notebook computer program less than 8 out of 10 schools in their district were fully state accredited due to some schools having less than 70% of their students passing the Virginia Standards of Learning test. However, by 2003 every regular school in their district was now fully accredited with school officials pointing to their technology initiative as the reason for this success (Pitler et al., 2004).

Similar results were also found in Texas's Technology Immersion Pilot (TIP) pilot program where teachers and administrators increased students' access to notebook computers resulting in improved state assessment scores in math (Shapley et al., 2010). During this same study they also found this same positive predictor of state math scores when students increased their frequency and duration of computer use while away from the school (Shapley et al., 2010). The study revealed that immersion through the one-to-one technology initiative also had a positive relationship with student reading achievement (Shapley et al., 2010). The majority of the students in the research group were primarily minority, from low socioeconomic circumstances, highlighting the importance of district provided laptops (Shapley et al., 2010). Equalization of learning experiences outside of school for students in disadvantaged situations expanded where and how learning occurs and increases the likelihood of academic success for these at-risk students (Shapley et al., 2010). Doing so promoted a ubiquitous learning environment, minimized the digital divide, and improved academic achievement for all students (Shapley et al., 2010).

The Pleasanton Unified School District in Pleasanton, California, established a notebook computer immersion program in 2001 (Gulek & Demirtas, 2005). Results from a study that was conducted of the program showed that it had a significant positive effect on math and language scores (Gulek & Demirtas, 2005). They also found that the student's overall cumulative GPA increased for their students in this program (Gulek & Demirtas, 2005). The University of South Carolina studied the one-to-one initiative at Beaufort County Schools District, in South Carolina, and found that students with individual notebook computers scored higher on standardized achievement tests than their non-laptop counterparts (Carter, 2001).

By 2002 the State of Maine, through its Maine Learning Technology Initiative implemented a one-to-one middle school notebook computer program for all seventh and eighth-grade students and their teachers (Silvernail & Gritter, 2007). This initiative also provided technical and professional development for teacher integration of one-to-one notebook computers into their curriculum and instructional practices (Silvernail & Gritter, 2007). Examination of the state's writing scores found that there was a statistically significant improvement in writing scores after the implementation of the one-to-one initiative when comparing 2000 writing scores to 2005 writing scores (Silvernail & Gritter, 2007). The study also found that the more extensively a student used the one-to-one in the development and production of a written product the greater the likelihood that a students writing would result in higher scores (Silvernail & Gritter, 2007).

Over 75% of the teachers in a Maine study reported that having notebook computer for their students allowed them to better meet Maine's statewide learning standards (Silvernail & Lane, 2004). This initiative also provided technical and professional development for teacher integration into their curriculum and instructional practices (Gulek & Demirtas, 2005). Conversely a study of Maine ninth-grade students found that the quantity and quality of their schoolwork and writing declined once they no longer had access to their school provided laptop when they entered 10th-grade (Pitler et al., 2004).

Many times students are able to increase the pace of their studies because of the time savings created by each student having their own computing device containing rich multi-media resources (Wenli, Lim, & Tan, 2011). One study showed that students could increase their timesavings from 30% to 50% on traditional school assignments when one-to-one computers were provided (Garthwait & Weller, 2005). Teachers and students are able to work smarter, go into more depth, reach higher levels of thinking with one-to-one laptop computers utilized within a subject area (Garthwait & Weller, 2005). This study also found that the greatest impact on student achievement was not the technology tool per se but rather the teacher's use of the technology tool in and out of the classroom (Shapley et al., 2010). No technology system has yet been designed to replace the role of a skilled classroom teacher and that is why professional development for the use of technology tools in teaching and learning are imperative for any technology initiative (Garthwait & Weller, 2005).

Either way parents/schools must find a way to provide students a way to carry home the laptops used in classes all day or encourage parents to provide a computer for their child's evening study (K-12 Lease-to-Own Laptop Initiatives, 2008). The decreasing cost, combined with the lighter weight of notebook computers and increasing availability of wireless connectivity, are making one-to-one initiatives more feasible to implement on a broad scale (Research: What It Says About 1 to 1 Learning, 2005). States such as Maine and Texas, for example, have invested in statewide initiatives to fund access to laptops for secondary school students (Research: What It Says About 1 to 1 Learning, 2005). Large districts like Henrico County in Virginia and Cobb County in Georgia are providing laptops and digital content to all middle and high school students

(Penuel, 2006). Hundreds of public and parochial schools are implementing large-scale projects that provide one-to-one, twenty-four hours a day, seven days a week access to computers and the Internet. Several studies show that the presence of educational resources in the home, including computers, is a strong predictor of academic success in mathematics and science (Jackson et al., 2006).

Ubiquitous access makes it possible for students to use a wider array of resources to support their learning, to communicate with peers and their teachers, and to become fluent in their use of the technological tools of the twenty-first century workplace (Research: What It Says About 1 to 1 Learning, 2005). One-to-one notebook computer access allows teachers to individualize instruction, which is a critical quality for a learner-centered environment that benefits all students (Dunleavy, Dexter, & Heinecke, 2007). Being able to take computers home further expands students' access, facilitates students keeping their work organized, and makes the computer a more "personal" device (Research: What It Says About 1 to 1 Learning, 2005). The use of word processing in writing instruction has been shown to have a positive effect on student writing, especially for struggling writers (MacArthur, 2009). Also, having 24-7 access to a notebook computer has been associated with higher test scores in reading, even after controlling for family income and other factors related to reading test scores (Jackson et al., 2006).

Beyond facilitating more frequent use of technology in class, many argue that providing students with better access to computers can provide students with more equitable access to resources and learning opportunities. Thus results of a reading study regression analyses indicated that children who used the Internet more subsequently had higher GPAs and higher scores on standardized tests of reading achievement than did children who used the Internet less (Jackson et al., 2006). Educational leaders have argued that providing students with a computer with Internet access gives everyone the ability to use up-to-date learning resources that before were available only to those who lived close to a library or benefited from school budgets that allowed for regular purchases of new textbooks (Penuel, 2006). There has been widespread interest and investment in initiatives designed to provide each student with a computer to support academic learning for close to ten years now in the United States. The earliest initiatives in the U.S. began appearing in the mid-1990s, and the most visible sponsored initiative at that time was Microsoft's "Anytime, Anywhere Learning Program" (Penuel, 2006). As part of this program, scores of schools and districts implemented programs in which students could lease or buy laptop computers that they and their teachers were expected to use in school. In the past five years whole districts and even states continue to invest in initiatives designed to give every student in particular grade level a laptop computer (Penuel, 2006).

Moreover, studies have indicated that playing games of an academic nature on a computer, namely action games that involve rapid movement, imagery, intense interaction, and multiple activities occurring simultaneously, improves visual intelligence skills (Jackson et al., 2006). Furthermore, some evidence suggests a positive relationship between computer game playing and visual spatial skills and between owning a home computer and school performance (Jackson et al., 2006). Collaborative tools such as blogs, wikis and social networking websites help students and teachers share content in much more meaningful and creative ways that lead to increased student motivation and engagement (Ferriter, 2009). Studies completed on one-to-one learning programs found that teachers felt more empowered and spent less time lecturing while at the same time using websites and online resources to create a more inquiry-based learning environment (Rockman, 1998).

The invention of the computer today is analogous to the invention of written language centuries ago (Turkle, 2004). The invention of written language brought about a radical shift in how we process, organize, store, and transmit representations of the world and even though writing remains our primary information technology, today when we think about the impact of technology on our habits of mind, we think primarily of the computer (Turkle, 2004). Schools hope that the increased use of notebook computers will lead to improved student scores in the area of academic achievement. To accomplish this, we need much more experience and experimentation with notebook computers in the classroom by our best teachers (Campbell & Pargas, 2003). Notebook computers for students will truly be fully integrated when they effectively become invisible by blending into the teaching and learning that is taking place within the learning environment rather than being a primary focus (Campbell & Pargas, 2003). Teachers must design tasks that are consistent with the curriculum and use software and the Internet in meaningful ways so students will see those connections (Crichton et al., 2011). A study of the Technology Immersion Pilot (TIP) pilot in Texas stated that one-to-one notebook programs can be instituted with fidelity if school districts and their individual schools are committed to ensuring student access within and outside the school and found the prospects for raising academic achievement very promising (Shapley et al., 2010).

Improvement of Writing

Both teens and their parents say that good writing is an essential skill for later success in life and 83% of parents of teens feel there is a greater need to write well today than there was 20 years ago. Furthermore, 86% of teens believe good writing is important to success in life--some 56% describe it as essential and another 30% describe it as important (Lenhart, Arafeh, Smith, & Macgill, 2008). In just 25 years, we have progressed from the first computers useful for word processing in our schools to students using Web 2.0 applications that support easy creation of written Internet content (MacArthur, 2009). The digital age does present a paradox for educators as most of the students they teach spend a considerable amount of their life composing texts, but those same students do not think that a lot of the material they create electronically is real writing (Lenhart et al., 2008).

Among children of college-educated parents, 47% believe that they write more outside of school thanks to computers, compared with 34% of teens whose parents have no college experiences (Lenhart et al., 2008). However, when measuring students' use of computers, it may be important to not only develop more precise measures of what students are doing with computers, but also what content students are learning as they use the computers (O'Dwyer, Russell, Bebell, & Tucker-Seeley, 2008). A meta-analysis of over 150 studies from 1990 through 1995 indicates that using computers for student writing assignments improves their written work because of the ease of editing which improves the quality of student writing (Burner, 2012). Without the ongoing barriers presented by verb tense, punctuation and other writing constructs, students are allowed to fully concentrate on generating ideas, organization of thoughts, making generalizations, and synthesizing ideas into their writing (Burner, 2012).

The phenomenon of students not meeting grade-level proficiencies as they progress through school is more prevalent among lower socioeconomic status students, where non-Whites are heavily over-represented (Suhr, Hernandez, Grimes, & Warschauer, 2010). Children of more economically advantaged families score significantly higher on reading and writing performance then their disadvantaged peers in regard to socioeconomics (Suhr et al., 2010). This disparity widens substantially in fourth-grade as students transition from the lower to the upper elementary grades (Suhr et al., 2010). A study confirmed that when fourth-grade students in nine separate school districts were put into classrooms with an abundance of technology resources they had higher scores on their state writing assessments (Suhr et al., 2010). Over a two-year interval students with notebook computers to use submitted higher quality written compositions, wrote longer essays, revised the writing more frequently, and exhibited mastery of the content then those students without a laptop computer (Suhr et al., 2010).

One Canadian school showed that access to notebook computers raised the proportion of students who met the national writing performance standard from 70% to 92% in a single year (Suhr et al., 2010). Notebook computers are not the magic bullet that will automatically raise writing scores single-handily, however, studies show that with effective instructional practices they have a positive impact on raising student achievement (Suhr et al., 2010). When it comes to using technology for school or non-school writing, teens believe that when they use computers to write they are more inclined to edit and revise their written texts (Lenhart et al., 2008). However, to get the full benefit of using a word processing program, students should complete the entire writing process from drafting through publication on their computer rather than mixing digital (e.g., computer) with analog (e.g., handwriting) tools (MacArthur, 2009). Nearly six in ten teens (57%) say they edit and revise more when they write using a computer compared with when they write by hand (Lenhart et al., 2008). Students who reported higher frequencies of computer use for editing papers during school time tended to have higher writing scores, while students who reported higher frequencies of computer use during school for creating presentations tended to have lower writing scores (O'Dwyer et al., 2005).

Readiness

Nearly all studies of one-to-one notebook computer programs success depend largely on their teachers and their preparation (Bebell & O'Dwyer, 2010). Successful one-to-one notebook computer programs have at their very core a strong professional development component (Pitler et al., 2004). From the very beginning of Apple's Classrooms of Tomorrow project sprang forth the conceptual framework that any proposed technology adoption goes through a process in which staff will use technology tools in their classroom in direct proportion to their comfort level with the tool and/or software being used (Donovan et al., 2007). What often happens is that teachers are rarely consulted on the usefulness of the innovation, yet they are expected to adopt it with open arms (Donovan et al., 2007). This feeling of discomfort must be acknowledged and addressed by school leadership when they plan and develop their professional development offerings (Donovan et al., 2007). By doing this, the school leader can help those being trained see the innovation adoption and implementation cycle as a developmental process rather than a one time event (Donovan et al., 2007). Even though one-to-one notebook computing schools have been in existence since the early part of this century, adopters of this system would still be considered on the front line for this type of implementation (Bebell & O'Dwyer, 2010). Special attention needs to be paid to provide essential supports for teachers, the school and the communities that have decided to undertake a one-to-one initiative (Bebell & O'Dwyer, 2010).

While technology can be a catalyst for change, only through congruent professional development can long-term positive change in the learning environment be achieved (Pitler et al., 2004). The professional development needs to be tied to the learning outcomes of the school and it must also be targeted and specific to developing the necessary skill set of classroom teachers so that they can focus on maximizing learning opportunities for their students (Gulek & Demirtas, 2005). Key findings from Microsoft's Anytime Anywhere study showed that the program resulted in staff increasing their use of constructivist teaching practices, while increasing the feeling of teaching empowerment, while at the same time lowering the amount teacher's lectured to students (Ching et al., 2005). The aforementioned Crossriver study also showed that teachers used more student-centered strategies, teacher as a coach practices, and peer-to-peer cooperative learning activities within their classroom to engage students and increase achievement (Lowther et al., 2003). All technology professional development should include instruction on the essential elements of the initiative, how to design technology enhanced learning environments, lesson development in the core subject areas, ongoing professional development offerings, as well as ongoing coaching and technical support (Bebell & O'Dwyer, 2010).

To ensure success of the Maine Learning Technology Initiative state legislators provided within their initiative funds technical support to limit failure points while also providing funds for professional development of teachers to ensure success of the notebook computer integration into their curriculum writing and teaching practices (Silvernail & Gritter, 2007). Professional development for technology has two key phases--Phase One is a series of trainings to master the basics of software and hardware with Phase Two being supporting integration into classroom practices (Carter, 2001). Schools rich with technology will need to quickly move from the "entry" phase--in which teachers make decisions not to use technology because of their discomfort, to "invention" phase--in which teachers are capable of transforming the learning environment within their classroom because of the use of the school's technology resources (Windschitl & Sahl, 2002). Strong administrative leadership coupled with professional development opportunities for teachers contribute to the success of one-to-one initiatives (Windschitl & Sahl, 2002).

Studies have shown that the lack of planning time, in the form of teacher collaboration, becomes a barrier to the successful implementation of any one-to-one notebook initiative (Bebell & O'Dwyer, 2010). The use of regular planning time with colleagues who share both an interest and desire to use technology in the classroom also has a positive impact on a teacher's success in integrating these tools (Windschitl & Sahl, 2002). Professional development is a very complex issue that requires a well thought out and simple process for teachers (Windschitl & Sahl, 2002). This process should include a mix of many professional development modalities that consistently reflect the district's expectations for technology use while at the same time respecting the teacher's beliefs about learners and learning (Windschitl & Sahl, 2002). Wise school leaders will need to understand how this technology trend affects the lives of their teachers as well as the school so they can make informed recommendations that allow good teaching to flourish regardless of the tools at hand in the classroom (Windschitl & Sahl, 2002). When implementing a one-to-one notebook program for the first time teachers need to be treated as learners and their learning must be honored and personalized as well as supported (Crichton et al., 2011). This process will ensure that their comfort with the tool or software allows them to successfully make professional practice judgments that will benefit their students (Crichton et al, 2011).

Schools must also have in place the necessary infrastructure to pull off a large-scale one-to-one notebook computer program. This would include the use of a secure Local Area Network (LAN) that is part of a robust Wide Area Network (WAN) (Crichton et al., 2011). Planning for security and computer configuration is also a vital but sometimes over looked task (Crichton et al, 2011). School administrators must also make certain that school policies and rules reflect the changing dynamics that these tools bring and take into consideration the potential issues associated with these type of endeavors (Crichton et al., 2011).

Current Broadband Divide

Access to broadband Internet is spreading in the United States but the Federal Communications Commission (FCC) shows that there are still 19 million Americans without access to this type of service as we entered the year 2012 (19 Million Americans Still Go Without Broadband, 2012). While this number has improved from the 2011 number of 26 million Americans the FCC continues to attribute this high number of disconnected people to those mainly living in rural areas (19 Million Americans Still Go Without Broadband, 2012). Education Week, a respected educational journal, commented that the lack of broadband Internet connections in many rural communities limits the educational options for all residents that reside in those areas (Broadband Access, 2012). They referred to this disparity as the "opportunity gap" between urban and rural communities (Broadband Access, 2012). When looking at rural versus non-rural homes only 1.8% of non-rural homes did not have access to high-speed Internet compared to 23.7% in rural areas (19 Million Americans Still Go Without Broadband, 2012).

When most think about rural areas they immediately envision places like Wyoming or Montana, yet 35% of the people living in California's rural areas could not order broadband Internet service at the end of 2011 calendar year (19 Million Americans Still Go Without Broadband, 2012). Cellular service providers are now offering mobile broadband service but nearly 20 million Americans, or 6.2% of the population, do not have access to this type of service either (19 Million Americans Still Go Without Broadband, 2012). FCC Chairman Julius Genachowski has set a goal of 2020 to try to deliver broadband Internet access to all people living within the boarders of the United States (19 Million Americans Still Go Without Broadband, 2012). While this lack of access is a concern for rural schools, it also can be limiting to post-secondary schools that may offer online courses that could add to people's credentials or job skills while at the same time increasing their potential earning power (Broadband Access, 2012). As we come near the exit of the 2012 calendar year this Internet divide between rural and urban America puts many at a disadvantage at benefiting from important learning opportunities and information (Broadband Access, 2012). It is only when one-to-one computer technology and broadband access are used in tandem that we may expect the greatest use of these tools to support student learning congruent with the expectations of the worlds of learning and work these students all will face tomorrow.

CHAPTER THREE

Methodology

Purpose of Study

The purpose of this study was to determine the effect of a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school on the norm-referenced achievement test scores, writing assessment scores, and grade point average scores of eighth-grade students who do not have high-speed Internet connectivity at home compared to eighth-grade students eligible and not eligible for free and reduced price lunch program participation who do have high-speed Internet connectivity at home.

Participants

Number of participants. The maximum accrual ($N = 57$) for this study included a naturally formed group of eighth-grade students who do not have high-speed Internet connectivity at home ($n = 19$), a randomly selected group of eighth-grade students who have high-speed Internet connectivity at home who qualify for free or reduced lunch program participation ($n = 19$), and a randomly selected group of eighth-grade students who have high-speed Internet connectivity at home who do not qualify for free or reduced lunch program participation ($n = 19$).

Gender of participants. Of the total number of selected subjects for this study ($N = 57$) 18 (32%) were male and 39 (68%) were female. The gender distribution of the students selected for participation while skewed towards higher female study participation was congruent with the total pool of eligible students assigned to both the naturally formed group and the two randomly assigned groups.

Age range of participants. The age range for all study participants was from 12 years to 14 years. All participants were in the eighth-grade during pretest measures and in the eighth-grade during posttest measures. The age range of the study participants is congruent with the research school district's age range demographics for eighth-grade students.

Racial and ethnic origins of participants. Of the total number of students for this study (*N* = 57) 47 (82.5%) were White, 8 (14.0%) were African-American, 1 (1.8%) was Hispanic, and 1 (1.8%) was Native American. The naturally formed group of eighth-grade students who do not have high-speed Internet connectivity at home (*n* = 19) 14 (74%) were White, 3 (16%) were African-American, 1 (5%) was Hispanic, and 1(5%) was Native American. For the randomly selected group of eighth-grade students who have high-speed Internet connectivity at home who qualify for free or reduced lunch program participation (*n* = 19) 15 (79%) were White and 4 (21%) were African-American. For the randomly selected group of eighth-grade students who have high-speed Internet connectivity at home who do not qualify for free or reduced lunch program participation (*n* = 19) 18 (95%) were White and 1 (5%) was African-American.

Inclusion criteria of participants. Students selected were enrolled in the eighth-grade and attended the research district's middle school where they completed both their seventh-grade and eighth-grade academic years.

Method of participant identification. Students selected completed and received grades in four core subject areas (English, social studies, science, math) in both their seventh-grade and eighth-grade school years and who also took part in both the EXPLORE test and state writing prompt pretest and posttest measures.

Description of Procedures

Research design. The pretest-posttest, three-group comparative efficacy study design is displayed in the following notation:

Group 1 X_1 O_1 Y_1 O_2

Group 2 X_1 O_1 Y_2 O_2

Group 3 X_1 O_1 Y_3 O_2

Group 1 = study participants #1. Naturally formed group of eighth-grade students who do not have high-speed Internet connectivity at home ($n = 19$).

Group 2 = study participants #2. Randomly selected group of eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation ($n = 19$).

Group 3 = study participants #3. Randomly selected group of eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program participation ($n = 19$).

X_1 = study constant. Eighth-grade students ($N = 57$) at Westside Middle School, Omaha, NE who completed a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school. These students also completed seventh-grade in the research school district.

Y_1 = study independent variable, high-speed Internet connectivity at home, condition #1. Eighth-grade students who do not have high-speed Internet connectivity at home.

Y_2 = study independent variable, high-speed Internet connectivity at home, condition #2. Eighth-grade students who have high-speed Internet connectivity at home who qualify for free or reduced lunch program participation.

Y_3 = study independent variable, high-speed Internet connectivity at home, condition #3. Eighth-grade students who have high-speed Internet connectivity at home who do not qualify for free or reduced lunch program participation.

O_1 = study pretest dependent measures. (1) Achievement as measured by the research school district's fall eighth-grade administration of the EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent scores. (2) Writing achievement as measured by the research school district's eighth-grade administration of the Fall Criterion-Referenced District Descriptive Writing Assessment for holistic/total category scores. (3) Classroom performance as measured by the research school district's spring seventh-grade second-semester grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores.

O_2 = study posttest dependent measures. (1) Achievement as measured by the research school district's spring eighth-grade administration of the EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent scores. (2) Writing achievement as measured by the research school district's eighth-grade administration of the Spring Criterion-Referenced District Descriptive Writing Assessment for holistic/total category scores. (3) Classroom performance as measured by the research school district's spring eighth-grade second-semester grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores.

Implementation of the Independent Variable

The independent variables for this study were eighth-grade students who do not have high-speed Internet connectivity at home, eighth-grade students who have high-speed Internet connectivity at home who also qualify for free or reduced lunch program participation, and eighth-grade students who have high-speed Internet connectivity at home who do not qualify for free or reduced lunch program participation.

Dependent Measures

The study's dependent variables are achievement, writing achievement, and classroom performance. Achievement will be measured by the research school district's spring eighth-grade administration of the EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent scores. Writing achievement will be measured by the research school district's eighth-grade administration of the Spring Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores. Classroom performance will be measured by the research school district's spring eighth-grade, second-semester grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores.

Research Questions and Data Analysis

The following research questions were used to analyze the Norm-referenced EXPLORE Test scores for eighth-grade students who completed a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school who do not have high-speed Internet connectivity at home compared to eighth-grade students eligible and not eligible for free and reduced price lunch program participation who do have high-speed Internet connectivity at home.

Overarching Pretest-Posttest EXPLORE Test Research Question #1. Do eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program participation lose, maintain, or improve their pretest beginning eighth-grade compared to their posttest ending eighth-grade Norm-referenced EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent Scores?

Sub-Question 1a. Is there a statistically significant difference between eighth-grade students who do not have high-speed Internet connectivity at home pretest beginning eighth-grade compared to their posttest ending eighth-grade Norm-referenced EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent Scores?

Sub-Question 1b. Is there a statistically significant difference between eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation pretest beginning eighth-grade compared to their posttest ending eighth-grade Norm-referenced EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent Scores?

Sub-Question 1c. Is there a statistically significant difference between eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation pretest beginning eighth-grade compared to their posttest ending eighth-grade Norm-referenced EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent Scores?

Analysis. Research Sub-Questions #1a, 1b, and 1c will be analyzed using dependent *t* tests to examine the significance of the difference between eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program participation norm-referenced pretest compared to posttest EXPLORE Test Normal Curve Equivalent Scores. Because multiple statistical tests will be conducted, a one-tailed .01 alpha level will be employed to help control for Type 1 errors.

Overarching Posttest-Posttest EXPLORE Test Research Question #2. Do eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program participation have congruent or different posttest compared to posttest ending eighth-grade EXPLORE Test (a) English, (b) reading, (c) math, (d) science, and (e) composite Normal Curve Equivalent scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school?

Analysis. Research Question #2 will be analyzed using Analysis of Covariance (ANCOVA) to determine the rate of score change over time between eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program participation posttest ending eighth-grade EXPLORE Test (a) English, (b) reading, (c) math, (d) science, and (e) composite Normal Curve Equivalent scores. An alpha level of .05 will be utilized to test the null hypothesis.

The following research questions will be used to analyze the Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores for eighth-grade students who completed a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school who do not have high-speed Internet connectivity at home compared to eighth-grade students eligible and not eligible for free and reduced price lunch program participation who do have high-speed Internet connectivity at home.

Overarching Pretest-Posttest Criterion-Referenced District Descriptive Writing Assessment Research Question #3. Do eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program participation lose, maintain, or improve their pretest beginning eighth-grade compared to their posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores?

Sub-Question 3a. Is there a statistically significant difference between eighth-grade students who do not have high-speed Internet connectivity at home pretest beginning eighth-grade compared to their posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores?

Sub-Question 3b. Is there a statistically significant difference between eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation pretest beginning eighth-grade compared to their posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores?

Sub-Question 3c. Is there a statistically significant difference between eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation pretest beginning eighth-grade compared to their posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores?

Analysis. Research Sub-Questions #3a, 3b, and 3c will be analyzed using dependent *t* tests to examine the significance of the difference between eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed

Internet connectivity at home and who do not qualify for free or reduced lunch program participation pretest compared to posttest Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores. Because multiple statistical tests will be conducted, a one-tailed .01 alpha level will be employed to help control for Type 1 errors.

Overarching Posttest-Posttest Criterion-Referenced District Descriptive Writing Assessment Research Question #4. Do eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program participation have congruent or different posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school?

Analysis. Research Question #4 will be analyzed using Analysis of Covariance (ANCOVA) to determine the rate of score change over time between eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores. An alpha level of .05 will be utilized to test the null hypothesis.

The following research questions will be used to analyze classroom performance as measured by the research school district's grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores for eighth-grade students who completed a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school who do not have high-speed Internet connectivity at home compared to eighth-grade students eligible and not eligible for free and reduced price lunch program participation who do have high-speed Internet connectivity at home.

Overarching Pretest-Posttest Classroom Performance Research Question #5. Do eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home lose, maintain, or improve their pretest ending seventh-grade compared to their posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores?

Sub-Question 5a. Is there a statistically significant difference between eighth-grade students who do not have high-speed Internet connectivity at home pretest ending seventh-grade compared to their posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores?

Sub-Question 5b. Is there a statistically significant difference between eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation pretest ending seventh-grade compared to their posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores?

Sub-Question 5c. Is there a statistically significant difference between eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation pretest ending seventh-grade compared to their posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores?

Analysis. Research Sub-Questions #5a, 5b, and 5c will be analyzed using dependent *t* tests to examine the significance of the difference between eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores?. Because multiple statistical tests will be conducted, a one-tailed .01 alpha level will be employed to help control for Type 1 errors.

Overarching Posttest-Posttest Classroom Performance Research Question #6. Do eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home have congruent or different posttest ending eighth-grade, grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school?

Analysis. Research Question #6 will be analyzed using Analysis of Covariance (ANCOVA) to determine the rate of score change over time between eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home posttest ending eighth-grade, grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores. An *F* ratio will be calculated and an alpha level of .05 will be utilized to test the null hypothesis. An alpha level of .05 will be utilized to test the null hypothesis.

Data Collection Procedures

All study achievement data were retrospective, archival, and routinely collected school information. Permission from the appropriate school research personnel was obtained. Achievement data in arm one (n = 19) were a naturally formed group of eighth-grade students who do not have high-speed Internet connectivity at home. Study participants in arm two (n = 19) were randomly selected eighth-grade students who have high-speed Internet connectivity at home who qualify for free or reduced lunch program participation. Study participants in arm three (n = 19) were randomly selected eighth-grade students who have high-speed Internet connectivity at home who do not qualify for free or reduced lunch program participation. Non-coded numbers were used to display individual de-identified achievement data. Aggregated group data, descriptive statistics, and parametric statistical analysis were utilized and reported with means and standard deviations on tables.

Performance site. The research was conducted in the public school setting through normal educational practices. The study procedures did not interfere with the normal educational practices of the public school and did not involve coercion or discomfort of any kind. Data were stored on spreadsheets and computer flash drives for statistical analysis in the office of the primary researcher and the dissertation chair. Data and computer files were kept in locked file cabinets. No individual identifiers were attached to the data.

Confidentiality

Non-coded numbers were used to display individual achievement. Individual data were de-identified by the appropriate personnel after all information was linked and the data sets were complete. All data were analyzed in the office of the Executive Director of Administrative Services at the Westside Community Schools Administration, Board, and Curriculum (ABC) Building located at 909 South 76th Street, Omaha, Nebraska, 68114. Data were stored electronically on spreadsheets and external hard drives for descriptive and inferential statistical analysis. Data and external hard drives were kept in the Executive Director's locked file cabinet. No individual student identifiers were attached to the data.

Institutional Review Board (IRB) for the protection of Human Subjects

Approval Category. The exemption categories for this study were provided under 45CFR.101(b) categories 1 and 4. The research was conducted using routinely collected archival data. A letter of support from the district was provided for IRB review.

CHAPTER FOUR

Results

Purpose of Study

The purpose of this study is to determine the effect of a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school on the norm-referenced achievement test scores, writing assessment scores, and grade point average scores of eighth-grade students who do not have high-speed Internet connectivity at home compared to eighth-grade students eligible and not eligible for free and reduced price lunch program participation who do have high-speed Internet connectivity at home.

Implementation of the Independent Variable

The independent variables for this study were eighth-grade students who do not have high-speed Internet connectivity at home, eighth-grade students who have high-speed Internet connectivity at home who also qualify for free or reduced lunch program participation, and eighth-grade students who have high-speed Internet connectivity at home who do not qualify for free or reduced lunch program participation.

Dependent Measures

The study's dependent variables are achievement, writing achievement, and classroom performance. Achievement will be measured by the research school district's spring eighth-grade administration of the EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent scores. Writing achievement will be measured by the research school district's eighth-grade administration of the Spring Criterion-Referenced District Descriptive Writing

Assessment holistic/total category scores. Classroom performance will be measured by the research school district's spring eighth-grade, second-semester grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores.

All study achievement data related to each of the dependent variables were retrospective, archival, and routinely collected school information. Permission from the appropriate school research personnel was obtained before data were collected and analyzed.

Table 1 displays demographic information of eighth-grade students participating in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school who do not have high-speed Internet connectivity at home compared to eighth-grade students eligible and not eligible for free and reduced price lunch program participation who do have high-speed Internet connectivity at home.

Table 1

Student Demographics

Students:	*n* (%)	*n* (%)	*n* (%)
	Naturally Formed Group/No Internet at home	Random Subject Selection/Internet at home	Random Subject Selection/Internet at home
	19 (100)	19 (100)	19 (100)
Lunch Program Participation:	*n* (%)	*n* (%)	*n* (%)
Eligible	8 (42.1)	19 (100)	
Not Eligible	11 (57.9)		19 (100)
Gender:	*n* (%)	*n* (%)	*n* (%)
Females	13 (73.7)	11 (57.9)	15 (78.9)
Males	6 (31.6)	8 (42.1)	4 (21.1)
Ethnicity:	*n* (%)	*n* (%)	*n* (%)
Black	3 (15.7)	4 (21.1)	1 (5.3)
White	14 (73.7)	15 (78.9)	18 (94.7)
Hispanic	1 (5.3)		
American Indian	1 (5.3)		

Research Question #1

Table 2 displays eighth-grade students who do not have high-speed Internet connectivity at home pretest beginning eighth-grade compared to their posttest ending eighth-grade Norm-referenced EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent Scores.

Sub-Question 1a. As seen in Table 2 the null hypothesis for English, math, science, and composite Normal Curve Equivalent Scores were not rejected in the direction of posttest score improvement where the English subtest score pretest M = 55.68, SD = 21.01, posttest M = 58.68, SD = 23.27, $t(18)$ = 1.16, p = .13 (one-tailed), ES = 0.135; math subtest score pretest M = 54.73, SD = 19.12, posttest M = 58.68, SD = 22.54, $t(18)$ = 1.66, p = .06 (one-tailed), ES = 0.189; science subtest score pretest M = 56.68, SD = 24.84, posttest M = 57.31, SD = 26.56, $t(18)$ = 0.15, p = .44 (one-tailed), ES = 0.024; and composite subtest score pretest M = 56.84, SD = 22.40, posttest M = 60.84, SD = 23.69, $t(18)$ = 1.49, p = .08 (one-tailed), ES = 0.173. Also as seen in Table 2 the null hypothesis for the reading Normal Curve Equivalent Score was rejected in the direction of posttest score improvement where the reading subtest score pretest M = 55.73, SD = 28.71, posttest M = 64.63, SD = 18.98 $t(18)$ = 2.07, p = .03 (one-tailed), ES = 0.373.

Table 2

Eighth-Grade Students Who Do Not Have High-Speed Internet Connectivity at Home Pretest Beginning Eighth-Grade Compared to Their Posttest Ending Eighth-Grade Norm-Referenced *EXPLORE Test for (A) English, (B) Math, (C) Reading, (D) Science, and (E) Composite Normal Curve Equivalent Scores*

	EXPLORE Normal Curve Equivalent Scores						
	Pretest		Posttest				
Source	*M*	*SD*	*M*	*SD*	ES	*t*	*p*
English	55.68	(21.01)	58.68	(23.27)	0.135	1.16	.13†
Math	54.73	(19.12)	58.68	(22.54)	0.189	1.66	.06†
Reading	55.73	(28.71)	64.63	(18.98)	0.373	2.07	.03*
Science	56.68	(24.84)	57.31	(26.56)	0.024	0.15	.44†
Composite	56.84	(22.40)	60.84	(23.69)	0.173	1.49	.08†

Note. Normal Curve Equivalent $M = 50$; $SD = 21.06$.
†*ns*. $*p < .05$.

Sub-Question 1b. As seen in Table 3 the null hypothesis for English, math, science, and composite Normal Curve Equivalent Scores were not rejected in the direction of posttest score improvement for math, science, and composite while the English score was not rejected in the direction of a lower posttest score where the English subtest score pretest $M = 53.00$, $SD = 15.08$, posttest $M = 50.57$, $SD = 16.14$, $t(18) = -1.14$, $p = .13$ (one-tailed), ES = -0.155; math subtest score pretest $M = 48.63$, $SD = 14.32$, posttest $M = 49.47$, $SD = 17.95$, $t(18) = 0.25$, $p = .40$ (one-tailed), ES = 0.052; science subtest score pretest $M = 51.63$, $SD = 17.99$, posttest $M = 51.84$, $SD = 22.77$, $t(18) = 0.07$, $p = .47$ (one-tailed), ES = 0.008; and composite subtest score pretest $M = 51.41$, $SD = 14.83$, posttest $M = 52.36$, $SD = 17.79$, $t(18) = 0.40$, $p = .35$ (one-tailed), ES = 0.058. Also as seen in Table 3 the null hypothesis for the reading Normal Curve Equivalent Score was rejected in the direction of posttest score improvement where the reading subtest score pretest $M = 51.26$, $SD = 16.92$, posttest $M = 55.47$, $SD = 16.00$, $t(18) = 1.75$, $p = .05$ (one-tailed), ES = 0.255.

Table 3

Eighth-Grade Students Who Do Have High-Speed Internet Connectivity At Home and Are Eligible for Free And Reduced Price Lunch Program Participation Pretest Beginning Eighth-Grade Compared to Their Posttest Ending Eighth-Grade Norm-Referenced EXPLORE Test for (A) English, (B) Math, (C) Reading, (D) Science, and (E) Composite Normal Curve Equivalent Scores

	EXPLORE Normal Curve Equivalent Scores						
	Pretest		Posttest				
Source	*M*	*SD*	*M*	*SD*	ES	*t*	*p*
English	53.00	(15.08)	50.57	(16.14)	-0.155	-1.14	.13†
Math	48.63	(14.32)	49.47	(17.95)	0.052	0.25	.40†
Reading	51.26	(16.92)	55.47	(16.00)	0.255	1.75	.048*
Science	51.63	(17.99)	51.84	(22.77)	0.008	0.07	.47†
Composite	51.42	(14.83)	52.36	(17.79)	0.058	0.40	.35†

Note. Normal Curve Equivalent $M = 50$; $SD = 21.06$.
†*ns*. *$p < .05$.

Sub-Question 1c. As seen in Table 4 the null hypothesis for English, math, reading, science, and composite Normal Curve Equivalent Scores were not rejected in the direction of posttest score improvement where the English subtest score pretest *M* = 64.31, *SD* = 18.46, posttest *M* = 66.42, *SD* = 16.39, *t*(18) = 0.86, *p* = .20 (one-tailed), ES = 0.120; math subtest score pretest *M* = 70.94, *SD* = 15.50, posttest *M* = 73.21, *SD* = 17.49, *t*(18) = 1.28, *p* = .11 (one-tailed), ES = 0.137; reading subtest score pretest *M* = 66.42, *SD* = 13.13, posttest *M* = 70.31, *SD* = 15.67, *t*(18) = 1.32, *p* = .10 (one-tailed), ES = 0.270; science subtest score pretest *M* = 65.42, *SD* = 18.09, posttest *M* = 69.47, *SD* = 16.49 *t*(18) = 0.96, *p* = .17 (one-tailed), ES = 0.234; and composite subtest score pretest *M* = 68.94, *SD* = 15.24, posttest *M* = 71.73, *SD* = 16.98, *t*(18) = 1.45, *p* = .08 (one-tailed), ES = 0.173.

Table 4

Eighth-Grade Students Who Do Have High-Speed Internet Connectivity at Home and Are Not Eligible for Free and Reduced Price Lunch Program Participation Pretest Beginning Eighth-Grade Compared to Their Posttest Ending Eighth-Grade Norm-Referenced EXPLORE Test For (A) English, (B) Math, (C) Reading, (D) Science, and (E) Composite Normal Curve Equivalent Scores

	EXPLORE Normal Curve Equivalent Scores						
	Pretest		Posttest				
Source	*M*	*SD*	*M*	*SD*	ES	*t*	*p*
English	64.31	(18.46)	66.42	(16.39)	0.120	0.86	.20†
Math	70.94	(15.50)	73.21	(17.49)	0.137	1.28	.11†
Reading	66.42	(13.13)	70.31	(15.67)	0.270	1.32	.10†
Science	65.42	(18.09)	69.47	(16.49)	0.234	0.96	.17†
Composite	68.94	(15.24)	71.73	(16.98)	0.173	1.45	.08†

Note. Normal Curve Equivalent $M = 50$; $SD = 21.06$.
†*ns*.

Research Question #2

Table 5 displays Analysis of Covariance (ANCOVA) posttest compared to posttest ending eighth-grade English EXPLORE Normal Curve Equivalent scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school. As seen in Table 5 the null hypothesis was not rejected for posttest ending English EXPLORE Normal Curve Equivalent adjusted mean scores where students with no Internet at home (ANCOVA adjusted $M = 60.40$), students with Internet at home who did qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 54.63$), and students with Internet at home who did not qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 60.64$) overall main effect of posttest ending eighth-grade English EXPLORE Normal Curve Equivalent scores was not statistically significant where, $F(2, 53) = 2.02$, $p = .14$. Because no significant main effect was found *post hoc* contrast analyses were not conducted where the rate of test score adjusted mean change equipoise correlation $r = .84$ and coefficient of determination $r^2 = .71$.

Table 5

Analysis of Covariance (ANCOVA) Posttest Compared to Posttest Ending Eighth-Grade EXPLORE Test English Normal Curve Equivalent Scores Following Participation in a Required Yearlong One-To-One Notebook Computer Program Supported by High-Speed Internet Connectivity at School

Source of Variation	Sum of Squares	Mean Square	*df*	*F*	*p*
Adjusted Means	425.35	212.67	2	2.02	.14†
Adjusted Error	5566.88	105.04	53		

	Observed Means	Adjusted Means
Students with no Internet at home	58.68	60.40
Students with Internet at home who did qualify for F/R Lunch	50.57	54.63
Students with Internet at home who did not qualify for F/R Lunch	66.42	60.64

†*ns*.

Table 6 displays Analysis of Covariance (ANCOVA) posttest compared to posttest ending eighth-grade math EXPLORE Normal Curve Equivalent scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school. As seen in Table 6 the null hypothesis was not rejected for posttest ending math EXPLORE Normal Curve Equivalent adjusted mean scores where students with no Internet at home (ANCOVA adjusted $M = 61.92$), students with Internet at home who did qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 58.58$), and students with Internet at home who did not qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 60.86$) overall main effect of posttest ending eighth-grade math EXPLORE Normal Curve Equivalent scores was not statistically significant where, $F(2, 53) = 0.40$, $p = .67$. Because no significant main effect was found *post hoc* contrast analyses were not conducted where the rate of test score adjusted mean change equipoise correlation $r = .81$ and coefficient of determination $r^2 = .66$.

Table 6

Analysis of Covariance (ANCOVA) Posttest Compared to Posttest Ending Eighth-Grade EXPLORE Test Math Normal Curve Equivalent Scores Following Participation in a Required Yearlong One-To-One Notebook Computer Program Supported by High-Speed Internet Connectivity at School

Source of Variation	Sum of Squares	Mean Square	*df*	*F*	*p*
Adjusted Means	104.84	52.42	2	0.40	.67†
Adjusted Error	6961.30	131.35	53		

	Observed Means	Adjusted Means
Students with no Internet at home	58.68	61.92
Students with Internet at home who did qualify for F/R Lunch	49.47	58.58
Students with Internet at home who did not qualify for F/R Lunch	73.21	60.86

†*ns*.

Table 7 displays Analysis of Covariance (ANCOVA) posttest compared to posttest ending eighth-grade reading EXPLORE Normal Curve Equivalent scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school. As seen in Table 7 the null hypothesis was not rejected for posttest ending reading EXPLORE Normal Curve Equivalent adjusted mean scores where students with no Internet at home (ANCOVA adjusted $M = 65.89$), students with Internet at home who did qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 59.24$), and students with Internet at home who did not qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 65.27$) overall main effect of posttest ending eighth-grade reading EXPLORE Normal Curve Equivalent scores was not statistically significant where, $F(2, 53) = 1.74$, $p = .19$. Because no significant main effect was found *post hoc* contrast analyses were not conducted where the rate of test score adjusted mean change equipoise correlation $r = .72$ and coefficient of determination $r^2 = .52$.

Table 7

Analysis of Covariance (ANCOVA) Posttest Compared to Posttest Ending Eighth-Grade EXPLORE Test Reading Normal Curve Equivalent Scores Following Participation in a Required Yearlong One-To-One Notebook Computer Program Supported by High-Speed Internet Connectivity at School

Source of Variation	Sum of Squares	Mean Square	*df*	*F*	*p*
Adjusted Means	104.84	52.42	2	0.40	.67†
Adjusted Error	6961.30	131.35	53		

	Observed Means	Adjusted Means
Students with no Internet at home	58.68	61.92
Students with Internet at home who did qualify for F/R Lunch	49.47	58.58
Students with Internet at home who did not qualify for F/R Lunch	73.21	60.86

†*ns*.

Table 8 displays Analysis of Covariance (ANCOVA) posttest compared to posttest ending eighth-grade science EXPLORE Normal Curve Equivalent scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school. As seen in Table 8 the null hypothesis was not rejected for posttest ending science EXPLORE Normal Curve Equivalent adjusted mean scores where students with no Internet at home (ANCOVA adjusted $M = 58.25$), students with Internet at home who did qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 56.62$), and students with Internet at home who did not qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 63.75$) overall main effect of posttest ending eighth-grade science EXPLORE Normal Curve Equivalent scores was not statistically significant where, $F(2, 53) = 0.95$, $p = .39$. Because no significant main effect was found *post hoc* contrast analyses were not conducted where the rate of test score adjusted mean change equipoise correlation $r = .70$ and coefficient of determination $r^2 = .49$.

Table 8

Analysis of Covariance (ANCOVA) Posttest Compared to Posttest Ending Eighth-Grade EXPLORE Test Science Normal Curve Equivalent Scores Following Participation in a Required Yearlong One-To-One Notebook Computer Program Supported by High-Speed Internet Connectivity at School

Source of Variation	Sum of Squares	Mean Square	*df*	*F*	*p*
Adjusted Means	492.70	246.35	2	0.95	.39†
Adjusted Error	13714.87	258.77	53		

	Observed Means	Adjusted Means
Students with no Internet at home	57.31	58.25
Students with Internet at home who did qualify for F/R Lunch	51.84	56.62
Students with Internet at home who did not qualify for F/R Lunch	69.47	63.75

†*ns*.

Table 9 displays Analysis of Covariance (ANCOVA) posttest compared to posttest ending eighth-grade composite EXPLORE Normal Curve Equivalent scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school. As seen in Table 9 the null hypothesis was not rejected for posttest ending composite EXPLORE Normal Curve Equivalent adjusted mean scores where students with no Internet at home (ANCOVA adjusted $M = 62.95$), students with Internet at home who did qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 59.61$), and students with Internet at home who did not qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 62.37$) overall main effect of posttest ending eighth-grade composite EXPLORE Normal Curve Equivalent scores was not statistically significant where, $F(2, 53) = 0.54$, $p = .59$. Because no significant main effect was found *post hoc* contrast analyses were not conducted where the rate of test score adjusted mean change equipoise correlation $r = .86$ and coefficient of determination $r^2 = .73$.

Table 9

Analysis of Covariance (ANCOVA) Posttest Compared to Posttest Ending Eighth-Grade EXPLORE Test Composite Normal Curve Equivalent Scores Following Participation in a Required Yearlong One-To-One Notebook Computer Program Supported by High-Speed Internet Connectivity at School

Source of Variation	Sum of Squares	Mean Square	*df*	*F*	*p*
Adjusted Means	114.03	57.01	2	0.54	.59†
Adjusted Error	5578.46	105.25	53		

	Observed Means	Adjusted Means
Students with no Internet at home	60.84	62.95
Students with Internet at home who did qualify for F/R Lunch	52.36	59.61
Students with Internet at home who did not qualify for F/R Lunch	71.73	62.37

†*ns*.

Research Question #3

Table 10 displays eighth-grade students who do not have high-speed Internet connectivity at home and eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation and eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program pretest beginning eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores to their posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores.

As seen in Table 10 the null hypothesis for the Criterion-Referenced District Descriptive Writing Assessment was not rejected in the direction of posttest score improvement for eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores pretests for those who do not have high-speed Internet connectivity at home pretest $M = 5.43$, $SD = 1.13$, posttest $M = 5.61$, $SD = 1.17$, $t(18) = 0.65$, $p = .26$ (one-tailed), ES = 0.153. Also in Table 10 the null hypothesis for the Criterion-Referenced District Descriptive Writing Assessment was not rejected in the direction of posttest score decline for eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores pretest for eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation pretest $M = 5.31$, $SD = 1.15$, posttest $M = 5.02$, $SD = 0.93$, $t(18) = -1.60$, $p = .06$ (one-tailed), ES = -0.284.

Table 10 also shows that the null hypothesis for the Criterion-Referenced District Descriptive Writing Assessment was rejected in the direction of posttest score decline for the eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores pretest for eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program participation pretest M = 6.31, SD = 0.74, posttest M = 5.87, SD = 0.92, $t(18) = -2.16$, p = .02 (one-tailed), ES = -0.528.

Table 10

Eighth-Grade Students Who Do Not Have High-Speed Internet Connectivity at Home and Eighth-Grade Students Who Have High-Speed Internet Connectivity at Home and Who Qualify and Do Not Qualify for Free Or Reduced Lunch Program Participation Pretest Beginning Eighth-Grade Criterion-Referenced District Descriptive Writing Assessment Holistic/Total Category Scores to their Posttest Ending Eighth-Grade Criterion-Referenced District Descriptive Writing Assessment Holistic/Total Category Scores

	Criterion-Referenced District Descriptive Writing Assessment Scores						
	Pretest		Posttest				
Source	*M*	*SD*	*M*	*SD*	ES	*t*	*p*
No Internet	5.43	(1.13)	5.61	(1.17)	0.153	0.65	.26†
Internet F/R	5.31	(1.15)	5.02	(0.93)	-0.284	-1.60	.06†
Internet not F/R	6.31	(0.74)	5.87	(0.92)	-0.528	-2.16	.02*

Note: Internet refers to home connectivity and F/R stands for Free or Reduced Lunch Program participation.
†*ns*. *$p < .05$.

Research Question #4

Table 11 displays Analysis of Covariance (ANCOVA) posttest compared to posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school. As seen in Table 11 the null hypothesis was not rejected for posttest ending science Criterion-Referenced District Descriptive Writing Assessment adjusted mean scores where students with no Internet at home (ANCOVA adjusted $M = 5.75$), students with Internet at home who did qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 5.22$), and students with Internet at home who did not qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 5.50$) overall main effect of posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment scores was not statistically significant where, $F(2, 53) = 1.81$, $p = .17$. Because no significant main effect was found *post hoc* contrast analyses were not conducted where the rate of test score adjusted mean change equipoise correlation $r = .55$ and coefficient of determination $r^2 = .30$.

Table 11

Analysis of Covariance (ANCOVA) Posttest Compared to Posttest Ending Eighth-Grade Criterion-Referenced District Descriptive Writing Assessment Holistic Scores Following Participation in a Required Yearlong One-To-One Notebook Computer Program Supported by High-Speed Internet Connectivity at School

Source of Variation	Sum of Squares	Mean Square	*df*	*F*	*p*
Adjusted Means	2.67	1.33	2	1.81	.17†
Adjusted Error	39.16	0.74	53		

	Observed Means	Adjusted Means
Students with no Internet at home	5.61	5.75
Students with Internet at home who did qualify for F/R Lunch	5.02	5.22
Students with Internet at home who did not qualify for F/R Lunch	5.87	5.53

†*ns*.

Research Question #5

Table 12 displays eighth-grade students who do not have high-speed Internet connectivity at home pretest ending seventh-grade compared to their posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores.

Sub-Question 5a. As seen in Table 12 the null hypothesis for English, social studies, and cumulative GPA scores were not rejected in the direction of posttest score improvement where the English scores pretest $M = 3.05$, $SD = 1.18$, posttest $M = 3.18$, $SD = 0.95$, $t(18) = 0.66$, $p = .26$ (one-tailed), ES = 0.123; social studies scores pretest $M = 3.05$, $SD = 1.34$, posttest $M = 3.42$, $SD = 1.03$, $t(18) = 1.66$, $p = .06$ (one-tailed), ES = 0.310; and cumulative GPA scores pretest $M = 3.26$, $SD = 0.73$, posttest $M = 3.33$, $SD = 0.77$, $t(18) = 0.83$, $p = .21$ (one-tailed), ES = 0.098. Also as seen in Table 12 the null hypothesis for the science scores was rejected in the direction of posttest score decline where the science scores pretest $M = 3.10$, $SD = 1.04$, posttest $M = 2.81$, $SD = 1.37$ $t(18) = -2.07$, $p = .03$ (one-tailed), ES = -0.240.

Table 12

Eighth-Grade Students Who Do Not Have High-Speed Internet Connectivity at Home Pretest Ending Seventh-Grade Compared to Their Posttest Ending Eighth-Grade Grade Point Average Scores for Core Subjects (A) English, (B) Science, (C) Social Studies, and (D) Cumulative GPA Scores

Core Content Areas and Cumulative GPA Scores

	Pretest		Posttest				
Source	*M*	*SD*	*M*	*SD*	ES	*t*	*p*
English	3.05	(1.18)	3.18	(0.95)	0.123	0.66	.26†
Science	3.10	(1.04)	2.81	(1.37)	-0.240	-2.07	.03*
Soc. Studies	3.05	(1.34)	3.42	(1.03)	0.310	1.66	.06†
Cum. GPA	3.26	(0.73)	3.33	(0.77)	0.098	0.83	.21†

†*ns*. **p* < .05.

Table 13 displays eighth-grade students who have high-speed Internet connectivity at home and also qualify for free and/or reduced lunch price program participation pretest ending seventh-grade compared to their posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores.

Sub-Question 5b. As seen in Table 13 the null hypothesis for English, social studies, and cumulative GPA scores were not rejected in the direction of posttest score improvement where the English scores pretest $M = 2.92$, $SD = 0.78$, posttest $M = 3.10$, $SD = 0.95$, $t(18) = 0.75$, $p = .23$ (one-tailed), ES = 0.212; social studies scores pretest $M = 2.47$, $SD = 1.02$, posttest $M = 2.94$, $SD = 0.97$, $t(18) = 1.71$, $p = .052$ (one-tailed), ES = 0.476; and cumulative GPA scores pretest $M = 2.86$, $SD = 0.65$, posttest $M = 3.05$, $SD = 0.76$, $t(18) = 1.55$, $p = .07$ (one-tailed), ES = 0.094. Also as seen in Table 13 the null hypothesis for the science scores was rejected in the direction of posttest score decline where the science scores pretest $M = 2.60$, $SD = 1.12$, posttest $M = 2.21$, $SD = 1.29$ $t(18) = -2.33$, $p = .02$ (one-tailed), ES = -0.327.

Table 13

Eighth-Grade Students Who Do Have High-Speed Internet Connectivity at Home and Also Qualify for Free and/or Reduced Price Lunch Program Participation Pretest Ending Seventh-Grade Compared to Their Posttest Ending Eighth-Grade Grade Point Average Scores for Core Subjects (A) English, (B) Science, (C) Social Studies, and (D) Cumulative GPA Scores

	Core Content Areas and Cumulative GPA Scores						
	Pretest		Posttest				
Source	*M*	*SD*	*M*	*SD*	ES	*t*	*p*
English	2.92	(0.78)	3.10	(0.95)	0.212	0.75	.23†
Science	2.60	(1.12)	2.21	(1.29)	-0.327	-2.33	.02*
Soc. Studies	2.47	(1.02)	2.94	(0.97)	0.476	1.71	.052†
Cum. GPA	2.86	(0.65)	3.05	(0.76)	0.094	1.55	.07†

†*ns*. *$p < .05$.

Table 14 displays eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free and/or reduced lunch price program participation pretest ending seventh-grade compared to their posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative GPA scores.

Sub-Question 5c. As seen in Table 14 the null hypothesis for English and science scores were not rejected in the direction of posttest score decline where the English scores pretest $M = 3.94$, $SD = 0.43$, posttest $M = 3.81$, $SD = 0.80$, $t(18) = -0.81$, $p = .21$ (one-tailed), ES = -0.213; and science scores pretest $M = 3.76$, $SD = 0.75$, posttest $M = 3.57$, $SD = 0.78$, $t(18) = -1.59$, $p = .06$ (one-tailed), ES = -0.240. Also seen in Table 14 the null cumulative GPA scores was not rejected in the direction of posttest score improvement where the cumulative GPA scores pretest $M = 3.77$, $SD = 0.50$, posttest $M = 3.79$, $SD = 0.54$, $t(18) = 0.35$, $p = .37$ (one-tailed), ES = 0.039. However as seen in Table 14 the null hypothesis for the social studies scores was rejected in the direction of posttest score improvement where the social studies scores pretest $M = 3.52$, $SD = 0.87$, posttest $M = 3.94$, $SD = 0.81$, $t(18) = 2.51$, $p = .011$ (one-tailed), ES = 0.501.

Table 14

Eighth-Grade Students Who Do Have High-Speed Internet Connectivity at Home and Who Do Not Qualify for Free and/or Reduced Price Lunch Program Participation Pretest Ending Seventh-Grade Compared to Their Posttest Ending Eighth-Grade Grade Point Average Scores for Core Subjects (A) English, (B) Science, (C) Social Studies, and (D) Cumulative GPA Scores

Core Content Areas and Cumulative GPA Scores

	Pretest		Posttest				
Source	*M*	*SD*	*M*	*SD*	ES	*t*	*p*
English	3.94	(0.43)	3.81	(0.80)	-0.213	-0.81	.21†
Science	3.76	(0.75)	3.57	(0.78)	-0.240	-1.59	.06†
Soc. Studies	3.52	(0.87)	3.94	(0.81)	0.501	2.51	.011*
Cum. GPA	3.77	(0.50)	3.79	(0.54)	0.039	0.35	.37†

†*ns*. *$p < .05$.

Research Question #6

Table 15 displays Analysis of Covariance (ANCOVA) posttest compared to posttest ending eighth-grade English scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school. As seen in Table 15 the null hypothesis was not rejected for posttest ending English scores adjusted mean scores where students with no Internet at home (ANCOVA adjusted $M = 3.30$), students with Internet at home who did qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 3.29$), and students with Internet at home who did not qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 3.50$) overall main effect of posttest ending eighth-grade English scores was not statistically significant where, $F(2, 53) = 0.35$, $p = .71$. Because no significant main effect was found *post hoc* contrast analyses were not conducted where the rate of test score adjusted mean change equipoise correlation $r = .47$ and coefficient of determination $r^2 = .22$.

Table 15

Analysis of Covariance (ANCOVA) Posttest Compared to Posttest Ending Eighth-Grade English Scores Following Participation in a Required Yearlong One-To-One Notebook Computer Program Supported by High-Speed Internet Connectivity at School

Source of Variation	Sum of Squares	Mean Square	*df*	*F*	*p*
Adjusted Means	0.43	0.21	2	0.35	.71†
Adjusted Error	32.20	0.61	53		

	Observed Means	Adjusted Means
Students with no Internet at home	3.18	3.30
Students with Internet at home who did qualify for F/R Lunch	3.10	3.29
Students with Internet at home who did not qualify for F/R Lunch	3.81	3.50

†*ns*.

Table 16 displays Analysis of Covariance (ANCOVA) posttest compared to posttest ending eighth-grade science scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school. As seen in Table 16 the null hypothesis was not rejected for posttest ending science scores adjusted mean scores where students with no Internet at home (ANCOVA adjusted $M = 2.86$), students with Internet at home who did qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 2.77$), and students with Internet at home who did not qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 2.95$) overall main effect of posttest ending eighth-grade science scores was not statistically significant where, $F(2, 53) = 0.32$, $p = .73$. Because no significant main effect was found *post hoc* contrast analyses were not conducted where the rate of test score adjusted mean change equipoise correlation $r = .85$ and coefficient of determination $r^2 = .72$.

Table 16

Analysis of Covariance (ANCOVA) Posttest Compared to Posttest Ending Eighth-Grade Science Scores Following Participation in a Required Yearlong One-To-One Notebook Computer Program Supported by High-Speed Internet Connectivity at School

Source of Variation	Sum of Squares	Mean Square	*df*	*F*	*p*
Adjusted Means	0.25	0.13	2	0.32	.73†
Adjusted Error	21.02	0.40	53		

	Observed Means	Adjusted Means
Students with no Internet at home	2.81	2.86
Students with Internet at home who did qualify for F/R Lunch	2.21	2.77
Students with Internet at home who did not qualify for F/R Lunch	3.57	2.95

†*ns*.

Table 17 displays Analysis of Covariance (ANCOVA) posttest compared to posttest ending eighth-grade social studies scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school. As seen in Table 17 the null hypothesis was not rejected for posttest ending social studies scores adjusted mean scores where students with no Internet at home (ANCOVA adjusted $M = 3.40$), students with Internet at home who did qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 3.19$), and students with Internet at home who did not qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 3.71$) overall main effect of posttest ending eighth-grade social studies scores was not statistically significant where, $F(2, 53) = 1.70$, $p = .19$. Because no significant main effect was found *post hoc* contrast analyses were not conducted where the rate of test score adjusted mean change equipoise correlation $r = .54$ and coefficient of determination $r^2 = .29$.

Table 17

Analysis of Covariance (ANCOVA) Posttest Compared to Posttest Ending Eighth-Grade Social Studies Scores Following Participation in a Required Yearlong One-To-One Notebook Computer Program Supported by High-Speed Internet Connectivity at School

Source of Variation	Sum of Squares	Mean Square	*df*	*F*	*p*
Adjusted Means	2.18	1.09	2	1.70	.19†
Adjusted Error	34.09	0.64	53		

	Observed Means	Adjusted Means
Students with no Internet at home	3.42	3.40
Students with Internet at home who did qualify for F/R Lunch	2.94	3.19
Students with Internet at home who did not qualify for F/R Lunch	3.94	3.71

†*ns*.

Table 18 displays Analysis of Covariance (ANCOVA) posttest compared to posttest ending eighth-grade cumulative grade point averages (GPA) scores following participation in a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school. As seen in Table 18 the null hypothesis was not rejected for posttest ending cumulative grade point averages (GPA) scores adjusted mean scores where students with no Internet at home (ANCOVA adjusted $M = 3.36$), students with Internet at home who did qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 3.44$), and students with Internet at home who did not qualify for free and/or reduced price lunch program participation (ANCOVA adjusted $M = 3.36$) overall main effect of posttest ending eighth-grade cumulative grade point averages (GPA) scores was not statistically significant where, $F(2, 53) = 0.18$, $p = .84$. Because no significant main effect was found *post hoc* contrast analyses were not conducted where the rate of test score adjusted mean change equipoise correlation $r = .82$ and coefficient of determination $r^2 = .67$.

Table 18

Analysis of Covariance (ANCOVA) Posttest Compared to Posttest Ending Eighth-Grade Cumulative Grade Point Averages (GPA) *Scores Following Participation in a Required Yearlong One-To-One Notebook Computer Program Supported by High-Speed Internet Connectivity at School*

Source of Variation	Sum of Squares	Mean Square	*df*	*F*	*p*
Adjusted Means	0.06	0.03	2	0.18	.84†
Adjusted Error	8.69	0.16	53		

	Observed Means	Adjusted Means
Students with no Internet at home	3.33	3.36
Students with Internet at home who did qualify for F/R Lunch	3.05	3.44
Students with Internet at home who did not qualify for F/R Lunch	3.79	3.36

†*ns*.

CHAPTER FIVE

Conclusions and Discussion

The following conclusions may be drawn from the study for each of the six research questions.

Conclusion Research Question #1

Sub-Question #1a. Evaluating eighth-grade students who do not have high-speed Internet connectivity at home posttest ending eighth-grade Norm-referenced EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent Scores converted to percentile ranks and stanine scores helps put their performance in perspective. Eighth-grade students who do not have high-speed Internet connectivity at home posttest ending English subtest score posttest $M = 58.68$ is congruent with a percentile rank of 66 and a stanine score of six which is the upper stanine in the average range (stanines 4, 5, and 6) predict that these students may expect to complete further high school English coursework successfully. Furthermore, eighth-grade students who do not have high-speed Internet connectivity at home posttest ending math subtest score posttest $M = 58.68$ is congruent with a percentile rank of 66 and a stanine score of six which is the upper stanine in the average range (stanines 4, 5, and 6) predict that these students may expect to complete further high school math coursework successfully. Also, eighth-grade students who do not have high-speed Internet connectivity at home posttest ending reading subtest score posttest $M = 64.63$ is congruent with a percentile rank of 75 and a stanine score of six which is the upper stanine in the average range (stanines 4, 5, and 6) predict that these students may expect to complete further high school reading coursework successfully. Eighth-grade students who do not have high-speed Internet connectivity at home posttest ending science subtest score posttest *M* = 57.31 is congruent with a percentile rank of 63 and a stanine score of six which is the upper stanine in the average range (stanines 4, 5, and 6) predict that these students may expect to complete further high school science coursework successfully. Eighth-grade students who do not have high-speed Internet connectivity at home posttest ending composite subtest score posttest *M* = 60.84 is congruent with a percentile rank of 70 and a stanine score of six which is the upper stanine in the average range (stanines 4, 5, and 6). In the main, these posttest English, math, reading, science, and composite EXPLORE standard scores indicate that these students may expect to complete further high school coursework successfully. Furthermore, high stakes assessment scores at this level also indicate the overall positive effects of student participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Sub-Question #1b. Evaluating eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation posttest ending eighth-grade Norm-referenced EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent Scores converted to percentile ranks and stanine scores helps put their performance in perspective. Eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation posttest ending English subtest score posttest *M* = 50.57 is congruent with a percentile rank of 53 and a stanine score of five which is the middle stanine in the average range (stanines 4, 5, and 6) predict that these students may expect to complete further high school English coursework successfully. Furthermore, eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation posttest ending math subtest score posttest $M = 49.47$ is congruent with a percentile rank of 50 and a stanine score of five which is the middle stanine in the average range (stanines 4, 5, and 6) predict that these students may expect to complete further high school math coursework successfully. Also, eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation posttest ending reading subtest score posttest $M = 55.47$ is congruent with a percentile rank of 61 and a stanine score of six which is the upper stanine in the average range (stanines 4, 5, and 6) predict that these students may expect to complete further high school reading coursework successfully. Also, eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation posttest ending science subtest score posttest $M = 51.84$ is congruent with a percentile rank of 53 and a stanine score of five which is the middle stanine in the average range (stanines 4, 5, and 6) predict that these students may expect to complete further high school science coursework successfully. Also, eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation posttest ending composite subtest score posttest $M = 52.36$ is congruent with a percentile rank of 55 and a stanine score of five which is the middle stanine in the average range (stanines 4, 5, and 6). In the main, these posttest English, math, reading, science, and composite EXPLORE standard scores predict that these students may expect to complete further high school coursework successfully. Furthermore, high stakes assessment scores at this level also indicate the overall positive effects of student participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Sub-Question #1c. Evaluating eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation posttest ending eighth-grade Norm-referenced EXPLORE Test for (a) English, (b) math, (c) reading, (d) science, and (e) composite Normal Curve Equivalent Scores converted to percentile ranks and stanine scores helps put their performance in perspective. Eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation posttest ending English subtest score posttest $M = 66.42$ is congruent with a percentile rank of 77 and a stanine score of six which is the upper stanine in the average range (stanines 4, 5, and 6) predict that these students may expect to complete further high school English coursework successfully. Eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation posttest ending math subtest score posttest $M = 73.21$ is congruent with a percentile rank of 86 and a stanine score of seven which is the lower stanine in the above average range (stanines 7, 8, and 9) indicate that these students may expect to complete further high school math coursework successfully. Eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation posttest ending reading subtest score posttest $M = 70.31$ is congruent with a percentile rank of 84 and a stanine score of seven which is the lower stanine in the above average range (stanines 7, 8, and 9) predict that these students may expect to complete further high school reading coursework successfully. Eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation posttest ending science subtest score posttest $M = 69.47$ is congruent with a percentile rank of 83 and a stanine score of seven which is the lower stanine in the above average range (stanines 7, 8, and 9) predict that these students may expect to complete further high school science coursework successfully. Eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation posttest ending composite subtest score posttest $M = 71.73$ is congruent with a percentile rank of 84 and a stanine score of seven which is the lower stanine in the above average range (stanines 7, 8, and 9). In the main, these posttest English, math, reading, science, and composite EXPLORE standard scores predict that these students may expect to complete further high school coursework successfully. Furthermore, high stakes assessment scores at this level also indicate the overall positive effects of student participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Conclusion Research Question #2

Posttest English Analysis of Covariance (ANCOVA) adjusted mean score comparison for eighth-grade students who do not have high-speed Internet connectivity at home (ANCOVA adjusted $M = 60.40$), eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation (ANCOVA adjusted $M = 54.63$), and eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 60.64) was not statistically different indicating a congruent pretest to posttest rate of gain with a coefficient of determination r^2 = .71 or 71% rate of English test score congruence. Equipoise indicates the overall positive effect on English test scores of students' participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Posttest math Analysis of Covariance (ANCOVA) adjusted mean score comparison for eighth-grade students who do not have high-speed Internet connectivity at home (ANCOVA adjusted *M* = 61.92), eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 58.58), and eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 60.86) was not statistically different indicating a congruent pretest to posttest rate of gain with a coefficient of determination r^2 = .66 or 66% rate of math test score congruence. Equipoise indicates the overall positive effect on math test scores of students' participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Posttest reading Analysis of Covariance (ANCOVA) adjusted mean score comparison for eighth-grade students who do not have high-speed Internet connectivity at home (ANCOVA adjusted *M* = 65.89), eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 59.24), and eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 65.27) was not statistically different indicating a congruent pretest to posttest rate of gain with a coefficient of determination r^2 = .52 or 52% rate of reading test score congruence. Equipoise indicates the overall positive effect on reading test scores of students' participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Posttest science Analysis of Covariance (ANCOVA) adjusted mean score comparison for eighth-grade students who do not have high-speed Internet connectivity at home (ANCOVA adjusted *M* = 58.25), eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 56.62), and eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 63.75) was not statistically different indicating a congruent pretest to posttest rate of gain with a coefficient of determination r^2 = .49 or 49% rate of science test score congruence. Equipoise indicates the overall positive effect on science test scores of students' participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Posttest composite Analysis of Covariance (ANCOVA) adjusted mean score comparison for eighth-grade students who do not have high-speed Internet connectivity at home (ANCOVA adjusted *M* = 62.95), eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 59.61), and eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 62.37) was not statistically different indicating a congruent pretest to posttest rate of gain with a coefficient of determination $r^2 = .73$ or 73% rate of composite test score congruence. Equipoise indicates the overall positive effect on composite test scores of students' participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Conclusion Research Question #3

Evaluating eighth-grade students who do not have high-speed Internet connectivity at home, eighth-grade students who have high-speed Internet connectivity at home and who qualify for free or reduced lunch program participation, and eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program posttest ending eighth-grade Criterion-Referenced District Descriptive Writing Assessment holistic/total category scores which can range from a low score of 2 to a high score of 8. The cut score requires students to receive a score equal too or greater than 4.33 to be considered proficient on this writing assessment measure. Students meeting or exceeding the cut score are deemed proficient while those below the cut score are deemed non-proficient.

Eighth-grade students who do not have high-speed Internet connectivity at home posttest ending Criterion-Referenced District Descriptive Writing Assessment holistic/total category score *M* = 5.61. In this group 89% (17 out of 19) scored equal too or greater than the necessary cut score of 4.33. The mean for this group is well above the necessary cut score and predicts that these students may expect to complete further high school writing prompts and coursework successfully. Also, eighth-grade students who have high-speed Internet connectivity at home and who also qualify for free or reduced lunch program participation posttest ending Criterion-Referenced District Descriptive Writing Assessment holistic/total category score *M* = 5.02. In this group 84% (16 out of 19) scored equal too or greater than the necessary cut score of 4.33. The mean for this group is well above the necessary cut score predicting that these students may expect to complete further high school writing prompts and coursework successfully. In addition, eighth-grade students who have high-speed Internet connectivity at home and who do not qualify for free or reduced lunch program participation posttest ending Criterion-Referenced District Descriptive Writing Assessment holistic/total category score *M* = 5.87. In this group 95% (18 out of 19) scored equal too or greater than the necessary cut score of 4.33. The mean for this group is well above the necessary cut score and predicts that these students may expect to complete further high school writing prompts and coursework successfully. Furthermore, high stakes assessment scores at this level also indicate the overall positive effects of student participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Conclusion Research Question #4

Posttest Criterion-Referenced District Descriptive Writing Assessment Analysis of Covariance (ANCOVA) adjusted mean score comparison for eighth-grade students who do not have high-speed Internet connectivity at home (ANCOVA adjusted *M* = 5.75), eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 5.22), and eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 5.50) was not statistically different indicating a congruent pretest to posttest rate of gain with a coefficient of determination r^2 = .30 or 30% rate of writing test score congruence. Equipoise indicates the overall positive effect on writing scores of students' participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Conclusion Research Question #5

Sub-Question 5a. Evaluating eighth-grade students posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative grade point average (GPA) scores for students who do not have high-speed Internet connectivity at home grade point average scores (GPA) that range from 4.5 to 0.0 converted to letter grades helps put their performance in perspective. Letter grades at the research site range from a high grade of A+ (4.5) to a low grade of F (0.0). Eighth-grade students who do not have high-speed Internet connectivity at home posttest ending English subtest score posttest *M* = 3.18 is congruent with a letter grade of B predicting that these students may expect to complete further high school English coursework successfully. Also, eighth-grade students who do not have high-speed Internet connectivity at home posttest ending science subtest score posttest *M* = 2.81 is congruent with a letter grade of B- predicting that these students may expect to complete further high school science coursework successfully. In addition, eighth-grade students who do not have high-speed Internet connectivity at home posttest ending social studies subtest score posttest *M* = 3.42 is congruent with a letter grade of B+ predicting that these students may expect to complete further high school social studies coursework successfully. Finally, eighth-grade students who do not have high-speed Internet connectivity at home posttest ending cumulative GPA subtest score posttest *M* = 3.33 is congruent with a letter grade of B predicting that these students may expect to complete further high school coursework successfully. Furthermore, core classroom grade scores at this level also indicate the overall positive effects of student participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Sub-Question 5b. Evaluating eighth-grade students posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative grade point average (GPA) scores for students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation grade point average scores (GPA) that range from 4.5 to 0.0 converted to letter grades helps put their performance in perspective. Letter grades at the research site range from a high grade of A+ (4.5) to a low grade of F (0.0). Eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation posttest ending English subtest score posttest *M* = 3.10 is congruent with a letter grade of B predicting that these students may expect to complete further high school English coursework successfully. Also, eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation posttest ending science subtest score posttest *M* = 2.21 is congruent with a letter grade of C predicting that these students may expect to complete further high school science coursework successfully. In addition, eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation posttest ending social studies subtest score posttest *M* = 2.94 is congruent with a letter grade of B predicting that these students may expect to complete further high school social studies coursework successfully. Finally, eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation posttest ending cumulative GPA subtest score posttest *M* = 3.05 is congruent with a letter grade of B predicting that these students may expect to complete further high school coursework successfully. Furthermore, core classroom grade scores at this level also indicate the overall positive effects of student participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Sub-Question 5c. Evaluating eighth-grade students posttest ending eighth-grade grade point average scores for core subjects (a) English, (b) science, (c) social studies, and (d) cumulative grade point average (GPA) scores for students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation grade point average scores (GPA) that range from 4.5 to 0.0 converted to letter grades helps put their performance in perspective. Letter grades at the research site range from a high grade of A+ (4.5) to a low grade of F (0.0). Eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation posttest ending English subtest score posttest *M* = 3.81 is congruent with a letter grade of A- predicting that these students may expect to complete further high school English coursework successfully. Also, eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation posttest ending science subtest score posttest $M = 3.57$ is congruent with a letter grade of B+ predicting that these students may expect to complete further high school science coursework successfully. In addition, eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation posttest ending social studies subtest score posttest $M = 3.94$ is congruent with a letter grade of A predicting that these students may expect to complete further high school social studies coursework successfully. Finally, eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation posttest ending cumulative GPA subtest score posttest $M = 3.79$ is congruent with a letter grade of A- predicting that these students may expect to complete further high school coursework successfully. Furthermore, core classroom grade scores at this level also indicate the overall positive effects of student participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Conclusion Research Question #6

Posttest English core grade score Analysis of Covariance (ANCOVA) adjusted mean score comparison for eighth-grade students who do not have high-speed Internet connectivity at home (ANCOVA adjusted $M = 3.30$), eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation (ANCOVA adjusted $M = 3.29$), and eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 3.50) was not statistically different indicating a congruent pretest to posttest rate of gain with a coefficient of determination r^2 = .22 or 22% rate of English core grade score congruence. Equipoise indicates the overall positive effect on English core grade scores of students' participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Posttest science core grade score Analysis of Covariance (ANCOVA) adjusted mean score comparison for eighth-grade students who do not have high-speed Internet connectivity at home (ANCOVA adjusted *M* = 2.86), eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 2.77), and eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 2.95) was not statistically different indicating a congruent pretest to posttest rate of gain with a coefficient of determination r^2 = .72 or 72% rate of science core grade score congruence. Equipoise indicates the overall positive effect on science core grade scores of students' participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Posttest social studies core grade score Analysis of Covariance (ANCOVA) adjusted mean score comparison for eighth-grade students who do not have high-speed Internet connectivity at home (ANCOVA adjusted *M* = 3.40), eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 3.19), and eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 3.71) was not statistically different indicating a congruent pretest to posttest rate of gain with a coefficient of determination r^2 = .22 or 22% rate of social studies core grade score congruence. Equipoise indicates the overall positive effect on social studies core grade scores of students' participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Posttest cumulative grade point average (GPA) core grade score Analysis of Covariance (ANCOVA) adjusted mean score comparison for eighth-grade students who do not have high-speed Internet connectivity at home (ANCOVA adjusted *M* = 3.36), eighth-grade students who do have high-speed Internet connectivity at home and are eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 3.44), and eighth-grade students who do have high-speed Internet connectivity at home and are not eligible for free and reduced price lunch program participation (ANCOVA adjusted *M* = 3.36) was not statistically different indicating a congruent pretest to posttest rate of gain with a coefficient of determination r^2 = .67 or 67% rate of cumulative grade point average (GPA) score congruence. Equipoise indicates the overall positive effect on cumulative grade point average (GPA) scores of students' participation in the research school districts one-to-one notebook computer take home initiative regardless of Internet connectivity at home.

Discussion

The results of this study support the implementation of one-to-one notebook computer programs as a systematic intervention to improve achievement for students eligible for free or reduced price lunch program participation as well as students who are not eligible for free or reduced price lunch program participation who may or may not have access to high-speed Internet connectivity at home. Programs such as these provide 24-7 access to technology-rich environments and instruction and they should merit consideration by policy makers and educators for implementation within their home districts (Gulek & Demirtas, 2005). School leaders should not only implement this type of program but they also need to guarantee the sustainability of these programs. School leaders know they can increase the achievement for all students while at the same time blurring the disadvantageous caused by students from low socioeconomic backgrounds and/or those with no Internet access at home. Furthermore, all pretest-posttest within group gains and posttest-posttest between group equipoise demonstrated that the achievement gap between students eligible and students not eligible for free or reduced price lunch participation with or without high-speed Internet connectivity at home had been mitigated through participation in the school-wide one-to-one notebook computer program. Providing all students with equity of opportunity in a digital way is fundamentally something that all school leaders in public and private educational settings should aspire to accomplish for their students. While the one-to-one notebook eighth-grade computer program in this study may not be singled out solely for between group equipoise causality, its inclusion as a fundamental academic programmatic component of this middle school's curriculum should be considered as a contributing factor.

Implications for practice. Educational leaders and policymakers are dealing with the challenges of selecting and implementing devices that provide access to high-quality digital resources (Bailey, Schneider, & Vander Ark, 2012). State governments and local school districts have invested billions of dollars to acquire and integrate computer-based technologies into American schools and board of educations and state officials want to see increased student achievement results from these expenditures (O'Dwyer et al., 2005). More and more schools are embracing one-to-one notebook computer initiatives, in which students of every grade at participating schools have access to a mobile technology throughout the day and at home in hopes of leveling the playing field for all of their students. Students will need access to devices that allow them to consume and create digital content tailored to their individual learning styles and instructional needs (Bailey et al., 2012). Using a project-based backwards design lesson coupled with a one-to-one notebook computer setting allows for students to personalize their learning meeting their unique learning requirements (Huff & Saxberg, 2009).

In actual practice school districts will need to ask themselves, how do students learn best and what can they create that demonstrates that learning (Lehmann, 2012). Schools will then need to provide access to the tools and resources necessary for all students to meet the challenges of the before-mentioned questions. Schools must provide rigorous, project-based lessons that focus on inquiry, research, collaboration, student reflections, and writing (Lehmann, 2012). Educators will be called upon to create the content and activities for a system that is targeted to engage the learners in the key concepts of their individual content areas (Huff & Saxberg, 2009). As educators peer-review these lessons they will quickly be able to see which activities work best for students with different learning styles (Huff & Saxberg, 2009)

Findings from numerous studies show that one-to-one notebook implementations have resulted in increased student peer collaborative work, increased participation in project-based learning, improved writing quantity and quality, improved problem-solving and critical thinking skills, and increased time spent working on school work away from school (Gulek & Demirtas, 2005). Along with this focus on individual students, educators will need real-time student information to make the best instructional decisions for their students. Broadband access coupled with technology tools would give teachers access to information from a central data repository in regard to each student's learning preferences, motivations, personal accomplishments, and achievement record over time which would allow teachers to tailor learning to meet each student's needs (Bailey, Carter, Schneider, & Vander Ark, 2012). Even at the University level access to electronic portfolios provide program participants real time access to their learning goals, academic progress, and serve as a gathering place for student artifacts that demonstrate that learning has taken place (Smith, 2011).

Technology tools allow staff to differentiate not only for a child's cognitive ability but for their social and emotional abilities as well. Students having difficulty communicating with other peers, develop difficulties building close friendships. Technology tools can break down those physical barriers that sometime disrupt students from working together. Friendships present opportunities for children to use, refine, and augment skills that allow them to network, negotiate, resolve conflicts, exchange ideas, collaborate, and solve problems (Hill & Coufal, 2005). These types of interactions, whether face-to-face or online, develop the necessary 21st century skills that allow a person to negotiate the complexities of today's world.

Implications for policy. Schools must learn to leverage and plan their technology purchases with devices already in the hands of their staff and students. Students have increased access to cellular connectivity--it has been 10 years since mobile phone subscriptions surpassed the number of fixed telephone lines in the United States (Bailey et al., 2012). Partnerships with city governments along with broadband providers can create community access points that make broadband connectivity more affordable for our most economically disadvantaged students (Bailey et al., 2012). School officials along with policy makers can use the current fiscal down-turn to combine limited resources and put an end to the "factory model" of education by leveraging community resources with school resources to prepare all students for college or work after their K-12 education has been completed (Schorr & McGriff, 2011).

Residents of the United States rank near the top of all countries by percentage of its citizens using Smart Phones to access content on the Internet (Olson, 2012). Schools in this country must be ready to implement policies that allow for students to use their mobile devices to take control of their learning. Many schools need to rethink their policies of barring students from using their Smart Phones during the school day. However, on a world scale there are 5 billion people with cell phone subscriptions, but only 2 billion are connected to the Internet. Government policymakers and school leaders must fight for the creation of affordable data plans so that more people worldwide can be empowered and benefit from access to online resources (Olson, 2012).

Today many parents, educators, students, and community members demand that technology tools, including student access to notebook computers, be integrated into the teaching and learning frameworks of the schools that serve their communities (Weston & Bain, 2010). School officials and policy makers must be mindful to create access opportunities to these powerful technology tools as well as access to rich and varied Internet content for their students and staff members. Providing these tools in conjunction with digital content is congruent with societal expectations for today's schools. This type of ubiquitous technology coupled with Internet access creates a shared value of success for all students. Educational institutions that display the shared values of fairness, justice, respect, cooperation, and compassion have a upbeat sense of community which in turn supports and motivates the teachers and students within that building (Keiser & Schulte, 2009). Failure to do so puts at risk the core value of public education--that is meeting the unique needs of the students they serve each and every day.

Implications for further research. The results of this study point to the need for further research in several areas. The findings suggest the need for researchers to measure the duration, scope and type of the student notebook computer use outside the normal school setting to evaluate the effectiveness of this type of technology intervention. Students are given omnipresent access to notebook computers at the research school but this study did not measure the amount time or type of use outside the school day. Drs. Neal Grandgenett, Neal Topp, and Bob Mortenson from the University of Nebraska-Omaha in 2005 completed a study on the amount of time students used their notebook computers away from school at the research district's high school one-to-one notebook program at Westside High School. They did find a positive correlation in the amount of time students spent on the computer away from school with engagement and motivation for learning (Grandgenett, Topp, & Mortenson, 2005). This same type of study should be conducted again and this time should include the eighth-grade students at this district who also participate in the one-to-one computer notebook program.

Also in this study, both students qualifying for free and reduced priced lunch programs and students who did not qualify for free or reduced priced lunch programs, including those with and without home high-speed Internet connectivity demonstrated student achievement gains in many of the measures. However, it is not known specifically which technology intervention or interventions impacted their performance. A mixed methods or qualitative study examining specific technology tools or instructional strategies deployed by the school district being studied would add further to this body of research. This type of design was not feasible within the limits and scope of this study. Finally, additional research should be conducted to follow students in a longitudinal study to track progress in student achievement. It would also be important to follow those students that are not demonstrating achievement gains and correlate the use of notebook computers within and outside the normal school day to achievement data of the student that participated in this computer notebook program and their long-term academic success.

A strategically designed and well-implemented one-to-one notebook computer initiative that allows for students to take those devices home can further effective instruction beyond the limits of class time and brick and mortar school walls. One-to-one notebook computer initiatives embolden teachers to use high-engagement instructional strategies, which in turn allow educators to create more student-centered learning opportunities within and beyond their classrooms. Ultimately, these results suggest that one-to-one notebook computer initiatives hold promise in providing equity of opportunity for all students. This bodes well for the technology-literate students entering our classrooms today that will one-day lead our nation tomorrow.

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