A Study of Internet Spending and Graduation Rates: A Correlational Study

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A STUDY OF INTERNET SPENDING AND GRADUATION RATES: A CORRELATIONAL STUDY

by

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ABSTRACT

The purpose of this study was to examine the relationship between school district spending on Internet access and student achievement, defined by graduation rates, in the state of Florida. Internet funding received for Internet access from E-rate funding administered by the Universal Service Administration Company (USAC) and graduation rates of the 67 school districts in the state of Florida were compared. Further, the data were adjusted for socio-economic status (SES) to determine the relationship between school districts' SES and spending on Internet access. Lastly, school district connectivity and bandwidth were examined to determine whether the ConnectED initiative requirements were related to student achievement and the implementation of school district digital learning programs. E-rate funding and graduation rates were not correlated. Regression and multiple regression analyses demonstrated that Internet spending, bandwidth, and ratio of computers to students did not statistically predict graduation rates during the years of the study.

I dedicate this dissertation to my family. I could never have completed this dissertation without the love and support of my beautiful family.

Courtney, this would never have been written if it wasn't for your inspiration.
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THE PROBLEM AND ITS CLARIFYING COMPONENTS

Background of the Study

According to the National Center for Education Statistics (NCES), 97% of teachers in the United States have computers in their classrooms, and 93% of the computers on the campuses are connected to the Internet (NCES, 2009). Although at the time of the present study, a vast majority of the nation's schools were connected to the Internet, they were connected with relatively the same bandwidth as a home, which was meant for two to three people, not 300-1,000. In 2014, according to DeNisco, approximately 99% of educational technology directors had indicated that they would need additional bandwidth for their school districts by 2017. Currently, approximately 23% of United States school districts, 21 million students, are not connected to the minimum federal ConnectED initiative recommended Internet bandwidth to support digital learning in classrooms. The state of Florida has lagged behind the nation's states in meeting the minimum recommendations and making progress toward the next generation recommendations, with only 40% of Florida's schools meeting the ConnectEd minimum recommended bandwidth, compared to states such as South Dakota and Kentucky, with 98% and 92% respectively meeting minimum requirements (Education Superhighway, 2015).

Although few researchers have suggested that home computers and Internet access affect student achievement (Vigdor, Ladd, & Martinez, 2014), studies have been completed that demonstrate positive correlations of computer ownership and graduation rates (Fairlie, Beltran, & Kuntal, 2010; T-Mobile, 2012). The digital divide has affected schools in similar and different ways than it has impacted individuals in their homes. Though the digital divide refers to systematic disparities in information technology access and use based on age, income, education, race, and ethnicity (Norris, 2001; U.S. Department of Commerce, 2002), this phenomenon also affects schools and the students within K-12 schools (Karsten & West, 2015). Teachers and administrators should be aware of the digital divide and how this issue affects students in their classrooms (Bell, 2010).

In 2009, the American Recovery and Reinvestment Act provided an unprecedented level of funding for K-12 education. In order for schools or school districts to receive funding, they are required to make specific commitments including "adoption of rigorous *college-ready and career-ready* standards and high quality assessments" (Webber et al., 2014, p. 13).

The Florida Department of Education [FDOE] (2015) defined college and career ready as having the knowledge, skills, and academic ability to apply, be accepted to, and engage in college curriculum without remediation courses. These same standards also apply to students entering the workforce after graduation, becoming gainfully employed in a position offering career advancement. The skills necessary to be considered college and career ready include, among others, effective communication skills, critical thinking, and analytical skills. To operate in the 21st century career environment, it is necessary to utilize technology to effectively communicate with others along with the ability to analyze data and information (FDOE, 2015). It is important to remember that contemporary schools are educating tomorrow's workforce, and that tomorrow's workplace environments cannot completely be imagined.

Although researchers have not unequivocally shown that technology integration and the requisite Internet access increase student achievement, the growing movement of technology integration into the classroom has not halted. State departments of education, school districts, and schools have continued to search for ways to prepare their students for the workforce of the future. Currently, the world is technologically driven and students need to be prepared to operate within that world academically and professionally (FDOE, 2015). The digital divide presents particular challenges to low socio-economic students in completing classwork outside of school on devices that they cannot connect at home (Karsten & West, 2015). Through examination of the correlation of school district Internet-based spending and graduation rates, inferences can be made as to whether school-based Internet access increases student achievement, reduces the digital divide, and prepares college and career ready students.

Statement of the Problem

There has been limited research conducted regarding the connectivity and school district spending on Internet access in K-12 schools and the effects of student achievement. School districts across the state of Florida are implementing digital learning plans and initiatives to support the rise of technology integration in the classroom (Florida Statute, section 1011.62(12)(b)). With this increase in the use of connected devices in the classroom and on campuses comes the need for increases in connectivity and bandwidth required by the schools and the school districts. There has been limited research conducted regarding the effects of increased connectivity, school district spending on Internet access in K-12 schools, and student achievement.

Purpose of the Study

The purpose of this study was to examine the relationship between school district spending on Internet access and student achievement, defined by graduation rates, in the state of Florida. The study was conducted to compare Internet funding received for Internet access received from E-rate funding administered by the Universal Service Administration Company (USAC) and graduation rates of the 67 school districts in the state of Florida. Further, the study adjusted for socio-economic status (SES) to determine the relationship between school districts' socio-economic status and the spending on Internet access. Lastly, the researcher sought to investigate school district connectivity and bandwidth to determine whether the ConnectED Initiative requirements were related to student achievement and the implementation of school district digital learning programs.

Significance of the Study

It is essential to determine the relationship of governmental spending on technological initiatives related to student achievement. This study was intended to add to the limited research in the arena of E-rate funding and school district spending on Internet access in school districts. According to a 2016 Florida Statute (section 1011.62(12)(b)), each county school district throughout the state of Florida has been required to develop and submit a digital classroom plan to the FDOE. Pursuant to this section 1011.62(12)(b), the digital classroom plan must include: measurable student performance outcomes, digital learning and technology infrastructure purchases and operational activities, professional development purchases and operational activities, digital tool purchases and operational activities and online assessment-related purchases and operational activities. Additionally, the FDOE Strategic Technology Plan (2014) has recommended Internet bandwidth per student of 100 Kbps and Internal School Network of 1000 Kbps. This strategic plan bases these requirements on the State Educational Technology Directors Association's (SETDA) guidelines offered in *The Broadband Imperative: Recommendations to Address K-12 Education and Infrastructure Needs* (Fox, Waters, Fletcher,

& Levin, 2012). This document stated current needs of an external Internet connection of at least 100 Mbps per 1,000 students/staff and internal wide area network (WAN) connections among schools of at least 1 Gbps per 1,000 students/staff. Further, Fox et al. (2012) projected needs in 2017-2018 of at least 1 Gbps per 1,000 students/staff and at least 10 Gbps per 1,000 students/staff, external and internal connections (ISP and WAN connections).

The Education Superhighway (2015) published research findings on the state of broadband connectivity in the nation's schools, and Florida scores were among the lowest in the nation in meeting the minimum 100 Kbps requirements cited by ConnectED and the FDOE. A mere 40% of Florida's schools were meeting the requirements, compared to states such as Kentucky, North Dakota, West Virginia, Nebraska, and Wyoming where over 90% of the schools were connected at the minimum requirements (Education Superhighway, 2015). Although these results do not reveal student achievement within the schools, Florida should not discount the movement toward technology integration in K-12 schools.

Administrators and teachers continue to believe that devices help to prepare students for the 21st century workplace, expose the students to worldly cultures, expand learning outside of the classroom, and move the students away from routine drill and practice assignments (Shapley et al., 2011). Additionally, researchers have also demonstrated that the digital divide, which refers to systematic disparities in information technology access and use based on age, income, education, race, and ethnicity in the United States (Karsten & West, 2015; Norris, 2001; U.S. Department of Commerce, 2002), is being bridged through the implementation of digital learning programs and one-to-one initiatives (Fairlie et al., 2010; Johnson, 2015).

There has been an onslaught of legislation and initiatives in the political arena regarding Internet connectivity in school districts, (e.g., ConnectEd Initiative), which have produced connectivity recommendations and requirements on K-12 schools to support technology integration (The White House, 2014). It is important to investigate these initiatives and to determine whether the additional expense to taxpayers, (i.e., federal through the USAC or local or state taxpayer dollars), supports the overall goal of increased student achievement. It is essential to determine the relationship of this governmental spending on these initiatives related to student achievement. This study was intended to add to the lacking research in the arena of E-rate funding and school district spending on Internet access in school districts.

Definition of Terms

Bandwidth. The amount of data transmitted in a given amount of time; usually measured in bits per second, Kilobits per second (Kbps), Megabits per second (Mbps), and Gigabits per second (Gbps).

Bring Your Own Device Program. A school-based program where students are allowed and encouraged to bring WiFi enabled devices to school for use in the classroom.

Broadband. A descriptive term for evolving digital technologies that provide consumers with integrated access to voice, high-speed data service, video-demand services, and interactive delivery services (e.g. DSL, Cable Internet, Fiber-Optic).

Broadband Technology Opportunity Program (BTOP). A four-billion-dollar grant program that seeks to deployment high-speed broadband networks in support of economic development, education, healthcare, and public safety.

Category One Services. E-rate funding category that includes data services transmissions and voice services.

Category Two Services. E-rate funding category that includes internal connections, managed broadband services, and basic maintenance of internal connections.

Computer Aided Instruction. An instructional technique integrating computer technology into the classroom such as graphics, sounds, videos, and text.

Dark Fiber. Fiber-optic broadband that is not lit or does not have the equipment installed or activated to enable data to transmit through it.

Electronic Textbook. An umbrella for a wide variety of electronic media that enhance instruction. In a general sense, it can denote any type of magnetic or digital content that is used in the classroom-software, videos, CD-ROMs, or online materials. However, electronic books or eBooks are defined as self-contained digital texts whose basic structure mimics traditional books, are viewed on an electronic display and are used by students (Felvegi & Matthew, 2002 p. 41)

E-rate Funding Program. Financial supplement from Universal Service Administrative Company (USAC) providing discounts for Internet connectivity in schools and libraries within the United States as prescribed by the Federal Communications Commission (FCC).

Universal Service Administrative Company (USAC). Administers the allocation of E-rate funding for schools and libraries.

Federal Communications Commission (FCC). Mandates and regulates E-rate funding, administered by USAC.

Implementation. School district spending on Internet and the resulting connectivity of the school district is considered to be the implementation relating to the cost-effectiveness analysis theory.

iPad. "Tablet PCs are personal computers that use touch-sensitive screens as the major input device" (Hu & Garimella, 2014, p. 49), rather than a traditional keyboard and mouse; also known as a tablet.

Internet Service Provider (ISP). A company providing Internet access to consumers and businesses, acting as a bridge between customer (end-user) and infrastructure owners for dial-up, cable modem, fiber-optic, and DSL services.

Kilobits per second (Kbps). 1,000 bits per second. A measure of how fast data can be transmitted.

Lit Fiber. Fiber-optic broadband that has active equipment to provide data transmissions through the fiber-optic cable enabling Internet, voice, and/or television service through the fiber.

Local Area Network (LAN). A geographically localized network consisting of both hardware and software. The network can link workstations within a building or multiple computers with a single wireless Internet connection.

Megabits per second (Mbps). 1,000,000 bits per second. A measure of how fast data can be transmitted.

Mobile Learning Devices (MLD). Hand held or portable computer devices that students use to view textbooks, conduct research, complete assignments, or engage in classroom activities. These may include, but are not limited to: laptops, iPads, tablets, iPhones, and smartphones, eReaders.

One-to-One Learning Program. A learning environment where each student has a mobile learning device accessible in the classroom for completing assignments, research, text, or engaging in classroom activities. These programs may include school provided devices or BYOD Programs.

Wide Area Network (WAN). A network that covers a broad area (i.e., any telecommunications network that links across metropolitan, regional, or national boundaries) using private or public network transports.

Theoretical Framework

"Cost-effectiveness analysis refers to the evaluation of alternatives according to both their costs and their effects with regard to producing some outcome or set of outcomes" (Levin, 1983, p. 17). This study was grounded in analysis of cost-effectiveness as it sought to determine whether school districts that spend significant funds for Internet access and have higher connectivity or bandwidth for their students and teachers realized a difference in graduation rates across a four-year time period, 2012 through 2015, compared to those school districts with lower spending and bandwidth.

The cost-effectiveness analysis has frequently been recommended for use as a tool in educational evaluation due to significant advantages. Frequently those in education seek to determine how programs or processes affect an outcome that is difficult to quantify in dollar figures, (e.g., graduation rates, increases in test scores, or learning gains). Measures of educational effectiveness cannot easily be conveyed in a cost-benefit scenario; however, cost-effectiveness, as posited by Levin (1983) yields this information. Levin believed "It is only necessary to provide a framework for incorporating the cost analysis into the evaluation" (p.

114). This can be accomplished by establishing a cost structure for implementation of a program at a school or district along with the outcomes to be measured such as increases in test scores due to the implementation. However, many cost-benefit studies require longitudinal studies which consume large amounts of time and resources. In contrast, cost-effectiveness studies can be completed virtually at any time, allowing for data to be gathered and analyzed during or after program completion. Less time and resources of the researcher are necessary when conducting a cost-effectiveness analysis (Levin, 1983).

According to Levin (1983), cost-effectiveness analysis makes the following assumptions: "(1) only programs with similar or identical goals can be compared and (2) a common measure of effectiveness can be used to assess them" (p. 18). Though the overarching goal of providing Internet access to students may not be to increase graduation rates, the study seeks to determine if providing connectivity, and therefore increased technology integration into the learning environment, changes the rate at which students complete their K-12 education. The programs within this study to be evaluated will be the Internet access spending of each of the 67 school districts in the state of Florida, based on E-rate funding allocated, along with the respective graduation rates of those school districts. All programs seek to provide similar goals of providing Internet access for students, teachers, and administrators while assessing the success of these implementations based on the school districts' graduation rates.

As stated previously, cost-effectiveness analysis is an appropriate choice for analysis for educational leaders as it allows for a great amount of flexibility in determining the effectiveness measure. Levin (1983) observed, "Almost any particular program objective can be utilized as a basis for constructing an effectiveness measure" (p. 115). For instance, this study could have used an effectiveness measure based on changes in Florida State Assessment (FSA) scores, school or district grades, or value added model (VAM) scores. Graduation rates were used in the present study due to the ongoing debate regarding validity and reliability of FSA and VAM measures.

When evaluating the cost-effectiveness of providing high-speed Internet access on school campuses, it is important to note that the most successful cost structures may not be the least expensive or the most cost effective. Those schools or districts that spend the least, typically do not have the requisite connectivity to support one-to-one learning environments. Though typically, cost-effectiveness seeks to determine the lowest cost for the greatest results, many times the most desirable outcomes come at a higher cost (Levin, 1983).

In summary, this study sought to determine a relationship between the school districts' cost of Internet access and the graduation rates. Cost-effectiveness, as put forth by Levin (1983), grounded this study in cost analysis theory.

Research Questions

This study sought to determine findings related to a number of variables. The independent variables were the dollar value of Internet spending per school district, based on E-rate funding, along with the bandwidth connections adopted by each school district. The dependent variables included: school district graduation rates, socio-economic status (SES), school district enrollment, and ratio of Internet connected computers to students. Several research questions were used to guide the research.

1. What is the relationship, if any, between the student enrollment of a school district and district spending on connectivity?

H_{01}: There is no statistical correlation between the student enrollment of a school district and district spending on connectivity.

2. What is the relationship, if any, between the amount of spending on school based Internet access, and the ratio of Internet connected computers to students within a school district?

   H_{02}: There is no statistical correlation between the amount of spending on school based Internet access, and the number of Internet connected computers within a given Florida school district.

3. What is the relationship, if any, of Internet bandwidth, or connectivity, and student achievement, as determined by graduation rates?

   H_{03}: There is no statistical correlation between Internet bandwidth, or connectivity, and graduation rates in K-12 school districts in the state of Florida.

4. What is the relationship, if any, between the amount of spending on school based Internet access and student achievement, as determined by graduation rates?

   H_{04}: There is no statistical correlation between the amount of spending on school based Internet access and student achievement, as determined by graduation rates.

Delimitations

This research study utilized the following delimitations regarding collection of data and information examined in this study.

1. E-rate funding was examined, rather than school district spending on Internet access, due to the discounts provided by E-rate. Many school districts receive significant E-rate funding which limits their school district spending on Internet connectivity

making E-rate funding more representative of the spending on Internet access for a given school district, assuming that school districts requested E-rate funding following the proper processes and procedures.

2. E-rate funding information was delimited by removal of funding unrelated to Internet access. Funding for internal connections, internal connections maintenance, and managed internal broadband services were removed from the data set to allow for comparison of cost of Internet connection only.
3. The study used graduation rates as a means of demonstrating student achievement. Florida Standardized Assessment (FSA) has seen its share of criticisms during the initial year of implementation, and the second-year implementation has yet to be seen. Differences in graduation rates determined whether digital learning initiatives and school based connectivity was correlated with students staying in school and completing their K-12 educational requirements.
4. This study was conducted to examine all 67 school districts within the state of Florida rather than individual schools within one school district or states across the United States. The researcher sought to analyze the relationship of Internet access in K-12 schools in the state of Florida to graduation rates and allow for comparisons across school districts.
5. The sample was drawn from the 67 school districts within the state of Florida, and the results may not be generalized to all states within the United States. They may, however, be generalized to states with similar demographics and department of education-guided, school based technology policies.

Limitations

This research study had the following limitations:

1. School districts' competence regarding submittals for E-rate funding may have differed from school district to school district. School districts of varying sizes manage E-rate funding in diverse manners and may receive different results from E-Rate based on application and filing processes.
2. E-rate funding may or may not have captured all of the school district spending Internet access.
3. E-rate funding includes all spending regarding broadband connectivity, not just Internet access. Also included are telecom, voice services, internal connections, internal connections maintenance, and managed internal broadband services.
4. The variables beyond control of the researcher which had the potential to influence the validity or reliability of the study included: school district leadership and buy-in regarding technology integration, competence of school district information technology staff of implementing strategic plans, donations made to schools or districts in the form of technology, and grants received by school districts in the form of technology.
5. This research may be limited due to the methods used by teachers to implement the use of the Internet in their classrooms.
6. There are a vast number of intervening variables that affect graduation rates, including but not limited to: demographics, socio-economic status, students' study

habits, teacher instruction, etc. These intervening variables cannot be discounted, however, and they were not accounted for within the scope of this research.

7. The study was conducted to compare socio-economic status of schools through utilization of the school district socio-economic status as determined by free and reduced lunch percentages. Title I schools require a school having a free and reduced percentage of 75%; however, community schools and schools that receive 21st Century Community Learning Center grants might report 100% free and reduced lunch without requiring all students to complete the free and reduced lunch applications as all students inevitably receive free meals on campus. Additionally, all families which could qualify for free or reduced lunch do not always apply and therefore may not have been included in the statistics. Therefore, the data may be skewed due to this information.

Assumptions

The researcher made the following assumptions in conducting the research:

1. Data provided within the E-rate reporting system were free from errors and correct.
2. The graduation rates reported by the FDOE were calculated properly and reported accurately.
3. The connectivity and bandwidth for each school district was updated and accurate.
4. Increased school district Internet spending equates to increased connectivity for students, teachers, and administrators.

Methodology

Research Design

This correlational research study utilized statistical procedures of regression analysis, multiple regression analysis, and Pearson *r* correlation in order to define the relationship between the school district Internet spending and student achievement, defined by E-rate funding and graduation rates, respectively. The study took into account school district socio-economic status, measured by the percentage of students receiving free or reduced lunch within the school district. The major independent variable within the study was school district E-rate funding, and the major dependent variable was graduation rates. Other variables were also examined in depth.

Population

The study was conducted to examine all school districts within the state of Florida. The 67 school districts had student enrollments ranging from 801 to 357,579 and free and reduced lunch price eligibility ranging from 22.51% to 100% (FDOE, 2015). Every school within the state of Florida has been required to submit a five-year digital classroom plan to the FDOE, pursuant with Florida Statute section 1011.62(12)(b). The FDOE makes recommendations of bandwidth requirements for support of digital learning through these plans (FDOE, 2015). In this study, E-rate funding data, graduation rates, bandwidth, and demographic variables were gathered for the population of 67 school districts.

Data Collection

Data for the research were collected from various resources in a timely, ethical, and organized manner.

Connectivity of School Districts. The bandwidth connectivity per school district and averages across school districts will be gathered from a public records request to the FDOE.

E-rate Funding Data. Prior to collecting the funding information from the E-rate website, it was imperative to gather the identification numbers (BIN) for school districts specific to the E-rate and USAC organizations. After collecting each BIN, the information was inputted into the E-rate portal to view the past and current E-rate funding. E-rate data were analyzed for years 2012, 2013, 2014, and 2015. E-rate information is typically presented in total dollars funded; however, an itemized list is provided detailing what categories were funded and what dollar amount. Monetary figures for Internet access were collected from these totals, to ensure consistency and accuracy. If a school district was funded a significant amount during 2014 for internal connections or maintenance, this category of cost may not occur for a span of five years. These costs are extremely variable and occur inconsistently, requiring those expenditures to be removed from the study.

Graduation Rates. Graduation rates per school district were gathered from the FDOE K-12 education information web portal for each consecutive year.

Population of School District. The enrollment population of the county school district was ascertained from the FDOE K-12 education information web portal for each consecutive year.

Ratio of Internet Connected Devices to Students. The ratio of Internet connected devices to students was ascertained from a public records request to the FDOE.

Socio-economic Status (SES) of School District. The school district socio-economic status was accessed from documentation on the FDOE K-12 education information web portal for each consecutive year.

Data Analysis

Quantitative data collected were tested and analyzed using regression, multiple regression, and Pearson *r* correlations to determine each of the relationships among the variables. Regression models were used to analyze predictor variables and determine correlation between variables affecting graduation rates in the Florida school districts based on Internet connectivity.

Table 1

Research Questions, Variables, and Sources of Data

Research Questions	Variables	Data Sources
1. What is the relationship, if any, between the student enrollment of a school district and district spending on connectivity?	Dependent: E-rate funding Independent: School district SES School district enrollment	FDOE E-rate funding data
2. What is the relationship, if any, between the amount of spending on school based Internet access, and the ratio of Internet connected computers to students?	Dependent: Ratio of Internet connected computers to students Independent: E-rate funding	FDOE E-rate funding data
3. What is the relationship, if any, of Internet bandwidth, or connectivity and student achievement, as determined by graduation rates?	Dependent: Graduation rate Independent: Connectivity of school district	FDOE E-rate filing data
4. What is the relationship, if any, between the amount of spending on school based Internet access and student achievement, as determined by graduation rates?	Dependent: Graduation rate Independent: E-rate funding	FDOE E-rate funding data

Organization of the Study

The presentation of the results of the research have been organized around using five chapters. This chapter has been used to describe the statement of the problem, purpose of the study, significance of the study, definition of terms, theoretical framework, research questions, limitations, and assumptions. Also included was an introduction to the methodology including the research design, population, data collection, data analysis, and organization of the study.

Chapter 2 contains a review of the literature relating to Internet access in K-12 schools and the relationship between technology and student achievement. The legislation of technology in the K-12 classroom is described, along with current federal initiatives, and the digital divide is explored to demonstrate the importance of effectively managing Internet access and connectivity in schools. Also reviewed was literature related to the effect of technology integration on student success, specifically graduation rates. The review was also conducted to demonstrate further why high-speed Internet is essential in schools, surveying the relative trends of technology in K-12 schools at present and moving into the future.

Chapter 3 explicates the methodology of the study including the selection of participants, data collection, and data analysis. Chapter 4 presents the findings of the study including the correlation coefficients derived from the tests performed on data relating to E-rate funding and graduation rates, E-rate funding and population of the school district allowing for socio-economic status, E-rate funding and ratio of Internet connected computers to students, and connectivity/bandwidth of school district and graduation rates. Chapter 5 provides a summary of the findings, including discussion, implications of the findings, and recommendations for further research.

CHAPTER 2
LITERATURE REVIEW

Evolution of Technology

Technology is constantly changing, evolving, and providing opportunities for innovation. Over the past few decades, technology has undergone a revolution, moving at an extremely rapid pace (Lipton, 2005). As industry, economics, society, and technology have evolved, people's lives have been impacted.

Just as pedagogy and instructional practices have evolved over time due to research or fads, technology available in the classroom has evolved and changed. Classroom technologies have moved through a progression of various technologies (e.g. textbook, chalkboard, radio, film, and television) that aided in the delivery of instruction and influenced educators' practice (Cuban, 1986). However, even though there have been influxes of technologies throughout the past century, such as radio, television, film, computers and other technology, many maintain that the classroom has failed to change dramatically. Most teachers continue to use textbooks, chalkboards or whiteboards as a primary medium of instruction (Cuban, 1986; Finn, 1960; Frankel, 1970; Lepper & Gurtner, 1989; Luehrmann, 1985).

The Classroom without Machines

Classrooms at the turn of the 20th century would seem today familiar to educators, students, and administrators in the 21st century. According to Cuban (1986), practices, organization, and aesthetics have not progressed dramatically over the course of 100 years. Students were seated neatly in rows, facing a chalkboard, only responding when the teacher asked questions. Report cards, homework, textbooks, chalkboards were common materials seen throughout the classroom; however machines were absent. Teachers played a role of drill sergeant, rather than coach. As pedagogy changed in academia, progressives pushed for "instruction built on student interests, that opened windows into the larger world, and that plunged students into activities that had social and intellectual outcomes" (Cuban, 1986, p. 10).

The Entrance of Films

Thomas Edison had a genuine passion for films, "'Books will soon be obsolete in the schools', he said in 1913, 'Scholars will soon be instructed through the eye. It is possible to touch every branch of human knowledge with the motion picture'" (as cited in Cuban, 1986, p. 11). During the early 1900s, film was thought to bring reality and life into the classroom--ideas and places that the student could experience more authentically than reading about the topic in a textbook. Numerous motion pictures were made for use in the classroom; and early in the 20th century, George Kleine circulated a 336-page *Catalogue of Educational Motion Pictures*, including over 1,000 film titles to be utilized by educators during lessons (Cuban, 1986). "Classroom use of films became a symbol of progressive teaching approaches…in the 1920's and 1930's, the black window shade, silver screen, and 16mm projector lent an aura of modernity and innovativeness to classrooms" (Cuban, 1986, p.12).

Several studies conducted and discussed by Cuban (1986) in the 1940s and 1950s attested that films encouraged student learning and created motivation in the classroom. However, researchers cited by Cuban (1986) also suggested that adoption of use continued to be low in school districts; adoption rates of 20-40% were common. Thus, although educators and administrators were aware that the use of films could increase student achievement, they failed to implement the instructional designs appropriately. Lack of skills, cost of the films and machines, inaccessibility of equipment, and alignment of the films to content were discussed as obstacles to implementing films in the classroom (Cuban, 1986).

Radios Blasting

Two decades prior to World War II, radio broadcasting entered the field of education. The Radio Division of the U.S. Department of Commerce began transmitting radio programming throughout areas of the United States, bringing a different medium of communication and instruction to the classroom (Cuban, 1986). Although programs were being broadcast during these early years, school districts had a myriad of equipment and supply issues, resulting in limited access to radio transmissions. By the 1930s, however, many of these issues were resolved, and various states reported 50-70% of schools had secured radio systems for their students and teachers. During the 1940s, many school districts produced and aired programs for their teachers to use in their classrooms. Some examples of programs might have been "Exploring the News, Story Book Land, Young Experimenters, Music Enjoyment, or Men of Freedom" (Cuban, 1986, p. 22).

> By 1945, radio sets failed to become 'as common in the classroom as the blackboard'. Nor had they achieved this by the 1950's when the enthusiasm for television kindled the dreams of another generation of school reformers. By then, research and journal articles on radio in the classroom had virtually disappeared (Cuban, 1986, p. 26).

Televisions Teaching

On May 25, 1953, television broadcasting first came to classrooms via KUHT in Houston, Texas (Cuban, 1986). McMeeken and Dede (1980) observed that television shows and programming “require sophisticated equipment, a large capital investment, and a carefully sequenced script drawing on insights from motivational and developmental psychology” (p. 229). By the mid 1950s, school districts were implementing television in the classroom using three adoption methods: (a) total instructional programming; (b) supplemented television instruction; and (c) television as a teaching aid (Cuban, 1986). Dependent on the adoption method of television programming, there were four broadcasting types:

> 1) broadcast on an educational channel, 2) broadcast on a commercial channel, 3) closed circuit in which live instructors are used to supplant instruction, and 4) the Compton type in which filmed lectures are distributed via closed-circuit medium as a replacement for classroom teachers (Finn, 1960, p. 374).

Total instructional programming only occurred in Samoa and for a five-year stint in Hagerstown, MD. The student assessment scores demonstrated that students learned as well, or better, using televised instructional methods; however, the fad dissipated and did not spread to other areas of the United States (Cuban, 1986).

During the 1960s, television broadcasting was less necessary to disperse instruction to students as more teachers entered the workforce. Television was increasingly used to complement instruction rather than deliver the lesson (Cuban, 1986). McMeekin and Dede (1980) stated, “programs such as Sesame Street have demonstrated the potential to improve basic skills, such as reading in young children” (p. 229). They believed that teachers and parents could utilize such educational programming within the classroom or home to increase basic skills. Salomon (1985) found that “children, particularly the more intelligent ones, view television as a relatively ‘easy’ medium requiring them to spend little mental effort in processing content” (p.212).

Teacher Technology Aids

Various miscellaneous, yet important, technologies emerged during the 20th century to assist students in application of learning. These include hand held micro-computers, calculators, slide projectors, overhead projectors, strip projectors, tape recorders, sound-slide projectors, transparencies, CD ROMs, VCR, laserdisc and videodisc, and cameras. Though costs of these devices have typically been quite low, they have provided great value to students and teachers (Bruder, 1988; McMeeken & Dede, 1980; Ohanian, 1971). According to McMeeken and Dede, tutorial approaches, inquiry approaches, dialogue, and explanation are various instructional practices that educators might leverage via hand held devices with their students. These instructional technologies can help to individualize instruction (Deep, 1970; Vargas, 1986) and “make self-instruction feasible” (Ohanian, 1971, p. 188). Prior to the arrival of some of these technologies, several avenues for electronic data processing became available for educators and secretarial workers increasing efficiencies, allowing for tests to become machine processed, alleviating teachers of the burden of hand scoring assessments (Hoos, 1975).

The Computer Age

“In 1982 *Time* Magazine put a computer on the cover of its issue heralding the editors’ choice of ‘Man of the Year’” (Cuban, 1986 p. 72). This statement touts the importance of this emerging technology in the 1980s within the economy, society, and schools. In the early 1980s there were two camps of thought regarding computers in the classroom: (a) that computers represented another educational fad and (b) that computers were the way of the future and needed to be embraces. During this timeframe, machines were primarily used for drill and practice (Cuban, 1986) typically for practice in addition, subtraction, multiplication, division, and reading (Deep, 1970). Upon the implementation of the microcomputers in the classroom, educators and administrators began to perceive the value of the hardware and software in assisting students to learn and achieve in different ways (Cuban, 1986; Lepper & Gurtner, 1989; Vargas, 1986). In addition, there were realizations that the interactions between computer and user were participatory and provided the ability for immediate feedback to the student and teacher. Further, word processing programs began to make learning to write easier for students, allowing them to edit their work instantly (Luehrmann, 1985). Presentation programs allowed instructors to teach to at least two learning styles, utilizing interactive modalities (i.e. sound clips, videos, Internet hyperlinks) to keep students interested and engaged in the material (McLafferty, 2000). Students who may not have succeeded previously began to have the ability to work freely, independently, and at their own pace (Lepper & Gurtner, 1989). Student usage of computers in school was found to enhance interest, cooperation, reduce anxiety of new material, and assist students in staying focused (Lepper & Gurtner, 1989; Salomon, 1984). Salomon viewed the computer as "a coach, or a drill sergeant; it may offer experiential learning opportunities through simulations, microworlds, or hypertext programs; it may also provide tools for word processing, data analysis, music composition, and telecommunications" (Lepper & Gurtner, 1989, p. 173). Additionally, it could provide teachers with extra time to plan for small group instruction or individual instruction through handling menial clerical tasks that are required of teachers such as grading assignments, grade calculation, scheduling, and lesson planning (Deep, 1970; Lepper & Gurtner, 1989).

Vargas (1986) stated that “educational software falls into four major categories: 1) drill and practice, 2) simulation, 3) tutorial, and 3) tools for writing, designing, or creating” (p. 740). Drill and practice programs typically present problems to students in a random order, allowing students to answer and gain immediate feedback. Many times, the format is game-like, making the practice fun and entertaining. Simulations do not ask questions of students. Rather, they place students in situations and require them to react and solve real world problems. Even though simulations can be excellent instructional tools, finding the right fit for the educational content can be challenging. Tutorials are designed to teach new material and typically include a number of reading pages and a quiz. Tutorials, however, are not considered to be wonderful instructional tools. The key to software and web based tools is integration, and technology has become integral to instruction; however, the technology cannot be haphazardly inserted into instruction. The addition must be seamlessly infused into pedagogy (McLafferty, 2000). Ohanian (1971) posited that “…educational technology will be only as effective as the teacher’s skill in using it” (p. 190).

Gros (2007) discussed the virtual world and gaming.

> Children and young people are introduced to the virtual world via video games, and the ways that they interact with technology may be changing the ways of learning and the production of knowledge…Digital games are user centered--they promote challenges, co-operation, engagement, and the development of problem solving strategies (p. 23).

Gros discussed the three generations of gaming--edutainment, cognitive based games, and lastly those that integrate social context into the systems. Gros believed that children develop cognitive literacy and exposure to science and technology through playing computer games. Other important skills include the ability to read images, such as diagrams, improved spacial realization and problem solving skills, more developed attention skills, personal and social development, knowledge of language and literacy, mathematical development, understanding of the world, and fine motor skill development (Gros, 2007).

Beginning in the 1990s, institutions began to blend learning environments which consisted of "the total mix of pedagogical methods, using a combination of different learning strategies both with and without the use of technology" (Verkroost, Meijerink, & Lintsen, 2008, p. 501). According to Verkroost et al., these learning environments were facilitated by various web-based programs such as WebCT, Blackboard, Learning Space, STUDIO, and more (Reid, Aqui, & Putney, 2009). Since 2008, many other programs have come onto the market such as Edmodo, WordPress, Moodle, My Big Campus, Brain Honey, and Google Classroom, to name a few (Kimmons, 2015). The environments allow students to work remotely while instructors monitor productivity, assess work, and provide feedback. Within the environment, there are email capabilities, web links, online lectures, and text materials. Students can participate in discussion boards with instructors and students, facilitating learning through teamwork. Generally, the online class environment is set up in modules allowing for students to work at their own pace with some restrictions or deadlines. Depending on the course in question, there may be face-to-face meetings, or the class could be implemented completely virtually

(Verkroost et al., 2008). These online learning environments have created a newfound flexibility in learning for students and teachers alike.

There are certain skills that are vital to succeed in an online learning environment: ability to navigate the Internet, online communications, and knowledge of word processing. (Reid et al., 2009). In the K-12 educational environment, blended learning can also be applied in a virtual school model. According to Reid et al. (2009), the virtual school can be modeled via TV/DVD/video or online. In the video model, the student would checkout videos or tune in to a television channel, complete assignments and submit to an education office, and be limited to contact with the instructor once per week via email or telephone. Through the online model, course material and assignments would be available on a web portal, such as Blackboard, Web 2.0, or Open Source ePortfolio and meetings conducted in an online forum with instruction delivered synchronously and asynchronously (Davis, Eichelman, & Zaka, 2013; Waters et al., 2014).

With the advent of the 21st century, technology and media has been made available at higher and higher rates in K-12 schools (Carver, 2016; Grant, Suha, Brown, Sweeney, & Ferguson, 2015; Martin & Carr, 2015). Delgado, Wardlow, McKnight, & O'Malley (2015) posited that the United States was going through a digital revolution, that the way that people "live, interact, communicate, and conduct business is undergoing a rapid, profound change" (p. 398), and that these societal changes were requiring changes to the educational system to prepare students for college and career readiness. This in turn was impacting educators, necessitating a paradigm or pedagogy shift in order to sufficiently prepare the citizens and workforce of the future. In their study, Martin & Carr (2015) identified important hardware and software used in schools. Hardware included desktop computers, laptops, notebooks, smartboards, mimeo, clickers, IPODs, and tablets. Multimedia which emerged as being used included PowerPoint, Vimeo, YouTube, Cantasia, Animoto, Prezi, and Xtranormal. Additionally, a study by Delgado et al. (2015) revealed that educators commonly have the following devices on hand in their classrooms daily: liquid crystal displays(LCD)/digital light projectors (DLP), interactive whiteboards, classroom response systems, digital cameras, MP3 or iPods, document cameras, and handheld devices/pocket PCs. Carver (2016) discussed a study where it was shown that 100% of educator respondents used a computer weekly, and 89% used a digital projector weekly, while approximately half used an interactive white board, digital camera, or iPad at least monthly. In their study, Martin & Carr (2015) further demonstrated that 57% of teachers utilized technology or multimedia in the classroom daily. A total of 94% of teachers surveyed used the technology to enhance a lesson, 81% to introduce a new topic, and 77% to demonstrate a concept. Of the technology and multimedia focused on during the study, PowerPoint was the most popular, with 93% using this tool, and YouTube being a second favorite with 48% accessing this site. Levin and Schrum (2013) affirmed that teachers who use technology and multimedia in their classrooms aided students by “taking advantage of teachable moments and capitalizing on current events” (p. 42)

Related research by Hu and Garimella (2014) was focused on the use of iPads in classrooms. The use of tablets and iPads have increased substantially since their inception (Hu & Garimella, 2014; Martin & Carr, 2015). Hu and Garimella (2014) noted that 65,000 educational applications (or apps) were on the market for K-12 use and varied across all subject areas. Through surveys of teachers, it was learned that teachers can use iPads in various ways to deliver instruction, enhance lessons, assess progress, and communicate with students.

> One participant described the iPad for collaborative learning and provided a specific example ‘lecture with class discussion and pictures on SMART Board, students read lessons with their partner and answer questions. Then the small group provides a presentation using the SMART Board.’ In this manner, K-12 students learn not only science and math content, but also team work. (Hu & Garimella, 2014, p. 59)

The apps loaded onto iPads can enhance lessons in science with simulations of dissections, providing experiences that students may not be able to engage in during class or as a precursor to a lab (Hu & Garimella, 2014).

Device programs can be implemented in schools in various ways, ranging from one-to-one learning programs provided by the school, bring-your-own-device (BYOD), or blended learning. (Delgado et al., 2015; Grant et al., 2015). Grant et al. reviewed the integration of mobile computing devices (MCD) into classrooms. MCDs included smartphones, tablets, and iPods. The themes that emerged from interviews with teachers included (a) ownership and control of the devices, (b) administrative support, (c) motivation for students, (d) relevant professional development for teachers, and (e) technical support. This study demonstrated that whether the device was student or school owned, the technology was useful; however, the rules of the classroom may vary. The majority of the programs worked best when the administrative team was engaged and supportive of the use of devices in the classroom. Teachers and administrators throughout the programs realized the increased motivation and engagement of students in lessons when devices were used (Carver, 2016; Grant et al., 2015). Some teachers stated that the school or district provided relevant training, although many noted that it was still necessary to seek out additional tutorials or training outside of the schoolhouse. Lastly, and important to the study of Internet access of schools, the major technical issues cited by the researchers indicated that network capacity and reliability presented the greatest threat. As more and more devices in schools demand connectivity, these issues are of great concern (Grant et al., 2015). In other relevant research, Carver (2016) stated that availability of equipment (56%), instructional time schedule (10%), and bandwidth (8%) were school based constraints on implementing classroom technology.

Felvegi and Matthew (2002) identified eBooks and eTextbooks as an important software infiltrating the arena of education. Computers, e-Readers, and tablets that hold volumes of books, create walking libraries for students and educators, saving paper, printing, and students' backs from carrying the textbooks from class to home. Although the benefits of eBooks are plentiful, Felvegi and Matthew (2002) cited problematic issues, (e.g., pagination, headings, and chapters). When teachers desire to cite a page or phrase, it can be difficult to direct students to the correct place in the text.

In addition to software, educators have capitalized on social networking sites (SNS) for various reasons. Examples of these sites are: Twitter, LinkedIn, Classroom 2.0, Facebook, Google Plus, Plurk Educator's PLN, Sophia, Everloop, and Second Life. These SNS allow students and teachers to collaborate, communicate, and integrate technology into their lessons. These approaches present lessons that are "project based, problem based, experiential, service, and challenge based" (Canbek & Hargis, 2015, p. 206) and permit teachers to conduct intricate, involved lessons in a more efficient manner. Many students in K-12 schools use SNS more proficiently than their educators in the classroom, making them the experts and providing the students confidence in engaging in this type of environment. Students, however, have made it clear that they desire their educational and personal SNS be separate so that individuals on each account are unable to view the other accounts. Essentially, an example might be the student would have a personal Google Plus account and a student account ensuring that their educational data would be discreet from personal, non-educational information.

School districts have increasingly begun to rely on the Cloud for system support and management. “If adopted and properly managed, Cloud delivered services potentially combine the advantages of economies of scale computing services with the ability of local K-12 systems to control and customize application services to meet the specific needs of their schools” (Pierce & Cleary, 2014, p. 864). Educational applications are being innovated and created using cloud based applications (Delgado et al. 2015). Uploading data to the cloud can save institutions on hardware and management costs, making the implementation of technology more cost effective. Working from the Cloud, however, can have implications for bandwidth usage which will be discussed later in this chapter.

Growth of Computers in Schools

As early as 1986, Cuban discussed the rapid growth of microcomputers available for instruction in schools:

> The number of microcomputers available for instructional use tripled in 18 months [fall 1980 to spring 1982] to over 100,000 machines. Two years later, that number climbed to 325,000. By 1984, of the 82,000 schools in the nation, 56,000 [or 68%] had at least one computer or machine to every 92 students. In 1985, 92% of all secondary schools had at

> least one machine available for instruction; for elementary schools, it was 82%. By 1984, the average elementary school had five machines, while the typical secondary had just over 13. (p. 78)

According to the National Center for Education Statistics [NCES] (2014), the number of computers in schools tripled between 1995 and 2008, from 5,621 to 15,434. The average number of computers per school increased from 72 to 189 and the ratio of students to instructional computers with Internet access changed from 6.6 in 1995 to 3.1 in 2008, demonstrating the growing trend toward labs and one-to-one learning initiatives. Integral to this study, the percentage of computers with Internet access grew from 8% in 1995 to 98% in 2008, indicating the emergent Internet needs of K-12 schools. Delgado et al. (2015) observed that 97% of teachers have one or more computers in the classroom with 93% of those computers having access to Internet. Additionally, 96% of computers or devices brought from home have access to the Internet every day.

These statistics along with the studies reviewed, validate the trends and movement toward a technologically driven educational system. Although these statistics reveal the growing movement toward computerization, they fail to show the growing bandwidth needs of schools. This trend will require greater Internet connectivity and capabilities. Bandwidth trends will be examined later in this chapter.

Summary

In 1989, researchers and educators began to consider a “dream toward which adherents of the computer aspire. They imagined a twenty-first century school in which each student is provided a portable computer comparable to current state-of-the-art machines in artificial intelligence" (Lepper & Gurtner, 1989, p. 170). As has been indicated in this review, the K-12 school environment has made progress toward this dream of the past. Through increases in one-to-one learning environments, students have increasingly been provided personal learning devices which they use to read textbooks online, conduct research, complete assignments, and collaborate in a blended learning model of instruction. Frankel (1970) wrote that a major purpose of education was educating, training, and preparing students capable of working the fields of science and technology. Just as this was true in 1970, it continues to be appropriate for 21st century students.

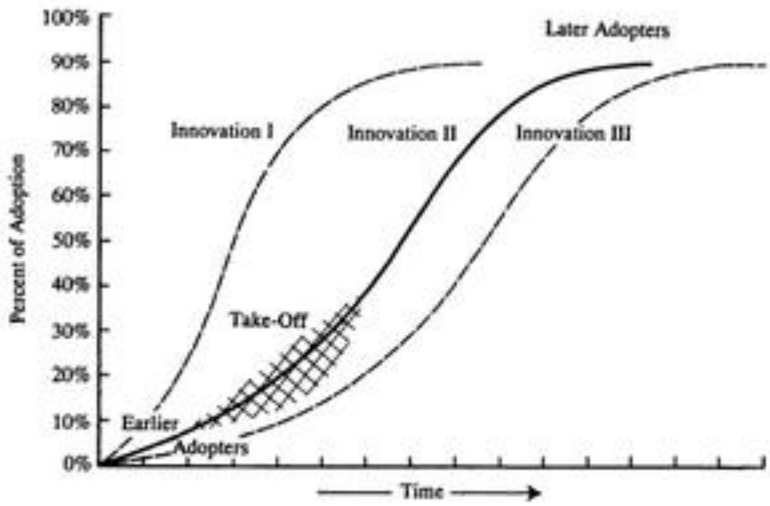
In *Teachers and Machines*, Cuban (1986) discussed educators' arguments over whether computers belonged in the classroom and people's resistance to change. "People resist change that threaten their basic securities and that they don't understand. People also resist being forced into change" (p. 108). Cuban demonstrated that technological innovations revolutionized the classroom with regard to film, radio, television, and microcomputers, at least until the 1980s. At the time of the present study, educators, parents, and students continued to debate the value of the use of educational technology in the classroom, specifically computers. Later in this chapter, issues of technology and student achievement are explored.

Diffusion of Innovation Theory

Internet connectivity and the increased bandwidth needs of Florida school districts can be viewed as an innovation. The innovation, fiber-based broadband or high-speed Internet, is necessary to provide the connectivity needed to support the one-to-one learning environments or technology based teaching practices. Rogers (2003) stated, "Diffusion is a process in which innovation is communicated through certain channels over time through members of a social system" (p. 5). The notion of high-speed broadband or Internet access has been presented to school districts through various channels including, but not limited to, Florida Department of Education rules for digital learning classroom plans (FDOE, 2015) the ConnectED initiative (The White House, 2014), and other communication channels. These two major channels within the State of Florida, digital classroom plans, and the ConnectED initiative, are explored in greater detail later in this chapter.

Rogers (2003) also demonstrated that the diffusion of innovation occurs at different rates. This is shown through various adopter categories: innovators, early adopters, early majority, late majority, and laggards. The school districts of Florida could be placed into these categories based on their Internet spending and rates of connectivity of their schools. As stated previously, Florida has lagged behind the states in the nation regarding Internet connectivity of schools and student utilization of Internet in schools (Education Superhighway, 2015). Considering school districts individually permits the identification of those school districts that are considered innovators or laggards, respectively, based on their school district policies, connectivity, number of digital learning schools, and Internet spending.

Rogers (2003) observed that an S-shaped curve where the innovators and early adopters are present early in the curve and the laggards enter the innovation when the S-curve begins to plateau demonstrated "the rate of adoption for an interactive innovation" (p. 344). He also determined that "The critical mass occurs at the point at which enough individuals in a system have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining" (p. 344). Roger's diffusion of innovation of an S-shaped curve is shown in Figure 1.



Note. From "Diffusion of Innovations" by E. Rogers, 2003, (5th ed., p. 11), New York: Free Press. Copyright by Everett M. Rogers. Reproduced with permission (Appendix A)

Figure 1. Diffusion of Innovation S-shaped Curve

During the process of communication dissemination to the school districts, various factors come into play determining the rate at which the school district will apply the innovation of high-speed Internet. Each organization will place a singular value on the innovation, and other variables may determine the rate of high-speed Internet adoption, such as E-rate funding knowledge, school district population, school district social economic status, digital learning schools, etc.

As discussed by Rogers (2003), school districts have various structures which assist or limit their adoption of innovations. Following are factors which, according to Rogers, lead to a predictable structure for the organization.

1. Predetermined goals: School districts are established for the explicit purpose of educating the students within the county.

2. Prescribed roles: Positions in the school district require tasks, roles, and responsibilities. Teachers are responsible for education, administrators are responsible for leading the school, and other positions are required to maintain the school district goals. Whether the school district budgets for positions to manage E-rate funding and Internet connectivity management could, in part, determine where the school district will fall in the rate of adoption process.
3. Authority structure: The hierarchy and the requisite decision making of those higher in the hierarchy, will, in a large part, determine where the school district will fall in the rate of the adoption process.
4. Rules and regulations: Many school districts have written rules and policies for hiring, evaluation, and student code of conduct, to name a few. Whether they also have written policies, rules, and strategies to maintain effective Internet connectivity within the school district to support digital learning may determine the school district's rate of adoption.
5. Informal patterns: The informal norms of a school district may also affect the rate of adoption of the innovation. If the norm is a high value on technology and digital learning, the school district may be adopting high-speed Internet at a higher rate than another school district that places lower value on technology.

The organizational innovation process includes: agenda setting, matching, redefining/restructuring, clarifying, and routinizing. During the initiation stages, the school district would conduct agenda settings and matching, "consisting of all of the information gathering, conceptualization, and planning for the adoption of an innovation" (Rogers, 2003, p.

421). The implementation stage requires redefining/restructuring, clarifying, and routinizing all the events involved in the innovation occurring. As a school district might realize that the connectivity of the schools or district do not fit the needs of the student population to support digital learning, it would be necessary for the leaders of the school district to move through this process to design and implement a high-speed Internet network.

This study sought to determine the relationship between Internet spending and connectivity of schools and graduation rates in Florida's school districts. Through analysis of this relationship, the rate of adoption of high-speed broadband Internet can be illuminated, and the rate of adoption can also be linked to Internet spending and connectivity. Further inference can be made as to whether the rate of adoption of high-speed Internet affects student achievement, based on graduation rates.

Educational Law and Technology

Beginning in the 1980s, education changed dramatically through the infusion of technology into its framework. Educators and administrators have had to shift paradigms and learn new methods of instructing students. In the 1970s, computers in the classroom or school for student use were non-existent. In the 1980s, more affluent school districts began using computer labs to integrate technology and computer processing into learning (Cuban, 1986). During the 1990s, with the advent of the Internet revolution, students and teachers began using more technology in varied ways. At the turn of the century, the technology revolution entered the school arena with the introduction of terms such as one-to-one learning models, digital academies, and technology integration (Carver, 2016; Grant et al., 2015; Martin & Carr, 2015).

The increased use of technology in the classroom has mandated a change in the infrastructure of the schools. A dial-up service connection will not suffice for a one-to-one student to tablet ratio at a high school. Service and technology need to change and increase, and these changes will inevitably cost school systems more money (Education Superhighway, 2015). The management of school systems and students will necessarily be altered. Moving a school from paper, pen, and text book to a digital learning center with tablets or devices for each student changes the management system of curriculum, learning tools, and students (FDOE, 2014). Finally, the laws and legislation that seek to govern and mandate the area of technology in the educational systems in the United States must be examined and revised as needed.

Executive Order 12999

On April 17th, 1996 President Bill Clinton signed Executive Order 12999 which mandated educational technology, ensuring opportunity for all children of the next century. This executive order stated that educationally useful federal computer equipment was to be transferred to schools in need and non-profit organizations, and federal employees of all agencies with computer knowledge were to be encouraged to assist in development of technology professional development of the teachers in the country (Exec. Order No. 12999, 1996). *Computers for Learning* (2016) reported many success stories of donations of technology and computers to various school systems around the nation. Evidence of teacher professional development that occurred as a result of the Executive Order was difficult to locate.

This executive order started an important movement of bringing technology into school systems, but many parents have worried about the negative effects of having additional technology in the learning environment. Through his interactions with school districts and municipalities, Courtney Violette, Chief Operating Officer of Magellan Advisors, has seen that the infusion of technology into the schools through student devices can be difficult in low-income areas where the families may not have access to Internet. In these instances, students are known to stay at local libraries until late in the night to utilize the free wireless Internet in order to complete homework assignments. Providing students with the ability to use devices outside of school to deepen learning is the goal; however, oftentimes the result is that students need to leave the safety of their homes to fully utilize the device (C. Violette, personal communication, March 7, 2015).

20 U.S.C.S. ß 6772: National Education Plan.

The National Education Plan seeks to promote a higher standard of learning through integration of advanced technology, increase access of low-income schools to technology, and use technology to assist in the implementation of systematic state reform strategies (20 U.S.C.S. ß 6772). The National Technology Plan supported the aim of Executive Order 12999 and relates to effectively using technology to provide all students with the opportunity to meet the challenging state academic content and student achievement standards.

Federal Laws Affecting Technology in the Schools

Protecting Children on the Internet

The Internet can yield positive effects in the classroom, engaging students and bringing a topic to life. A student with a device, however, can also access other websites or material on the Internet that are inappropriate for the school environment. The Children's Internet Protection Act (CIPPA) of 2000 was enacted by Congress in 2000 to address concerns about children's access to obscene or harmful content over the Internet (Federal Communication Commission, 2015). The Children's Internet Protection Act (2000) requires that schools and libraries that receive E-rate funding must satisfy certain requirements, including institution of a district Internet safety policy. Within the policy, the district must address: access by minors on the Internet, safety of using forms of electronic communication, hacking issues, dissemination of personal information, and access to harmful materials. The Children's Internet Protection Act (2000) requires policies, including but not limited to filtering, and decisions need to be made by school districts on restrictions on filters. Educators become frustrated when information cannot be accessed, and parents become frightened that students may access something that is inappropriate. If a lesson includes showing a demonstration of a dissection or surgery via the Internet and the teacher becomes locked out of the website the day of the lesson, the teacher may become aggravated. If the teacher is using a website that is not approved by the school district and it includes inappropriate nudity or language, the parent may have a right to be upset. A key is to find the best solution. In order to achieve the right balance, technology professionals, educators, and administrators should have open communication when making these decisions (Johnson, 2013).

Parents not only want to protect their children from information and material on the Internet. They also want to protect their children's sensitive information. Legislation such as the Children's Online Privacy Protection Act (COPPA) of 1998 and Family Educational Rights and Privacy Act (FERPA) of 1974 seek to protect minors' sensitive personal information such as addresses, social security numbers, and educational information. The Children's Online Privacy Act (1998) sought to protect data that a child may enter into a website to gain access without the parent's verifiable consent. Family Educational Rights and Privacy Act [FERPA] (1974) is a federal law, designed to protect student educational information, that applies to all schools that receive federal funds. Several provisions are made for parents through FERPA (1974). First, parents and students have the right to view student records held at the school. If errors are found, the parents or students may request that the errors be corrected. Also, schools must have written permission to release student records; however, FERPA (1974) exempts this rule under certain conditions including, but not limited to, "school officials with a legitimate educational interest, transferring schools, specified officials for audit or evaluation purposes, appropriate parties in connection with financial aid, or organizations conducting certain studies (USDOE, FERPA, 2015).

If a teacher were to email another individual regarding a student record and that person did not have a purpose to have this information, the parents would only have redress through injunctive relief and through contacting the Department of Education. By contacting the Department of Education, parents can file a complaint; however, the law provides that there is not an ability to sue the school district or individual regarding these matters (Alexander & Alexander, 2012).

President Obama has proposed the Student Digital Privacy Act. The Act would protect student educational and personal information from being sold to third parties for marketing and research purposes. Data would continue to be able to be used for viable educational research purposes, for instance to study instruction and learning, but not to study how to market products to the country's youth. President Obama stated, "This is a direct threat to the economic security of American families and we've got to stop it. If we're going to be connected, we need to be protected" (Summers, 2015). This proposed bill was based on legislation passed in the State of California (The Student Online Personal Information and Protection Act, Cal. § 22584, 2014).

The Elementary and Secondary Education Act [ESEA] (1965) was passed in an effort to strengthen and improve educational quality and educational opportunities in the nation's elementary and secondary schools. It sought to do so through financial support of low-income area schools. This financial support has been provided through payments for eligible states and grants mandated by the legislation, and eligibility is based on application for the program through the process mandated. ESEA (1965) has also appropriated funds to the states for library and instructional resources. An amendment was made in 2002 to include Part D of Section II, titled Enhancing Education through Technology (2001). The primary goal of this section was to improve student academic achievement through the use of technology in elementary schools and secondary schools. Additional goals include assisting every student in crossing the digital divide by ensuring that every student is technologically literate by the time the student finishes the eighth grade and encouraging the effective integration of technology resources and systems with teacher training and curriculum development. The overall purpose has been to assist states and localities in developing comprehensive programs and initiatives to increase student learning through technology. Other purposes include increasing teacher development programs, evaluation, and parent involvement in the schools through technology. Funds were appropriated through this legislation in the amount of $1,000,000,000 during 2002 and for the succeeding five years.

Telecommunications Act of 1996

The Telecommunications Act (1996) was designed to allow more companies to enter the market to create a competitive marketplace for telecommunications companies. The goal was fair play and increased choices for consumers, and this legislation opened the doors for additional phone and Internet based companies. It was realized that telecommunications were changing rapidly during the 1990s, and additional laws were needed to protect consumers. The Federal Communications Commission is the governing body that administers and implements the Act (Telecommunication Act, 1996).

The Telecommunications Act (1996) directly references its effects on the educational systems in the United States. Sec. 708 (a)(C) stated

> The goals are to create, maintain, utilize and upgrade interactive high networks capable of providing audio, visual, and data communications for elementary schools, secondary schools, and public libraries; to distribute resources to assure equitable aid to all elementary schools and secondary schools, and achieve universal access to network technology; and upgrade the delivery and development of learning through innovative technology-based instructional tools and applications. (Telecommunications Act, 1996. Sec 708.C.I-III.)

Although the Telecommunications Act (1996) has been integral in proponing technology and network based systems for school systems, it is important to note that many schools continue to lack high quality systems (Education Superhighway, 2015). Discussed later in this review of literature, the E-rate program demonstrates how this program will move the United States' school systems into the information technology era with Internet and broadband service.

Florida Statutes Governing Technology and Broadband in Schools

Florida Statute 1007.2616: Computer Science and Instruction

Fla. Stat. § 1007.2616, which is included in K-12 Education Code, Articulation and Access, is related to computer science and instruction. This state law concerns technology and computer integration into the K-12 school curriculum.

Elementary, middle, and high schools may provide opportunities for computer science learning including computer coding and programming. Elementary and middle schools may also create digital learning classrooms to provide opportunities to increase digital literacy and competency. High schools may provide computer courses required for graduation. This integration coordinates with the emphasis on college and career readiness in many counties in the State of Florida. Becoming technologically competent and digitally literate is important for college preparation or technological careers. Although the Florida statute requires the use of computer courses in the state, it fails to mention that many schools may not have the network and Internet capabilities to completely support these programs (Fla. Stat. § 1007.2616).

Florida Statute 364.0135: Promotion of Broadband Adoption

Fla. Stat. § 364.0135, included in Railroads and other Regulated Utilities, concerns telecommunication companies. This statute seeks to promote broadband services, as it is critical to the economic and business development of the state and is beneficial for libraries, schools, colleges and universities, healthcare providers, and community organizations. By being sustainably adopted, communications providers have the ability to offer broadband services in the absence of governmental subsidies. A portion of this statute provides for a baseline assessment of statewide broadband deployment in terms of percentage of households with broadband availability. Further, it seeks to build and facilitate local technology planning teams or partnerships with members representing libraries, K-12 education, and colleges and universities, to name a few (Fla. Stat. § 364.0135).

Florida Statute 1011.62: Funds for operations of schools

Fla. Stat. § 1011.62, in the K-12 Education Code, relates to the funding for the operation of schools. This regulation states that if the annual allocation from the Florida Education Finance Program (FEFP) to each district for operation of schools is not determined in the annual appropriated act or the substantive bill implementing the appropriated act, it will be determined by this statute. The statute also addresses the implementation of digital learning and technology infrastructure, stating that "Purchases related to digital learning and technology must be tied to measureable outcomes, including but not limited to connectivity, broadband access, wireless capacity, Internet speed, and data security all of which must meet or exceed requirements" (Fla. Stat. § 1011.62. Sec.12.b.2.). Each year the district uses funds for infrastructure. The district must hire a third-party company and must conduct an assessment of the technology infrastructure. The measureable outcomes must be documented annually and include an independent evaluation and validation of the reported results. The improvements to use of technology must be tied to student performance and integrating technology into instruction (Fla. Stat. § 1011.62).

Fla. Stat. § 1011.62 further discusses the creation and implementation of the digital classroom or campus. Funds may be appropriated for a digital classroom or charter school through submission of application to the department, approval by the Commissioner of Education, and the school district superintendent. The Commissioner of Education is directed within this statute to support the implementation of digital classrooms through partnerships and efforts with professionals in the field including, but not limited to, administrators and teachers. The school districts are required within Fla. Stat. § 1011.62 to provide teachers, students, and parents with: instructional materials in digital or electronic format; digital materials for student use; and teaching and learning resources, including those used to assist administrators and teachers to manage student data (Fla. Stat. § 1011.62).

This statute demonstrates the changing face of education and learning. Teachers, administrators, and students have been required to integrate technology into their instruction, work, and learning (Fla. Stat. § 1011.62). School infrastructure, however, does not always support integration of new technology into the building. If the school building is older, wiring may be an issue. Upgrading network capabilities may not be in the budget. The plans for moving a school district into the technological age are discussed in the following sections of this paper.

President Obama's ConnectED Initiative and the E-rate Program.

On June 6, 2013, President Barack Obama set the stage for the development of the ConnectED initiative and the E-rate program.

> Today, we're going to take a new step to make sure that virtually every child in America's classrooms has access to the fastest Internet and the most cutting-edge learning tools. And that step will better prepare our children for the jobs and challenges of the future and it will provide them a surer path into the middle class. (The White House, 2013, para. 12)

As noted by Adler (2014), home owners have been increasingly active in adding new automated devices to their homes, (e.g., air conditioning, Pentair to control pool temperatures and settings, and even crock pot appliances), all of which can be controlled from smart phone or wireless devices.

> The number of everyday and enterprise devices that will soon be connected to the Internet will be huge…1.9 billion devices today, and 9 billion by 2018, roughly equal to the number of smartphones, smart TVs, tablets, wearable computers, and PCs *combined*. (Adler, 2014, para. 1)

These products and innovations, however, require bandwidth which many older Internet connections cannot handle. Technology is integrated into schools in the same manner it is into home life, but as more technology is added, (i.e., more devices, and more applications), the question is whether the educational Internet-based infrastructure can support it.

<u>ConnectED Initiative</u>

As stated by President Obama,

> We are living in a digital age, and to help our students get ahead, we must make sure they have access to cutting-edge technology. So today, I'm issuing a new challenge for America--one that families, businesses, school districts, and the federal government can rally around together--to connect virtually every student in America's classrooms to high-speed broadband Internet within five years, and equip them with the tools to make the most of it. (The White House, 2013, p. x).

The ConnectED Initiative set a lofty goal of connecting 99% of America's schools to high-speed Internet, capable of supporting digital initiatives and technology in the educational and economic systems of the United States. In the announcement, President Obama questioned "In a country where we expect Wi-Fi with our coffee, why shouldn't we have it in our schools? Why wouldn't we have it available for our children's education?" (The White House, 2013, para. 15). This statement rang true for many Americans. Although Americans place devices in the hands of the children to use for education and learning, many schools around the country have not been able to support students' technology in the classroom. At the time of the present study, many times, students and teachers could not utilize technology or devices simultaneously as the bandwidth would not support all of the applications or devices. For instance, teachers may not be able to stream videos on an interactive white board as students follow along on an Internet-based application.

The ConnectED initiative was introduced by the Obama Administration in June of 2013 and sought to connect 99% of schools to high-speed wireless broadband. The initial goal was 100 Kbps per student, 1 Gbps per school, 1 Gbps inside each school, and a Wi-Fi network capable of supporting one-to-one learning on each school campus. After 2018, each school was to have a goal of 1 Mbps per student while maintaining other previous goals for the schools and campuses. In 2013, the Obama Administration saw that although 99% of schools across the nation were connected to the Internet, the connectivity and bandwidth used by many institutions was no longer sufficient to educate 21st century students. Dial-up, LTE, and copper-based broadband have not had the ability to support the explosion of technology including devices and laptops, learning applications, streaming videos, and live chats. ConnectED looks to foster a robust ecosystem for learning. Leveraging and further increasing this bandwidth should allow teachers and students to have access to technology anytime and anywhere on their school campuses (Education Superhighway, 2014).

ConnectED recognizes that many educators who have been in the field for a number of years do not have the technology knowledge or skills to integrate technology into their classrooms.

> Using existing federal funding through Title II of the Elementary and Secondary Education Act (ESEA), the Department of Education will work with states and school districts to invest in this kind of professional development to help teachers keep pace with changing technology. (White House, 2014, p. 1).

By using these resources and professional development opportunities, teachers can be sufficiently updated to ensure that they are using technology and infrastructure to educate students to the highest degree and lead them to be college- and career-ready upon graduation from high school. This initiative has the hopes of “unleashing private sector innovation” (p. 3) through placement of education devices into the hands of students in every school, exposure of students to global opportunities with technology, support of classrooms with educational digital content, thereby upgrading the United States in vital areas of technology and innovation. In order to stay globally competitive in education, technology must advance in the classrooms (White House, 2014).

The growing movement is one-to-one learning initiatives where students have laptops or tablets issued to them to use during class time and at home. As students are accessing assignments, chats, and etextbook materials, teachers may be streaming videos or lessons on interactive white boards at the front of classrooms. Significant bandwidth is needed for schools to be able to institute these teaching and learning strategies in each and every classroom on their campuses (Education Superhighway, 2015). Research by the Education Superhighway (2015) shows cases where graduation rates have improved through the use of online courses, personalized learning has been increased through the use of digitally mastered lessons, and digital learning has been applied to real world experiences. All of these cases show applicability of demonstrating to students the global opportunities that arise through the use of technology and the Internet (Education Superhighway, 2016).

The Trends in International Mathematics and Science Study (TIMSS) is an international assessment that benchmarks countries regarding their students' success in math and science and is a reference point for educators and politicians. According to the TIMSS results, countries such as Korea, China, Finland, Russia, Japan, and Singapore consistently outperform the United States in math and science (Buckely, 2012). Bringing students into the digital age, accessing learning on a digital level, and allowing teachers to teach on digital platforms may assist U.S. students in competing on a global scale.

According to the Education Superhighway (2016), a non-profit organization conducting studies on the ConnectED initiative's performance, 77% of schools were meeting the 100 Kbps per student goal in 2015, compared with 30% of schools not meeting the 100 Kbps goal in 2013. "To meet 2018 demand, the typical school district will need to grow bandwidth at least threefold and ensure ubiquitous Wi-Fi to support digital learning needs" (Education Superhighway, 2016, para. 2). Tremendous growth regarding the broadband infrastructure of our schools will be required in order to support the 1 Mbps per student goal which will take effect in 2018.

Relation to Politics, Governance, and Finance of Educational Organizations

There has been a lack of research regarding the ConnectED Initiative and politics and governance. The Education Superhighway is the major player in research based studies regarding the ConnectED initiative. Regarding politics, the organization states that 38 governors support the policy and 24 are considered leaders in that they are making strides in upgrading the schools in their states. Florida has not been considered to be a major player in the movement, as only 40% of Florida schools have met the 100 Kbps per student goal. However, at the time of the study, 91% of schools in the state had access to fiber-based broadband, and 80% had Wi-Fi within their schools. Florida's neighboring states (Georgia, Alabama, Mississippi, and the South Carolina) all had greater connectivity for the students of their school districts compared to Florida. Georgia, Alabama, and Mississippi had 75-89% of their schools meeting the current goal and South Carolina had 90-100% of its schools meeting the goal (Education Superhighway, 2016). A comparison of all states meeting the current goals is included in Appendix B. In order for politicians to make these decisions regarding Internet and broadband connectivity for the students of the State of Florida, school district leaders must make their case in Tallahassee to press the issue forward to provide high-speed Internet for their schools, teachers, and students.

The funding structure that supports the ConnectED Initiative is the E-rate program, administered by the Universal Service Administrative Company (USAC). The Federal Communication Commission (FCC) makes decisions based on the changes or modernization of the E-rate program and hears appeals from school districts, schools, libraries, and consortiums. School districts, schools, libraries, and consortiums file with USAC for E-rate funding which covers Category 1 and Category 2 services. In general, Category 1 services fund telecommunications costs, and Category 2 services fund hardware and management of systems. E-rate program logistics and parameters are discussed in greater detail within in this chapter; however, it is important to note that the system can be cumbersome and difficult for school districts, particularly small districts, to navigate without outside consultants. There are many cases that have been on the FCC docket to discuss and remedy school district errors in reporting (USAC, 2015).

Major Contributors and Supporters of ConnectED

Upon the announcement of the ConnectED Initiative, President Obama "called on businesses, states, districts, schools, and communities to support this vision" (The White House, 2013, para. 1) which requires no congressional action. As has been noted, 38 states have made commitments to support this initiative and make upgrades to their schools and libraries. Also important to note, however, many companies and organizations have supported this initiative through grant offerings, tools, and resources to support the use of technology in K-12 schools. For instance, Apple has provided grant programs to 114 schools across the country. These schools and students have been provided computers, laptops, iPads, and educational tools allowing for personalized learning in classrooms. One of the requirements for these schools was free and reduced lunch percentages over 96%. Additionally, in order to ensure that the educators had the knowledge and ability to use these robust tools with their students, Apple provided professional development. Further, Adobe has offered free software to schools; AT&T offers a tablet based program; AutoDesk offers a program to provide engineering and architecture software; Esri offers a GIS (Geographic Information System) program for schools; Microsoft offers a discount software program; Prezi has committed $100 million in Edu Pro licenses; and Sprint and Verizon have programs to assist in mobile learning (The White House, 2015).

Federal Communication Commission E-rate Program Rules

In September of 2014, the Federal Communications Commission met to discuss and seek comments regarding proposed rules for modernizing the E-rate program. The Federal Communications Commission adopted these rules on July 11, 2014. The proposed rules were concerning competitive bids, requests for service, discounts, caps, and ordering services. A major change includes phasing out of voice services for coverage (FCC, 2014).

Competitive bidding requirements state an eligible school, school district, library, or consortium must submit for competitive bids as dictated by the requirements. School districts must post bids for at least 28 days. If the school district is offered a pre-discount of $3,600 for high-speed Internet service or the service included 100 Mbps downspeed and 10 Mbps upspeed or higher an exemption can be made for competitive bidding requirements. Service providers bidding for the client must demonstrate that they are in compliance with state and local procurement laws (FCC, 2014).

The person authorized to order the services for the eligible school, library, or consortium must sign Federal Communication Commission Form 471. The service provider must also submit a Federal Communication Commission Form 472, the Service Provider Acknowledgement, in order to seek reimbursement for services. The service provider must certify that they will remit the discount and payment amounts approved for the Billed Entity Applicant; they are in compliance with rules and orders governing the district, school, or library; and failure to comply with the rules can result in civil or criminal prosecution by law enforcement authorities. Each year, the service provider was also required to submit a Form 473 to the administrator (FCC, 2014).

The single discount percentage rate for the entire school district is determined by dividing the total number of students eligible for the National School Lunch Program within the school district by the total number of students within the school district. This rate is then applied to the matrix (Appendix A) as the discount for the supported services for the entire school district. The breakdown of the percentage on the National School Lunch Program is as follows: <1, 1-19, 20-34, 35-49, 50-74, 75-100. (47 CFR §54.505). Considerations are made based on classifications of rural or urban school districts, as well. The discounts differ for urban and rural for each breakdown layer for the initial four layers and equal for the upper 50%. The discounts increase from a minimum of 20% and 25% for both category discounts to a maximum of 90% for both Category discounts. For instance, for a school district with 20-34% students utilizing the National School Lunch Program, Category 1 and Category 2 discounts would calculate to 50% or 60%, urban and rural, respectively. Multi-year contracts can be applied for by the school districts; however, those contracts will not exceed five years. Service providers must demonstrate that they are providing school districts, schools, libraries, or consortiums with the lowest corresponding price for services (47 CFR §54.511). Additional discounts are also available for state matching funds for special construction. These discounts are available to all E-rate applicants, tribal schools, and tribal libraries for special construction on a dollar-to-dollar contribution up to an additional 10%; however, the total contribution cannot exceed 100% (FCC, 2014).

School districts and the service providers have record keeping requirements. Schools, libraries, and consortium must keep documents related to the application for, receipt, and delivery of, discounted telecommunications and other supported services for at least 10 years after the last day of the delivery of services or from the end of the applicable funding year, whichever is later. They must also retain documents required by statute or law for the school or library requirements. Asset or inventory documentation must also be kept on file for 10 years after purchase (47 CFR §54.516).

Service providers retain documents related to the delivery of discounted telecommunications and other supported services for at least 10 years after the last day of the delivery of services or from the end of the applicable funding year, whichever is later. They must also keep on file those documents retained according to statute or regulation of telecommunications (47 CFR §54.516).

Order 16-1023, Schools and Libraries Universal Service Support Mechanism, is the Eligible Services list and documentation to support schools, libraries, and consortiums in making telecommunications decisions. The release date was September 12, 2016 and has been used in support of the rules provided by the Federal Communications Commission. The documentation describes the telecommunications services available under the E-rate program and places them into categories. Category 1 includes digital transmission services, commonly called "wide area networks", or WAN, email services, lit fiber or dark fiber, interconnected voice over internet protocol, Internet access, paging, telephone service, voicemail, web hosting, and wireless Internet access. Voice and phone services are being phased out of E-rate funding eligibility at a rate of 20 percentage points per year, beginning in 2015. During fiscal year 2017, these services will incur 60% points less than other Category 1 services. Category 2 service details internal connections that are eligible for discount. These include cabling and connectors, circuit cards and components, data distribution, data protection, interfaces, gateways, antennas, servers, software, storage devices, telephone components, video components, and other eligible internal connections components. Basic maintenance of internal connections is also considered Category 2 (47 CFR §54.502).

Category 1 services are those related to telecommunications and Internet access services. Digital transmission services provide for transfer of information from a school or library facility to other locations. These services include but are not limited to broadband over power lines, digital subscriber line, DS-1 or DS-3, Ethernet, fiber, satellite services, T-1 or T-3, and wireless services. Distance learning, or interactive video conferencing, is eligible for discount, however, only for educational or library purposes. Email services may be discounted via an Internet plan or on a per user basis, depending on the needs of the school district (47 CFR §54.502).

Lit or dark fiber is eligible. However, if dark fiber is chosen, the user must light it immediately. Maintenance and installation of dark fiber is eligible as is modulating appliances for the lit fiber. If the subscriber chooses voice over Internet protocol (VoIP), it is generally eligible for discount as well. When considering lit versus dark fiber, the school district must take bids for lit fiber and dark fiber along with the equipment and provisioning of lighting the dark fiber (FCC, 2016).

Some charges are not eligible for E-rate funding discounts as a Category 1 service. End user equipment, modulating equipment, dark fiber warehousing, and non-telecommunication components are not eligible. Design, engineering managements costs, digging trenches, and laying of fiber are not considered for E-rate discounts or funding. Some telephone, Internet, and web hosting costs are not included with E-rate funding and discounts (FCC, 2016).

Category 2 items are eligible for funding from the E-rate program and are listed within the rules. These items are costs related to basic maintenance of internal connections including, but not limited to, repair and upkeep of eligible hardware; wire and cable maintenance; basic technical support; and configuration changes (FCC, 2016).

The rules also detail what is not eligible for funding support for clarity for the information technology professionals or individuals tasked with reviewing, planning, requesting, and implementing the use of E-Rate funds for their organizations. Going forward into fiscal year 2017, there were limited exceptions listed for Category 1 services. Managed internal broadband services are not eligible for most servers unless they are used for caching. Though basic maintenance on Category 2 services is eligible, it is important that the maintenance is for eligible products (FCC, 2016).

The various rules amended 47 C.F.R. Part 54, Subparts A, D, F, and I by the Federal Communications Commission. These subparts were related to universal service support for high cost areas, schools and libraries, and administration. In regard to schools and libraries, amendments were made for: eligible services, competitive bidding requirements, requests for services, discounts, and caps. Changes in administration of the rules related to filing deadlines (FCC, 2014).

Current payable services have been listed within the Eligible Services list that has been updated annually (47 CFR § 54.502). The current list is documented within DA 16-1023 and was adopted on September 12, 2016 (FCC, 2016). According to FCC-14-99, the current funding years for the E-rate program are 2015-2016 and the eligibility requirements amended for 2015 are represented in the Category 2 support which relates to maintenance and support of the internal connections (FCC, 2014).

Competitive bidding requirements are detailed in greater depth within the orders such as the requirements and information needed within the request for proposal for the request for funding. Examples include the following: the school district or school needs to provide a list of service requests, a detail of construction of the network facilities that the applicant will own, type of fiber plan the organization will deem appropriate, extent of the construction of the network in order to determine bids for the construction, extent to which the organization would need special construction for fiber, and the extent to which the applicant seeks bids for equipment and maintenance costs regarding the fiber (47 CFR §54.503).

Cap accounts for the annual cap of $2.25 billion per funding year for schools and libraries, of which $1 billion will be available for Category 2 funding (47 CFR § 54.507). The orders also take inflation into account during the fiscal year. When discussing amendments to administration, applicants are required to abide by additional filing deadlines for the management of the E-rate program (47 CFR § 54.720).

The Federal Communications Commission meets in Washington, DC to further discuss the modernization of the E-rate program and make updates and amendments to the rules and Eligible Service list. Each year the Eligible Services list is updated and reported for the use of organizations to ensure that those organizations construct accurate requests and proposals (FCC, 2016).

Named Decisions by the Universal Service Administrator

When organizations make requests for funding, documentation is required. When the documentation is incomplete or inaccurate, the program may not provide the funding. If organizations, schools, or school districts wish to seek recourse for a decision regarding funding, they must first submit an appeal to the Universal Service Administrative Company, prior to filing an appeal with the Federal Communication Commission (47 CFR §54.719). A review of named decisions is located in Appendix C. These decisions have allowed school districts to seek recourse for erroneous submittals; further, the requests have facilitated changes to the modernizations of the E-rate Program. For instance, in 2011, a high school in Burbank, Illinois noted a specific service provider would be used on the Form 470 submittal; however, within that document the school district also stated that bids for service providers were being sought through a competitive bidding process. The case changed the requirements to allow applicants to name a product or service as long as "or equivalent" was also noted to inform the E-rate program administrators that other choices would be acceptable through the competitive bidding process (Queen of Peace High School Burbank, IL vs. Universal Service, 2011).

There have been many cases demonstrating the arduous process. One such case was a class action suit of 196 appeals to the Universal Service Administration Company (USAC). These appeals were regarding clerical and ministerial errors. The minimum processing standards are necessary based on the thousands of requests that the organization receives annually. These standards required that incomplete applications be returned to applicants without further review and be marked as denied. From this case came additional processing directives for the USAC. First and foremost, USAC agreed to send applicants written notice of denials with a period of time to remedy clerical or ministerial errors. Applicants then have 15 days from the receipt of the notice to make changes or correct forms or certifications. This was applied to past and future applications for funding.

Going forward, USAC agreed to create more elaborate outreach programs to educate and inform applicants of the process, time windows, application requirements, and certification requirements. Educating applicants should assist in making the program easier to navigate and increase the efficacy of the program (USAC, 2016).

The new directives have not in any way reduced the minimum processing standards or procedures to complete application for the E-rate program. The 196 appeals, however, brought difficulties to the attention of the organization. Accommodations have been made to ensure that hardship is not imposed on the applicants. Though steps have been taken to ensure that schools, libraries, and consortiums continue to receive funding via a process easier to navigate, standards have not been reduced. Accurate, complete data is necessary to process the application by USAC (Bishop Perry Middle School New Orleans, LA, et al. v. Universal Service, 2006).

Moving Forward with the E-rate Program

President Obama instituted the ConnectedED initiative in 2013 and made goals to implement within five years. At the time of the present study, the program was three years into the plan of action to meet those goals in 2018 (Department of Education, 2016). On December 11, 2014, an order was adopted adding additional funds to the E-rate program, moving it from a cap of $2.4 billion to $3.9 billion. These funds can help schools and school districts make better decisions regarding technology programs in the schools and classrooms. The new order makes amendments for other specifications. Construction costs will now be able to be repaid over multiple years rather than over a small number of years. The schools will be able to make decisions on building their own broadband network, when construction is the best option. Additional E-rate support will be provided through a 10% matching program for construction costs. The high cost program has been developed, allowing access to broadband systems for rural and low-income areas (FCC, 2014).

Digital learning, one-to-one student learning, digital divide, and college and career continue to be buzz words in schools regarding technology and digital advancements, the statistics speak volumes. At the time of the present study, 45% of schools nationwide do not have the Internet capabilities to move to a one-to-one learning rationale in the classroom. Though 39% of schools in affluent areas meet ConnectED targets, only 14% of rural or urban schools meet the same targets. With the buzz and the E-rate discounts, schools should be moving to higher levels of connectivity and technology in the classrooms, but it does not seem to be progressing as planned (Education Superhighway, 2014).

When conducting the business of the school, a savvy school leader may need to consider the following laws and regulations regarding technology. Parents and teachers understand the benefits of using technology and devices in the classrooms; however, they also have a fear of the dangers of using these technologies. First, the Children’s Internet Protection Act (2000) and the Children’s Online Protection Act (1998) determine how the nation’s students interact with computers in the classroom and effect online safety measures. The Student Digital Privacy Act (2015) was proposed by President Obama in an effort to protect student information online. This Act has furthered the mandates of Federal Educational Rights and Privacy Act (FERPA), extending them to the online arena.

The Telecommunications Act (1996) was designed to allow telecommunications companies to enter the marketplace in a fair and equitable manner and to create competition in the market. It directly references school systems by noting that school districts should be seeking to create network systems capable of audio, visual, and data communications.

Florida statutes are not extensive when searching for technology law. Fla. Sta. § 1007.2616 relates to computer science and instruction relative to those credits or courses required in the elementary, middle, and high schools. By promoting the adoption of broadband, the administrator or superintendent can encourage lesson plans that are interactive and engaging for the students. The Florida Education Funding Program determines how funds are to be allocated, including funds for technology (FDOE, 2015).

In 2013, President Obama launched the ConnectED initiative. This initiative proclaims that 99% of schools in the United States will have connectivity that will enable schools to be capable of supporting one-to-one digital learning in the classrooms. The ConnectED initiative works with the E-rate program in order to assist schools and school districts to meet these goals within a five-year time frame. Statistics show that the school districts in the United States have not been meeting the current goals and are far from meeting the five-year goals (The White House, 2014).

Through the creation of the ConnectED initiative and further modernization of the federal E-rate Program, mandated by the Federal Communications Commission and managed by the Universal Service Administration Company, it can be hoped that current goals and objectives will be met by time frames specified. Overall, the goal is to bring the nation’s educational system into the technological age with Internet access to support a digital learning environment affording all students in the United States an equitable education where they can learn more effectively and efficiently (The White House, 2014).

Bridging the Digital Divide

The shift in education to integration of technology into instruction and student study brings devices into the hands of students within the confines of the school and at home. Schools across the nation are implementing digital learning programs, which place devices at a one-to-one ratio for students. These programs provide e-textbooks, and instructors utilize materials in a format that requires the use of the Internet (OCPS, 2014). Although these programs can reduce the use of traditional texts and paper homework assignments, it can be debated whether students from low-income families without Internet, or high-speed Internet, can fully access the curriculum and assignments from their homes. If students are assigned a tablet device and the family has wired Internet in the home, students may not be able to complete web-based assignments in their homes. Similarly, if the device requires high-speed Internet to utilize the application or web-based material, students may not be able to complete web based assignments in their home (Karsten & West, 2015).

In this section, literature has been reviewed to explore whether there is a disparate impact on low-income students due to the use of digital devices for completion of assignments outside of the school. Also explored is the use of free or discounted high-speed wireless Internet access for K-12 students through examples from two very different school districts on opposite coasts in the United States.

Federal Initiatives to Increase Adoption of Broadband

The Obama Administration has recognized the digital divide and the need for broadband. Over the past two years the President's administration has been vigilant regarding initiatives to support schools and libraries with Internet access that sustain the technology moving forward in the nation's school systems and communities (The White House, 2014). "The President warns that unequal access to the Internet creates an 'access to learning gap' and a 'homework gap' which will only further entrench our country's economic gap" (Karsten & West, 2015).

The two major initiatives of the administration have been ConnectED and ConnectHome. As has been noted, in 2013, President Obama announced the ConnectED initiative that aimed to connect 99% of schools with high-speed Internet access by 2018, with minimum speeds of 100 megabytes per second (Mbps) and a goal of one gigabyte per second (Gbps). Currently, "fewer than 40% of America's schools have the broadband they need to teach using today's modern technology" (The White House, 2014). Based on one-to-one initiatives and technology integration in the classrooms, adoption of broadband and high-speed Internet for school districts should be imperative. The vision is based on upgraded connectivity, training teachers to utilize technology, and building on the private sector's innovation. When upgrading the connectivity, the schools increase bandwidth from a minimum of 100 Mbps to a target of one Gbps. ConnectED also seeks to build upon the Broadband Technology Opportunity Program (BTOP) by leveling the playing field for rural communities which are typically the most underserved.

Training teachers to use the resources at their fingertips is essential to moving educational systems forward in the technology era. Training and resources need to be organized and delivered to the teaching profession in the United States. By utilizing private sector innovation, devices can be placed in the hands of students who will become more globally competitive. Educational content will go digital, and fundamental areas in the United States will work to be rebuilt. (The White House, 2014).

During the summer of 2015, President Obama proclaimed another initiative to build on and support the ConnectED initiative. The ConnectHome initiative builds on the ConnectED initiative in that it seeks to provide high-speed Internet access to families that do not currently have access. The administration realized that although "nearly two-thirds of households in the lowest-income quintile own a computer, less than half have a home Internet subscription" (The White House, 2015, p. 1). "The U.S. only has on average the ninth-fastest Internet connection speed in the world despite being home to many cutting-edge Internet technologies, such as Google Fiber" (Karsten & West, 2015, p. 2). Slow connectivity in homes thwarts students from completing homework assignments or downloading the necessary resources to be successful in today's educational system (The White House, 2015).

ConnectHome was intended to connect 28 communities across the United States with Internet service providers that will give access to low-income Americans. Internet service providers, (e.g., Google Fiber, Cox Communications, CenturyLink, and Sprint), will partner with public officials and communities to deliver affordable access to the Internet (The White House, 2015). Supported by Mossberger, Tolbert, Bowen, & Jimenez's (2012) research, HUD authorities collaborated with non-profits and the private sector to offer new technical training and digital literacy programs for residents in assisted housing units (The White House, 2015). The intention was that by cooperating with Internet Service Providers (ISPs) and public sector technology organizations, schools, libraries, communities, and municipalities would be able to provide low cost, high-speed Internet access along with the technical training needed for individuals to establish and utilize connections effectively (The White House, 2015).

Lifeline Phone and Internet Access

The Lifeline program was established to provide discounted phone service to qualified low income citizens. This allowed for citizens to be connected, secure, and safe regarding work, family, or emergency service. (FCC, 2015). In March, 2015,

> Tom Wheeler, chairman of the Federal Communications Commission, circulated a plan to his fellow commissioners suggesting sweeping changes to a $1.7 billion subsidy program charged with ensuring that all Americans have affordable access to advanced telecommunications services, according to senior agency officials. (Ruiz, 2015)

House and Senate Republicans believed that the plan would waste federal funds. Republicans argued that the $1.7 billion program was plagued by fraud and not operating effectively. Although both parties agreed that access to Internet is essential to locating employment and engaging in a technological society, the Republicans did not agree that the program should be expanded and utilized (Sasso, 2015).

Many ISPs, such as Brighthouse, Cox, Sprint, and Verizon already offer these programs for low-income households in select areas. Many plans, however, include fine print which inhibits some individuals from gaining the low-cost subscriptions in their homes (USAC, 2016). If residents or parents are disinterested in the Internet or lack the technological skill to implement the network components or navigate the system to gain access, they may not move forward with installation of Internet in the home (Mossberger et al., 2012).

The Digital Divide

The term digital divide refers to systematic disparities in information technology access and use based on age, income, education, race, and ethnicity. (Karsten & West, 2015; Norris, 2001; U.S. Department of Commerce, 2002). The National Telecommunications and Information Administration [NTIA] (2011) stated that 68% of Americans subscribe to high-speed (4G) Internet. This leaves 32% without Internet access or slow dial-up connections that are unacceptable for many educational applications.

> People with college degrees adopt broadband at almost triple the rate of those with some high school education (84% versus 30%), among adults 25 years and older. The rates for Whites (68%) and Asian non-Hispanics (69%) exceed those for Black non-Hispanics (50%) and Hispanics (45%) by 18 percentage points or more. Rural America lags behind urban areas by ten percentage points (60% versus 70%)" (NTIA, 2011, p. 2)

Mossberger et al. (2012), conducted a study of residents in Chicago, Illinois to explore the rates at which residents did not have Internet access and the reasons some chose not to have Internet in the home. The data supported NTIA findings in regard to adoption of Internet rates. Surveys conducted by Mossberger et al. (2012) detailed reasons for not subscribing to Internet to include interest, cost, and technological skill (Mossberger, 2012). Cleary, Pierce & Trauth (2005) also conducted a study to understand disparities in Internet usage in school age children which indicated that gender of the head of household, race, and citizenship all correlate to the rate at which a certain class might adopt high-speed Internet in the household. If a male headed the household, it was 7% more likely that the home would have Internet access. Based on this research, White families were 26% to 30% more likely to have Internet over Black or Hispanic families, respectively. As a family's income increased from $5,000 annually to $75,000 or above, the rate of adoption steadily increased from 34% to 79% (Cleary et al., 2005). Income of the household and race have been shown to determine home based high-speed Internet usage, and researchers have advocated that policy should address these issues (Cleary et al., 2005; Mossberger et al., 2012).

The digital divide needs to be addressed and understood when implementing digital learning communities and schools. All educators, especially librarians and technology teachers, should be aware of students who may not have Internet access (Bell, 2010). It could be argued that, in some schools, school leaders should also be aware of these students. As schools move to a one-to-one learning environment and students take devices home to complete assignments and study for examinations, leaders should be aware of the students who do not have access or communicate effectively with families that lack the resources or the knowledge and ability to connect to the Internet. Many schools are providing students with laptops or tablets to take home to complete assignments (OCPS, 2014). Various learning management systems, such as Moodle and Schoology, and Cloud based productive applications, such as Google Docs, require Internet connectivity. When implementing these one-to-one initiatives, educators and school leaders need to take the digital divide into consideration (Fairlie et al., 2010; Johnson, 2015). It is vital to remember "the lower income groups without Internet at home may have to wait in line at the public library or try to find free Wi-Fi" (Karsten & West, 2015, p. 1) in order to complete online course material or assignments.

There seems to be little research suggesting that home computers and Internet access affect student achievement. (Vigdor et al., 2014). Findings in one study, however, showed a positive correlation between computer ownership and grades and a 6% to 8% higher probability of high school graduation (Fairlie, 2010). Vigdor et al. found a positive relationship between home computer ownership and student achievement. However, these findings may have been affected by selection bias, as members of the group may have purchased their computers during a prosperous period of time. These studies demonstrate that computer ownership and Internet access can affect student achievement, specifically graduation rates. Although many districts have begun to provide the devices for the students, when there is no connection at home, there is potential for decreases or reduction in achievement or graduation rates. The question then arises as how schools that provide the technology and the devices can ensure they are properly and easily utilized for assignments in the home. Following are descriptions of the unique situations of two different school districts with respect to digital learning and home-based Internet connectivity.

Orange County Public Schools (OCPS)

Orange County Public Schools (OCPS) is a large, urban school district in central Florida with over 150 schools. It services almost 200,000 students in Orange County with demographics including 29% White, 27% Black, 37% Hispanic, 4% Asian, and 3% other (FDOE, 2014). OCPS is a high needs school district with 65% of the student population qualifying for the free or reduced lunch program (OCPS, 2014). The school district describes the program as follows:

> OCPS is building on a legacy of innovative practice, revolutionizing the way we teach, lead, and learn through personalized digital curriculum and professional learning in a blended environment. The OCPS Digital Classroom Plan (DCP) focuses on the scale-up of the existing digital curriculum pilot program over the course of the next five years in order to meet state and local goals (OCPS, 2014, p. 7).

A five-year plan was established to move all schools to digital classrooms. During 2014-2015, pilot schools implemented their digital learning communities. Within the 2015-2016 school year, additional secondary schools were added to the digital rollout with completion of the secondary schools projected to be implemented in 2017-2019. Through the 2017-2019 time frame, elementary schools will be prepared and involved as well. The school based device ratios are scheduled to move to one-to-one for high schools by 2016 and middle schools by 2017. Elementary schools are geared to have a two-to-one ratio by 2019. Within the Digital Classroom Plan, OCPS also prepared to procure five Gbps of bandwidth per school to support utilization of the digital devices and school based testing (OCPS, 2014). These bandwidth requirements meet and surpass the ConnectED initiative recommendations of a minimum of 100 Mbps or target of one Gbps (White House, 2015).

These goals of Orange County Public Schools are decisive, strategic, and measured. There are no recommendations within the document for promoting Internet connectivity in the home, however. Briefly, the document mentions “the strength of the students’ access and use of technology was a consistent positive predictor of students’ reading and mathematics scores, with students' use of their laptops at home as the strongest implementation predictor of reading and math scores" (OCPS, 2015, p. 46), but does not delve into how to ensure that all students have the connectivity outside of the classroom. OCPS also plans to facilitate parent involvement sessions promoting the use of technology at home during 2014-2019 and will determine the effectiveness by the percentage of parents attending (OCPS, 2014).

During September of 2015, an interview was conducted with the Director of Digital Curriculum and Instructional Design to gain insight into the digital program initiatives and how OCPS is managing home based Internet issues. According to the director, OCPS spends a lot of time discussing and identifying issues of connectivity in the home and providing alternatives for students. A survey conducted in 2014, to which 60,000 responded, implied that 64% of the student population had Internet access either by wired or wireless connections. These numbers seemed promising to OCPS as the rate was comparable to the free or reduced lunch rate for the school district, so leadership believed that Internet access may not be correlated with student economic status (SES). The survey was conducted via an Internet or phone based survey and 60,000 of almost 200,000 students or parents replied. The Director admitted that the survey might have had limited participation by some members of the population that they were attempting to survey and that had more of the population been included, the numbers may not have been as promising (M. Mariel, personal communication, September 24, 2015).

OCPS relies on various programs and initiatives to assist students in subscribing to home-based Internet. First and foremost, a flyer detailing the Lifeline Internet Programs available from local ISPs is included in the back-to-school paperwork at the beginning of the school year that goes home to all parents. When a student is approved for the free or reduced lunch program, another flyer is sent home with the student. Less than 10% of the student population participates in the Lifeline programs. The Lifeline programs, through local ISPs, can provide services for $9.95 per month to families that meet certain financial requirements. At times, the fine print of these programs can preclude families from participating if they have been a customer of the ISP within a certain time period. For instance, if a parent has Brighthouse television cable, they may be denied services for the Lifeline Internet Program. During the conversation, it was stated that there are ways around these requirements, and parents would need to be advocates for their students by contacting a school representative or principal for assistance (M. Mariel, personal communication, September 24, 2015). It could be argued that many individuals that need access to these services may not have the time or capability to navigate the system to gain access.

The Director discussed some of the options for students who do not have home-based Internet access. Students can locate free Wi-Fi through the Wi-Fi map that is provided so that they can study at local libraries, restaurants, and coffee shops. Also, the school district is committed to teaching students the "rules of the road" at Wi-Fi access points, namely, they should always be paying customers and not be disruptive to other patrons. Additionally, OCPS has partnered with local area libraries as places for their students to meet, study, and continue to learn outside of the classroom. Local area libraries provide free Wi-Fi to students and offer a safe, conducive place for study. OCPS values its relationships with the libraries and encourages students to utilize them. Many of the OCPS schools extend the hours of their media centers to allow students to study and work there after school, along with some schools providing transportation via shuttle after school hours. Students are also made aware of other community organizations that offer free Wi-Fi that they may use, such as the local YMCA or Boys and Girls Clubs. In regard to the migrant or homeless population of students, when identified, schools may offer filtered wireless hotspots that these students may take from the school. These hotspots are filtered for educational use and the students can connect their devices virtually anywhere.

Although the interview with the OCPS director was valuable in understanding some of the plans that the school district currently had in place to aid students in need, it is imperative to consider the missing data caused by the low response rate to the district wide survey regarding Internet access. Previous studies have shown that as income decreases, so does Internet adoption (Cleary et al., 2005; Mossberger, 2012). Additional survey participation may have yielded more substantial results with regard to the potentially disparate impact on students from low income homes. Also, if the parents within the household have a lack of interest or technology skill, the likelihood of Internet adoption is subsequently low (Mossberger, 2012).

Winters Joint Unified School District (Winters, CA)

> The Winters Joint Unified School District (WJUSD) serves approximately 1,630 students within the city of Winters and surrounding unincorporated areas of Yolo and Solano counties. The District schools are Waggoner Elementary (grades K-3), Shirley Rominger Intermediate School (grades 4-5), Winters Middle School (grades 6-8), Winters High School (grades 9-12), and Wolfskill Continuation High School. The District student population is approximately 49% Hispanic, 48% Caucasian, and 3% other. Students have access to excellent core academic programs which are complimented by strong curricular and extra-curricular activities, including

visual/performing arts, advanced placement courses, student leadership, and athletics. (Winters Joint Unified School District, 2015, para. 1)

Additionally, 66% of the students in WJUSD are eligible for the free and reduced lunch program. This is considerably higher than the state average (CDOE, 2015 para. 1).

The Winters Joint Unified School District has had recent technology upgrades in 2014. A grant was in place to provide the students with iPads to utilize in the classroom and at home. The home-based Internet access, however, was inconsistent throughout the county. Often, students could be seen huddled around a local area library as this was the only place in the area with high connectivity. Though many homes may have had wired connections, this is unacceptable with iPads that require wireless connectivity. In these cases, a wireless router would be required which may be included in the ISP plan; however, installation requires technological knowledge (Magellan Advisors, 2015). Researchers have shown that individuals may not adopt Internet access based on interest, cost, or skill, especially for Latinos (Mossberger, 2012). Winters' population had a large proportion of Hispanic population, so these factors may come into play for the residents and parents. The City of Winters has taken a proactive approach, realizing "this is symptomatic of the issues described and if they are not mitigated, the School District's technology-based learning programs will not be fully realized in the community" (Magellan Advisors, 2015, p. 97).

The principal and assistant principal (2015) of Winters Middle School shared, during a phone interview, that students in the Winters Joint Unified School District have had challenges when accessing their Google Chrome books from home. Students were seen huddled around the local library during the late night hours accessing the free Wi-Fi to complete assignments

(Golden, 2015). If students lack Internet access at home, they had other avenues for Internet in Winters, however. The Winters Middle School media center is typically open later when there are activities on campus, and the public library is open until 5:00 pm. The school transportation leaves after school releases at 3:00 pm, and another bus leaves at 4:05 pm. Public transportation in the City of Winters is non-existent, with the exception of buses that transport individuals between the cities in the area. The City of Winters offers a Wi-Fi network crossing approximately five to eight city blocks in downtown Winters, California although many of the students do not live in that area, and getting there is not convenient. There are also a few businesses and coffee shops in the town that offer free Wi-Fi, and some students utilize these businesses. Though these businesses and access points have been helpful, a key is that public transportation is not readily available for the student population in Winters, California. If parents are working and students are in the home, they may not have the means to transport themselves to the areas with Wi-Fi connection. The Winters Joint Unified School District was not satisfied with these solutions. They believed in the safety and security of their student population and that all students should have Internet access in the home to complete their schoolwork (J. Barsotti & M. Studer, personal communication, October 29, 2015).

Winters Middle School began a survey, developed by CGS Emerging Technology Fund, in 2014 of one grade level of students and surveyed two additional grades in 2015. The beginning of the year survey was administered online during orientation, and garnered 100% participation. The end-of-year survey was conducted online through the Google Chrome Books or via paper copy, based on the family choice. The results of the survey administered to all students during orientation showed that 40-50% of students lacked Internet access with the capabilities to operate the student-held Google Chrome Books. Thus, though some students had dial-up Internet or DSL, they lacked the copper or fiber broadband connections that would be required to run the devices provided by the school district. Though researchers have shown that some Hispanics lack interest in adopting home-based Internet, (Mossberger et al., 2012), Winters administrators have not seen this as the case. During the 2015 orientation, all but one family accepted the devices and were willing to sign the documentation and accept the training. Students and parents have been receptive and interested in acquiring, utilizing, and maintaining the devices in the home for educational purposes; however, gaining the broadband access has been a struggle in the rural community (J. Barsotti & M. Studer, personal communication, October 29, 2015).

Lifeline Internet has not been established in the area. However, Winters Joint Unified School District hoped that AT&T would begin offering this service during 2015-2016. The school district anticipated that this would add millions of people in California to AT&T broadband services (J. Barsotti & M. Studer, personal communication, October 29, 2015).

In general, Winters Joint Unified School District has been playing a waiting game. The school district managed the Internet connectivity issues to the best of its ability for its students. The area is waiting for broadband to make Internet connectivity more accessible, but in the meantime, some students must deal with less than adequate Internet access, and this may impact their school performance.

In comparing the two school districts, the differences in size and structure are obvious, as are the distinctive viewpoints on Internet needs of their students. Table 2 contains a summary of the characteristics of the two districts. The administrators in Winters, California realize that their students are underserved in the area of Internet access and solutions need to be determined. Reliable, high-speed Internet is not a commonplace in the area and hard to come by (J. Barsotti & M. Studer, personal communication, October 29, 2015). In Orange County, Florida high-speed Internet is readily available and not seen as an issue for the student population (M. Mariel, personal communication, September 24, 2015). The condition in Winters, California is more common in many areas of the country where reliable Internet is not accessible to many students, although educators and school districts are providing devices and expecting that students are able to utilize them and complete assignments from the home (Education Superhighway, 2016).

Table 2

Characteristics of Winters Joint Unified School District and Orange County Public Schools

Characteristics	Winters Joint Unified School District	Orange County Public Schools
Number of schools	5	150
Number of students	1,630	200,000
Free and reduced lunch	67%	65%
Initial method of student survey of internet access	In-person at orientation via Google Chrome Book	Phone or Internet
Students with internet access for devices	50%	64%
Lifeline services available	No	Yes
Communication with parents regarding Internet access	At orientation and additional flyers sent home periodically	Flyers sent home with free and reduced lunch information
Attitude toward student needs	Proactive toward assisting stakeholders in development of solutions	Internet needs of students are not pressing--most students are well served.

Digital Classroom Plans

School districts within the State of Florida are required to create and submit Digital Classroom Plans (DCP) to the Florida Department of Education (Fla. Stat. § 1011.62). The Digital Classroom Plan includes five components: (a) student performance outcomes, (b) digital learning and technology infrastructure, (c) professional development, (d) digital tools, and (e) online assessment support. The Florida Department of Education provides support for the school districts by providing links to guides, materials, and templates for organizing, creating, and submitting their plans (FDOE, 2015).

In review of 10 selected DCPs submitted by school districts across Florida, several themes emerged. As the DCPs are compiled using a template, many of them look quite similar and utilize the same formatting and language; however, some stark differences emerged in review. Orange County Public Schools' DCP was extremely thorough and included many figures describing the school district's planning and implementation processes along with the results of comprehensive needs assessment and analysis of computer-based testing needs (OCPS, 2014). Hillsborough County Public Schools' DCP was, in contrast to the OCPS plan, undescriptive and lacking in sufficient content in the allocation proposal section. Additionally, the learning and achievement goals for the school district were very modest, consisting of increasing achievement, learning gains, and graduate rates by 1% each over the five-year period. An assessment conducted by a third-party consultant also was due to be attached to the document; however, this information was not available to the researcher (HCPS, 2014).

When assessing professional development, the school district is required to state where its educators fall with regard to the TIMSS levels of technology integration. The scale of integration ranges can be defined by: entry, adoption, adaption, infusion, and transformation. By moving up the scale, the educator utilizes more technology, more effectively, and inspires more learning within the classroom. This learning scale can be described as: active, collaborative, constructive, authentic, and goal directed (Florida Center of Instructional Technology, 2016). Within the DCPs, some school districts state where their educators currently fall within the technology integration and where they plan to have their educators achieving in the future.

Others simply state where they currently fall or where they would like to see them. The presentation of this information varies from school district to school district. Alachua County Public Schools indicated it plans to have teachers at the following levels by 2019: 20% entry, 25% adoption, 30% adaptation, 10% infusion, and 15% transformation (ACPS, 2014). Orange County Public Schools also has a plan to move educators to the following ranges of integration: 8% entry, 10% adoption, 50% adaptation, 30% infusion, and 2% transformation. The time for implementation varies by school level (OCPS, 2014). Columbia County School District indicated it plans to have all teachers (100%) meeting transformation by 2018 (CCSD, 2014), Flagler County Public Schools plans to move all teachers (100%) from adaption to transformation by 2017 (FCPS, 2015), and Broward County Public Schools simply stated that the professional development will be implemented by 2018 (BCPS, 2014).

Many school districts indicated they were planning to make or have made implementations of one-to-one device programs in their school districts. Of those reviewed, Alachua, Flagler, Hillsborough, Orange, Polk, and Walton projected that they would have a program in place. A number of these, however, would include Bring Your Own Device (BYOD) programs (ACPS, 2014; FCPS, 2015; HCPS, 2014; OCPS, 2014; PCPS, 2014; WCSD, 2014). In reviewing the plans, it was apparent that Lake and Seminole school districts would focus on connectivity in the classroom and providing more robust technology such as interactive whiteboards and document cameras as opposed to laptop or tablets for every student (LCS, 2014; SCPS, 2014). This differential emphasis could be due in part to the need to refresh devices every two to three years which could become cost prohibitive.

Bandwidth supports the school districts' initiatives for one-to-one learning. Ubiquitous Internet access, meaning that students, educators, and administrators have continuous high-speed Internet access throughout the day is essential for implementation of one-to-one learning (Burns, 2014). Four of 10 of the school districts were meeting the bandwidth expectations in 2014: Flagler, Hillsborough, Lake, and Polk (FCPS, 2014; HCPS, 2014; LCS, 2014; PCPS, 2014). Columbia County School District had no schools meeting bandwidth requirements but expected to have all on standard by 2015, in one year's time. This school district indicated that plans were underway for a fiber broadband network to service its school system to be complete in 2025 (CCSD, 2014). Of those districts with a varying number of schools meeting the bandwidth requirements, Seminole had 10% meeting the expectation with a goal of 100% by 2019 and Orange had 75% meeting expectations with a goal of 100% by 2015 (SCPS, 2014; OCPS, 2014). Many of the DCPs failed to lay out exactly how they would increase their bandwidth speeds, Broward elaborated that it would implement one access point in every classroom, a LAN network enabling 2 Gbps as a campus backbone, WAN circuits increased to 1 Gbps to the district core, and upgrades to network electronics which would produce future speeds of 40-80 Gbps based on a utilization analysis (BCPS, 2014). Columbia County School District discussed its turmoil of increasing Internet connectivity. The school district will be increasing its speeds to 250 Mbps; however, this increase will provide only 22.2 Kbps per student. When the ISPs, AT&T and DMS, begin offering 1 Gbps, the school district will subscribe. However, even this speed fails to provide their students 100 Kbps. Though they are in the process of creating a fiber broadband network, the specifics, aside from a target completion date of 2025, were not included in the DCP (CCSD, 2014). In an effort to monitor bandwidth needs to respond efficiently, Walton County School District stated it is implementing a software to assist the school district in this task (WCSD, 2014).

In order for a technology program or initiative to be successful, many pieces must fall into place. Levins & Schrum (2013) discussed in their analysis that successful schools and districts attend to the following simultaneously to enact such programs (a) vision, (b) leadership, (c) school culture, (d) technology planning and support, (e) professional development, (f) curriculum and instructional practices, (g) funding, and (h) partnerships. Again, the authors stated that if any of the pieces were missing or not applied effectively, the program risked failure. Technology planning and support ranked fourth in the necessary processes to attend to regarding program implementation. When school districts complete the Digital Classroom Plans for the Florida Department of Education, the process should be more than a required exercise. This process should be, and is in many districts, a useful strategic process assessing technology integration and implementation and taking decisive actions towards ensuring that statewide and nationwide goals are being met or progress is being made toward achieving them.

Educational Bandwidth Trends

As emphasized throughout this literature review, additional technology requires additional bandwidth to keep students connected to the Internet effectively and efficiently (Burns, 2014). “In a school environment, the two main drivers of how much network bandwidth are needed are 1) the number of devices like tablets, laptops, and smartphones the network is supporting and 2) how often these devices will be used” (Shellabarger, 2015). Schools with one-to-one learning programs require more bandwidth than a school simply using teacher-led technology programs. Schools with individual classroom use where teachers are leading instruction to facilitate technology and media at various times during the day need moderate bandwidth which requires 1 access point per 1.5 classrooms and 100 Kbps per student Internet bandwidth. Schools implementing a one-to-one device program where students are using their technology on most school days need high bandwidth which requires 1.2 access points per classroom and 1 Mbps per student Internet bandwidth. A school with media-rich technology use builds upon the one-to-one learning initiative, requiring students to utilize their devices continuously throughout the day, and this mandates very high bandwidth of 1.2 access points per classroom and over 1 Mbps per student Internet bandwidth. In order to implement a one-to-one learning initiative, the school district or school must alter its technology infrastructure, adding access points and subscribing to Internet through a provider (Shellabarger, 2015). SEDTA (2016) reported that a small school district with less than 1,000 students should have at least 1.5 Mbps per user; a medium school district with approximately 3,000 students should have at least 1 Gbps per 1,000 users; and a large school district with more than 10,000 students should have at least 0.7 Gbps per 1,000 students. The forecast, however, has been to move to 4.3 Mbps per user, 3 Gbps per 1,000 users, and 2 Gbps per 1,000 users, respectively. In order to understand why these bandwidth trends are growing significantly, it is important to demonstrate how much bandwidth each program or application requires. SETDA (2016) reviewed the bandwidth requirements per application using *The Broadband Imperative II: Equitable Access for Learning* (Fox, Waters, Fletcher, & Levin (2012). The requirements are shown in Table 3.

Table 3

Bandwidth Requirements per Application

Application	Bandwidth Requirement
Searching the Web	1 Mbps
Checking email	.5 to 1 Mbps
Downloading digital instructional materials, including OER	1 Mbps
Engaging with social media	.03 Mbps
Completing multiple choice assessments	.06 Kbps
Sharing cloud-based documents (Office 365/Google Apps)	50 Mbps
Music streaming	2 Mbps
Video streaming—SD quality	3 Mbps
Video streaming—HD quality	5 Mbps
Video streaming—Ultra HD quality	25 Mbps
Streaming HD video or university lecture	4 Mbps
Watching a video conference	1 Mbps
Collaborating in HD videoconferencing	4 Mbps
Collaborating in a video conference	1 Mbps per user
Taking an online class	.25 Mbps
Engaging with simulation and gaming	1 Mbps
Engaging in two-way online gaming	4 Mbps

Source. SETDA (2016)

Although this table is fairly comprehensive it fails to take standardized assessments into consideration. The increased use of computer-based testing has necessitated additional Internet bandwidth, and school districts can opt for low, moderate, or high bandwidth solutions. Using the minimum with caching model, the school district should require 5 Kbps per student. The minimum without caching model should require 50 Kbps per student. The recommendation for assessment and instruction, meaning that assessments are taking place in some classrooms while instruction is occurring in others, should require 100 Kbps or faster per student (Partnership for Assessment of Readiness for College and Careers [PARCC], 2016).

As students and teachers interact with various programs, applications, tools, and assessments throughout the course of a day, they utilize bandwidth from the Internet. If a school does not have enough bandwidth, the network slows or fails. When school districts make decisions regarding bandwidth within the schools, it is imperative to consider how the devices and applications will be used (SEDTA, 2016).

Educational Technology and Student Achievement

In the 1980s and 1990s, educators and researchers began to "worry that computerization of the classroom may not cause increased individualization of instruction, but instead a much greater regimentation and homogenization of classroom learning experiences to the detriment of students with different learning styles" (Lepper & Gurtner, 1989, p. 172). The growing pressure for accountability that affects states and districts as well as classroom teachers can be realized; and many states, school districts, and schools are making digital changes (Irving, 2006). Educators and administrators have realized that technology is not an educational fad that will be obsolete in coming years, and the incorporation of technology into the classroom has become increasingly important (Cheung & Slavin, 2013). In particular, the correlation between various educational technology implementations and student achievement is of vital importance.

Irving (2006) discussed the importance of assessment of and for learning and how using technology can make contributions to both. In essence, assessment of learning includes summative and formal assessments, whereas assessment for learning includes formative and informal assessment strategies and tools. Irving considered how having connectivity in the classroom to implement student response systems and formative assessment tools can benefit student learning. Specifically, Irving observed that "connected classroom systems offer opportunities for improved formative assessment through questioning and immediate feedback, which has the potential for affording the teacher the necessary information to tailor instruction to meet student needs" (p. 36). In addition, with the rise of computerized standardized testing, connectivity in the school house is imperative to implementing these robust systems. Importantly, the connection is made between assessment of knowledge acquisition and providing the instruction effectively (Irving, 2006).

One-to-One Learning.

One-to-one learning refers to the level of technology available in the classroom; however, as discussed by Bebell and O'Dwyer (2010), it does not reference actual educational practices or pedagogy in implementing these initiatives.

> Each 1:1 setting has its own unique 1:1 program and comprises a set of expectations, funding mechanisms, and individual implementation models including variation in hardware, software, networking, teacher training and professional development, as well as program support (Bebell & O'Dwyer, 2010, p. 6).

Harper and Milman (2016) noted in their review of research that most one-to-one initiatives they examined "provided students with at least some achievement-related benefit," (p. 131) although this review of research demonstrated mixed results with regard to one-to-one learning and its effect on student achievement. Many of the studies that Harper and Milman reviewed yielded favorable increases in student achievement; and even the studies which did not present statistically relevant correlations, revealed positive academic outcomes from the use of technology (Harper & Milman, 2016).

Cristol & Gimbert (2014) conducted a study in a rural school district in the midwest United States to determine the effects of utilizing Mobile Learning Devices (MLD) or Bring Your Own Device (BYOD) programs in classrooms, specifically based on student achievement and response. The researchers found that the use of devices in the classroom increased reading and mathematics scores significantly at the 8th-grade level and marginally in social studies and science at the 10th-grade level. Importantly, "higher scores were reported for those students using MLDs in their classroom in all instances" (Cristol & Gimbert, 2014, p. 28). In support of the mixed reviews of one-to-one learning initiatives, Lobeto (2015) found in his study of a large urban Florida school district that elementary students fared worse, middle school students fared better, and high school students fared the same on standardized assessments when one-to-one programs were in place.

Computer-based Instruction

In 2000, a high school in a small town in the Northeast was dealing with plummeting mathematics standardized test scores. The school administration made the decision to implement a computer-based instruction tool, PLATO, to increase the student achievement scores on campus. Within two years of implementing the program, the school realized significant improvement in its mathematics scores on campus and in comparison to the state averages. Specifically, the students enrolled in PLATO realized an average gain score of 20 points where the students not enrolled in PLATO realized an average 11-point increase (Hannafin & Foshay, 2008). Further, a meta-analysis of 74 studies conducted by Cheung & Slavin (2013) sought to determine the effect size of utilizing educational technology in K-12 classrooms. In this study, it was determined that there were slight to moderate effects of using educational technology to increase mathematics scores. As in the prior study, PLATO was one of the tools assessed, along with other computer-based, or computer-aided (CAI), instruction programs. Cheung & Slavin noted that of the studies analyzed, those with smaller sample sizes realized higher effect sizes; and conversely, those with larger sample sizes garnered smaller effect sizes. Overall, among the three types of educational technology applications, supplemental CAI had the largest effect on mathematics achievement, an effect of +0.19. The other two interventions, computer-management learning (CML) and comprehensive programs, had a much smaller effect size, +0.09 and +0.06 respectively (Cheung & Slavin, 2013). Additionally, Cheung & Slavin found that increases in reading achievement may be greater through the use of computer-aided instruction tools.

> Educational technology is making a modest difference in learning of mathematics. It is a help. It is not a breakthrough. However, evidence to date does not support complacency. New and better tools are needed to harness the power of technology to enhance mathematics achievement for all children (Cheung & Slavin, 2013, p. 102).

As stated by Cheung & Slavin (2013), there may be greater increases in reading achievement through the use of CAI. Knezek & Christensen (2007) analyzed the effect of a technology-based reading program on first and second-grade reading achievement. The study was conducted in a large school district in Texas and utilized a standards-based reading assessment to determine results. “In all but one case, the impact of the technology enhanced instruction was greater for the technology-intensive reading program than for the control group” (Knezek & Christensen, 2007, p. 32). In several meta-analyses and reviews of literature regarding the relation of educational technologies to achievement, effect sizes ranging from a minimal +0.19 to a substantial effect +0.65 have been determined (Delgado et. al., 2015; Knezek & Christensen, 2007).

Wu and Zhang (2010) conducted a small-scale study examining the potential of increased student achievement in fourth and fifth grade when students had access to handheld computers. The researchers found that in all instances, students using the hand held devices increased mathematics and vocabulary skills at higher rates than those students that used pencil and paper assessment methods. In a larger scale study of fourth grade, at-risk student achievement when utilizing a one-to-one laptop program, significant gains in reading and moderate gains in math, 12% and 3% respectively, were realized (Mabry & Snow, 2006). This research demonstrated that though gains were not consistently large, they were consistent. This could confirm that the implementation of the program on the part of the teacher could greatly affect the academic achievement of the students. Training and professional development to foster successful implementation and use could be important indicators for future study in these cases.

An example of the use of intensive professional development to increase technology integration for student achievement was shown in a study where a school district implemented an intensive summer professional development. The goal was to increase student achievement scores in a low performing school district. The implementation of a four-week summer professional training, with multi-year opportunities for training, included aspects of general Internet research and integration to higher level programming and model simulations. The training included varied levels, depending on the needs of the teacher. Over a four-year period, the school district realized a 35% increase in graduation rates, and over a six-year period a 38%

increase in graduation rates. The school district increased assessment scores from 20 percentage points in Chemistry and 29 percentage points in mathematics. Some areas, (e.g., Earth Sciences) experiences decreases of 23 percentage points in scores (Yasar, Maliekal, Little, & Veronesi, 2014).

It is vital to analyze the pieces needed to implement an educational technology program effectively. Levins & Schrum (2013) demonstrated in their analysis that successful schools and districts attend to the following simultaneously to enact such programs (a) vision, (b) leadership, (c) school culture, (d) technology planning and support, (e) professional development, (f) curriculum and instructional practices, (g) funding, and (h) partnerships. The authors cautioned that if any of these pieces were missing at any time during the process, the project risked failure. Professional development was fifth in importance within this study, further supporting Yasar et al.'s. (2014) findings regarding the importance of professional development of educators.

Lei & Zhao (2005) examined the relationship between middle schoolers' time spent in front of a computer and student GPA. It was determined that there was a threshold of three hours of screen time; essentially, GPA increased as computer time increased up to the three-hour point. After three hours, the student GPA began to decline. This interception point may be indicative of how the student is interacting with the computer, whether the student is engaging in school work, games, or social media. Although 81% of participants, within the Lei & Zhao (2015) study, reported using the computer for homework, a large percentage reported "Surfing the Internet for Fun" and "Chatting with Friends," 58% and 51% respectively. The inference could be made, therefore, that after homework, time spent social networking and playing on the Internet could effectively reduce student GPA (Lei & Zhao, 2015).

Mardis (2016), in her study, specifically sought to correlate Internet connection speed of the school with students' academic achievement. She found a negative correlation between building connection speed and standardized assessment scores in science and the school district grade. As connection speeds increased, standardized science scores and district grades declined. "The meaning of these unexpected relationships is a fertile area to explore" (Mardis, 2016, p. 49). Mardis' work lends support for the construction of a study using diverse variables to further understand why this data would show an inverse relationship between student achievement and broadband speeds.

Technology in education trends are not projected to slow anytime soon (Fox et al., 2012; SETDA, 2014). With the rise of ubiquitous computing, one-to-one device programs, simulation programming, educational gaming, and virtual learning comes an increase in need for large amounts of bandwidth within schools, classrooms, and homes (Bebell & Dwyer, 2012; Burns, 2014; Gros, 2007; NTIA, 2011; The White House, 2015). As has been shown, there is a lack of research surrounding the correlation between Internet connectivity spending and student achievement (Mardis, 2016). There have been numerous studies, some of which have been discussed in this chapter, regarding the effect of technology on student achievement. Findings, however, have been conflicting. The objective of the present study was to determine a relationship between school-based Internet connectivity and student achievement, defined by high school graduation rates.

The New Economy

The world and national economy are moving through a revolution, a revolution based on technology (Goodwin, 2017) and changing business models (Manuika, Lund, Bughin, Robinson, Mischke, & Mahajan, 2016). According to authorities, the rise of artificial intelligence, automation, and technological advances will significantly change the way businesses operate and people work within them (Executive Office of the President, 2016; Goodwin, 2017; Thompson, 2016). Additionally, the labor market is evolving into a “gig economy,” where individuals work independently, creating their own businesses and working in a project or service delivery environment (Manuika et al., 2016; Mulcahy, 2016). These forces inevitably affect how the future workforce needs to be educated to be successful in the economy (Executive Office of the President, 2016).

In January of 2017, the World Economic Forum met in Davos, Switzerland and technology, artificial intelligence, and automation were in the spotlight of discussions. During these dialogues, the members deliberated on how these technological advances could disrupt employment, potentially creating social and political unrest in many countries. Specifically, driverless vehicles and the potential reductions in blue collar and white collar jobs were noted as significant drivers of conceivable political issues (Goodwin, 2017; Mather, 2016; Rotman, 2017). Society, and politicians, need to keep pace with these changes, forming policies that support the use of technology and the individuals who may be displaced because of the changes in the economical milieu (Executive Office of the President, 2016; Goodwin, 2017).

Traditionally, it was believed that blue collar workers would be the only working class to suffer from automation; however, advances in software programs have spurred reductions in other sectors, such as paralegals, security guards, and financial analysts. White collar employees in the financial, administrative, retail, service, science, and technology industries may also see reductions in positions in the future (Aguilera & Barrera, 2016; Goodwin, 2017). Frey and Osmond (2013) examined the probability of 702 various jobs being computerized and found that 47% of jobs within the United States were at risk of being automated by 2023. The model predicted that employment within the transportation, logistics, office administration, and manufacturing sectors were at the greatest risk of being automated. The researchers posited that low skilled labor will suffer the most through the implementation of technology and automation and that workers affected will need to be reallocated to other sectors, sectors that will most likely require creativity and social intelligence.

Some of these dislocated employees may require a change in career, which could include movement into the "gig economy." In the past, many individuals would have steered away from these roles based on benefits; however, with the Affordable Healthcare Act, individual retirement accounts, and personal 401K accounts, individuals can establish their own benefits on the free market (Mulcahy, 2016; Rotman, 2017). Manuika et al. (2016) compiled a McKinsey Global Institute report detailing the development and make-up of the independent working class. At the time of the report, approximately 20-30% of the United States and European Union workforce engaged in independent work and were classified as free agents, casual earners, reluctants, and the financially strapped. Free agents consist of individuals who work for themselves, moving from gig to gig or project to project, to earn a sufficient living. Casual earners typically take gigs or work for extra, supplementary income. Reluctants work independently due to being unable to find a traditional work assignment; those in the financially strapped category take projects or jobs to make ends meet. Through the advent of digital platforms, social media, and the Internet, these independent workers are able to gain access to gigs and jobs more efficiently than ever before. The researchers also noted that individuals in the free agent or casual earner classes report higher job satisfaction than those in traditional workplaces, as they have more autonomy and control over their work and schedules. The types of jobs within this market run the gamut from dog walker, photographer, artist, web site designer, business consultant to lawyer. This market is not limited to low or high income possibilities. Being technologically savvy can aid these individuals in marketing themselves or becoming involved with digital platforms to connect with potential clients (Manuika et al. 2016).

The Executive Office of the President of the United States released a report, *Artificial Intelligence, Automation, and the Economy* in December of 2016. The report reviewed how artificial intelligence may affect the economy, the near-term changes, and possible strategic policy responses to support the economy and the workers within in it through the transformation. The proposed policy strategies included: “invest in and develop artificial intelligence for its many benefits, educate and train Americans for the jobs of the future, and aid workers in the transition and empower workers to ensure broadly shared growth” (Executive Office of the President of the United States, 2016, p. 3). The report specifically called upon K-12 education to increase the nation’s students’ proficiency in science and mathematics, along with supporting high-quality early education programs. Additionally, although many low skill jobs may be automated in the future, the strategy builds on the *Computer Science for All* initiative, supporting courses in computing and computational thinking within K-12 education.

Moving into the future, it will be imperative to align education with these rapid technological advances to ensure that the future workforce is prepared to engage in the evolutionary economy (Executive Office of the President, 2016; Rotman, 2017).

Summary

This chapter has provided a review of the literature and research related to the topic of interest in the present research. Major topics addressed include the evolution of technology, educational law and technology, bridging the digital divide, and educational technology and student achievement. Chapter 3 contains a discussion of the methods and procedures used to conduct the study.

CHAPTER 3
METHODOLOGY

Introduction

The objective of this study was to determine a relationship between school based Internet access and student achievement. Correlations between Internet spending defined by E-rate funding data and student achievement defined by graduation rates were examined to fulfill the objectives of study. The study was conducted by gathering publicly available data and using statistical analysis. This methodology and procedures used to conduct the study are explained in detail in this chapter.

Selection of Participants

The participants in the quantitative study consisted of the 67 school districts in the state of Florida (Appendix D). The representative E-rate funding, graduation rates, district enrollments, district level socio-economic status, ratio of Internet connected computers to students, school district Internet connectivity, and school district enrollment were analyzed through data collection from different sources detailed in this chapter.

Data Collection

Prior to beginning the research study, the Institutional Review Board process was followed, as determined by the University of Central Florida. CITI Training specific to ethical academic research was completed. The IRB application was submitted and accepted, enabling data collection to commence.

All data utilized in the study were public data, available through access on the FDOE web portal, E-rate Central website, Universal Service Administrative Company online documents, or through public records requests of the FDOE. A public records request was submitted to the FDOE for bandwidth connectivity and number of Internet connected computers per school district for each of the four years to be examined. The FDOE responded by providing the 2011-2012 School Survey data, 2011-2012 District Survey data, 2012-2013 School Survey data, 2013-2014 School Inventory Summary, and 2014-2015 School Inventory Summary data. In an effort to better understand the data provided, the researcher requested the survey questions for each of the databases provided. Each year the FDOE inquired about Internet connectivity and bandwidth in varying formats. The 2011-2012 District Survey simply inquired about the school district bandwidth, without further elaboration. Additionally, only 36 of 67 districts responded to the question on the survey, decreasing the reliability of the data. The 2012-2013 School Survey required school sites to conduct five bandwidth speed tests at varying locations throughout the campus sites. The survey also allowed for the school to note the school bandwidth in ranges: less than 10 Mbps, between 10 and 50 Mbps, between 51 and 100 Mbps, and over 100 Mbps. The researcher averaged the speed test per school site and for each school district in order to determine the average bandwidth for each of the 67 Florida school districts to be used in the analysis for the 2012-2013 school year. The 2013-2014 School Inventory Summary listed the school district bandwidth in Mbps by connected fiber, copper, wireless, or other. This provided multiple variables for comparison regarding school district connectivity. The 2014-2015 District Inventory Summary provided school district bandwidth by DWAN, @3rd Party ISP, DMS FIRN, and maximum burstable speed. The researcher determined that maximum burstable speed would provide the most reliable data point as this is the highest bandwidth available through the district ISP and most likely, the school districts' contracted bandwidth rates through their ISP.

Table 4

Florida Department of Education (FDOE) Bandwidth Representations

School Year	FDOE Survey Tool	Bandwidth Data
2011-2012	District survey	Bandwidth
2012-2013	School survey	Average school bandwidth speed tests
2013-2014	School Inventory summary	Bandwidth by fiber, copper, wireless, or other
2014-2015	District Inventory summary	Maximum burstable speed

E-rate Funding data were gathered from the E-rate Central web portal by utilizing school district BIN codes garnered from the USAC Schools and Libraries web portal. When gathering data from USAC, the researcher searched for the years of funding and downloaded the represented funding data into a spreadsheet database. In analyzing the data, the Internal Connections and Management funding was removed to allow for comparison of only Internet Access of Telecom funding commitments. The researcher determined that Internal Connections and Management included hardware, technology, and maintenance which changed annually. Many times, a school district may not update the hardware or equipment for a five-year time period. Removing these funding allocations and commitments allowed the researcher to examine only Internet funding commitments.

The computer to student ratio was compiled through the data sets provided in response to a public records request from the FDOE. The ratio was determined through ratios of enrollment to Internet connected computers in each of the Florida school districts. Enrollment data and SES data, based on free and reduced lunch registration, were gathered from publicly available data on the FDOE web portal.

Each research question required correlations and regressions of different variables. Question 1 was used to gather data from E-rate funding, school district free or reduced lunch percentage, and school district enrollment. These data were garnered from E-rate Central portal and FDOE K-12 Education Information web portal. Question 2 required the acquisition of data of the ratio of computers to students from a public records request through the FDOE and E-rate funding available through E-rate Central. Question 3 utilized data from the FDOE K-12 Education Information web portal, and school district connectivity was acquired via a public records request submitted to the FDOE. Question 4 required data be acquired from E-rate funding and FDOE K-12 Education Information web portal.

Data Analysis

Regression analysis was used to determine the predictor variables correlation regarding graduation rates and Internet based spending in Florida school districts. Prior to analyzing the regression model, it was necessary to determine Pearson *r* correlations to determine significance of the variables and to determine if the predictors were "collectively predicting the criterion outcome" (Steinburg, 2011). If $r(66) > .40$, $p <.10$ or $R^2(66) > .15$, $p < .10$, the independent variable was viewed as statistically significant regarding the regression or multiple regression analysis. When making judgements on whether to accept or reject hypotheses, the researcher used the methodology of $p < .10$ as a determining factor in addition to regression and correlation statistics.

The multiple regression model used was the following, where Y was the dependent variable, graduation rates, ratio of Internet connected computers to students, and E-rate funding, depending on the research question. Various multiple regression analyses were detailed to examine the scope of the research questions from different perspectives.

$Y' = b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + a$

Independent variables within the model included: (a) E-rate funding; (b) connectivity of the school district, measured in megabits per second speed; (c) school district socio-economic status, defined by free or reduced lunch percentage; and (d) school district enrollment.

SPSS was used to generate the regression or multiple regression analysis, which provided: descriptive statistics, such as variable means, standard deviations, and variance; Pearson r correlations; ANOVA[a] summary statistics; coefficients; and the regression model summary. Regressions or multiple regressions were generated to answer the research questions detailed in the study: Research Question 1 entailed a multiple regression using E-rate funding (dependent), school district socio-economic status (independent), and school district enrollment (independent); Research Question 2 required an analysis using the ratio of Internet connected devices to students (dependent) and E-rate funding (independent); Research Question 3 utilized an analysis of the correlation of bandwidth of the school district and student achievement using graduation rates (dependent) and school district bandwidth (independent); and Research Question 4 utilized a regression analysis of graduation rates (dependent) and E-rate funding (independent).

The statistics produced from the regressions and multiple regressions were analyzed to determine correlations between predictor variables and the dependent variable, graduation rates. These results were used to accept or reject the hypothesis for each of the research questions detailed in the study. Subsequently, inferences were made, as appropriate, regarding the statistical significance of Internet connectivity and the effects on student achievement, based on graduation rates.

This study was conducted to analyze regression and correlational data to answer each of the research questions and determine if Internet spending and connectivity significantly affected student graduation rates in the state of Florida. Additionally, the theoretical framework, cost effectiveness analysis, was used as a basis to determine whether investment in significant bandwidth supported the school districts' goals of increasing student achievement. Initially, it was important to analyze descriptive statistics for each of the variables, independent and dependent, for means, variance, and statistical significance based on Pearson *r*. Each of the questions then were analyzed in detail. Research Question 1 determined correlation coefficients and the model results regarding E-rate funding (dependent), school district socio-economic status (independent), and school district enrollment (independent). Research Question 2 included an analysis of the correlation coefficients and the model results regarding ratio of Internet connected computers to students (dependent) and E-rate funding (independent). Research Question 3 examined the correlation coefficients and model results comparing Internet bandwidth and graduation rates, or student achievement. Research Question 4 included reviewing the correlation coefficients and the model results regarding the Internet spending of the district (independent) and graduation rates (dependent). A summary of the methodology of the study is displayed in Table 5.

Table 5

Research Questions, Variables, Data Sources, and Methods of Analysis

Research Questions	Variables	Data Sources	Analysis
1. What is the relationship, if any, between the student enrollment of a school district and district spending on connectivity?	Dependent: E-rate funding Independent: School district SES School district population	E-rate funding data FDOE	Multiple Regression Pearson *r*
2. What is the relationship, if any, between the amount of spending on school based Internet access, and the ratio of Internet connected computers to students?	Dependent: Ratio of Internet connected computers to students Independent: E-rate funding	FDOE E-rate funding data	Regression Pearson *r*
3. What is the relationship, if any, of Internet bandwidth, or connectivity and student achievement, as determined by graduation rates?	Dependent: Graduation rate Independent: Connectivity of school district	FDOE E-rate funding data	Multiple Regression Pearson *r*
4. What is the relationship, if any, between the amount of spending on school based Internet access and student achievement, as determined by graduation rates?	Dependent: Graduation rate Independent: E-rate funding	FDOE E-rate funding data	Regression Pearson *r*

Summary

This chapter has presented the methods and procedures used to conduct the study, detailing the use of a regression and multiple regression model in the analysis if data. The selection of the 67 school districts, data collection process, and data analysis have been described in full. Chapter 4 reveals the findings of the study and Chapter 5 contains a summary of the study, implications, and recommendations for future research.

CHAPTER 4
RESULTS

Introduction

The results of analysis are presented based on methodology of statistical processes previously discussed in detail in this chapter. The descriptive statistics regarding the variables are presented to provide an overview of the data used in the analyses. Regression analyses were used to determine coefficients and relationships between the variables in an effort to determine whether school district spending on Internet access or bandwidth of a school district statistically predicted a school district's student achievement, based on graduation rates. The data utilized for the study were gathered from public records request of the Florida Department of Education, the Florida Department of Education web portal, and the E-Rate Central State Information web portal.

Descriptive Statistics

Variables

Graduation Rates, E-rate Funding, Socio-Economic, and Enrollment Variables

At the time of this study, the state of Florida had recently made a change from the Florida Comprehensive Assessment Test (FCAT) to the Florida Standardized Assessment (FSA). Therefore, there were only two years of data for the FSA scores and the initial year had not been validated. In order to have additional years of data to analyze, graduation rates across the 67 school districts were determined to be an effective measure of student achievement. These data were gathered from Florida Department of Education K-12 Education Information web portal.

Table 6 reports the minimum, maximum, mean, and standard deviation for graduation rates per year of the study across the 67 school districts in the state of Florida. Over the course of the four-year span, 2012 through 2015, graduation rates across the state of Florida increased almost 5% points. In the final year of study, 2015, the mean graduation rate was 76.56% with a standard deviation of 8.66%.

Table 6

Descriptive Statistics: Graduation Rate

Year	N	Minimum	Maximum	Mean	Std. Deviation
Graduation Rate 2012	67	42.60%	89.00%	71.94%	8.37%
Graduation Rate 2013	67	35.10%	90.90%	73.39%	9.61%
Graduation Rate 2014	67	49.50%	95.40%	74.60%	8.72%
Graduation Rate 2015	67	49.00%	96.90%	76.56%	8.66%

Review of the descriptive statistics for E-rate funding commitments revealed decreasing means of spending on Internet connectivity across the 67 school districts. As shown in Table 7, over the course of the study, mean E-rate funding commitments decreased $297,390.56 between 2012 and 2015. Standard deviation of the E-rate funding commitments also decreased by $554,321.44 indicating a decrease in variance, or flattening effect, of spending across the 67 school districts. Due to the extreme difference in the range of funding across the school districts, the standard deviations for the E-rate funding commitments were consistently larger than the mean over the course of all four years of the study.

Table 7

Descriptive Statistics: E-rate Funding Commitment

Year	N	Mean	Std. Deviation
2012	66	$655,971.69	1,208,851.64
2013	67	$586,541.85	1,132,984.74
2014	67	$579,728.38	1,103,472.38
2015	65	$376, 581.13	654,530.20

Select analyses to follow were adjusted for socio-economic status of the student population of the school districts throughout the state of Florida. Socio-economic status (SES) was defined by the number of students enlisted in the federal free or reduced lunch programs within the school districts. Table 8 details the changes in Florida school districts SES throughout the years of study, 2012 through 2015. The descriptive statistics note the minimum, maximum, mean, and standard deviation for each year of the study. The mean changes seem slightly volatile, with an increase of 1.07% from Year 1 to Year 2, a decrease of 3.22% from Year 2 to Year 3, and an increase of 1.38% from Year 3 to Year 4.

Table 8

Descriptive Statistics: Socio-Economic Status (SES)

Year	N	Minimum	Maximum	Mean	Std. Deviation
SES 2012	67	22.30%	85.20%	59.97%	12.24%
SES 2013	67	22.50%	100.00%	61.04%	13.67%
SES 2014	67	22.80%	100.00%	57.82%	13.47%
SES 2015	67	23.90%	98.00%	59.20%	12.22%

Population size of the school district was represented by each school district's enrollment for each of the study's corresponding years, 2012 through 2015. These data were gathered from the Florida Department of Education K-12 Education Information web portal. Over the course of the study, Florida's school districts' mean enrollments decreased by 3,891 students. These data were used to determine the relationship, if any, between the overall size of a school district and spending on Internet access for the school district. Table 9 provides descriptive statistics for the independent variable, enrollment, including: minimum, maximum, mean, and standard deviation. Similar to the descriptive statistics for E-rate funding commitments, the standard deviations for enrollment are consistently larger than the mean. This is due to the wide range of enrollment numbers for the 67 school districts across the state of Florida during each year of the study.

Table 9

Descriptive Statistics: Enrollment

Year	N	Minimum	Maximum	Mean	Std. Deviation
Enrollment 2012	67	1,029	350,239	44,841.12	74,347.80
Enrollment 2013	67	1,040	354,262	45,172.90	75,229.99
Enrollment 2014	67	963	356,232	40,406.36	65,541.27
Enrollment 2015	67	888	356,964	40,949.87	66,325.82

The ratio of students to the number of Internet connected computers per school district was used to determine a correlation of the school districts' E-rate spending. Inferences of these ratios may be made related to school district programs and one-to-one learning initiatives. School districts with lower ratios may relate to high E-rate spending for Internet access. Table 10 contains the descriptive statistics for the dependent variable, student per device ratio. The mean ratio of student per device generally decreased year over year, with the exception of the fourth year, 2015. The maximum ratio for 2015 demonstrated a significant increase which resulted in an increased mean. The significant increase in the standard deviation from 2014 to 2015 indicated that some school districts' ratios increased greatly over the previous year.

Table 10

Descriptive Statistics: Students/Devices

Year	N	Minimum	Maximum	Mean	Std. Dev.
2012	67	1.59	4.76	2.75	.69
2013	66	1.19	4.17	2.39	.54
2014	67	1.25	4.39	2.30	.57
2015	62	1.06	5.69	2.45	1.16

Testing the Research Questions

Descriptive, regression, and multiple regression statistics were used to answer the four research questions which guided the study. In order to examine Research Questions 1 and 3, a regression and a multiple regression analysis were used to provide statistics for analysis. The multiple regression was reproduced for each year to determine correlation statistics over the course of each year to determine a relationship. Research Question 1 sought to determine if there was a predictive relationship between population size of the school district and school district spending on Internet connectivity. Research Question 3 pursued a predictive relationship between school district Internet connectivity and graduation rates. Research Question 2 used regression analyses to evaluate data concerning ratio of Internet connected computers and school district spending on Internet connectivity. Research Question 4 sought a predictive relationship between school district Internet spending and graduation rates. Each of these regression analyses were repeated for each year of study to determine the relationships between the variables over time.

Research Question 1

What is the relationship, if any, between the student enrollment of a school district and district spending on connectivity?

A regression model was initially generated to determine Pearson *r* correlations and levels of significance for enrollment and school district spending on connectivity, without the addition of socio-economic status. Table 11 reports the means and standard deviations for E-rate funding commitments and enrollment and Table 12 reports the Pearson *r* correlations and levels of significance per year of the study, 2012 through 2015. Throughout the years of study, the relationship between enrollment and school district spending on connectivity was significant at $p = .00$. Each year Pearson *r* correlations constituted sizable relationships, year after year, according to definitions by Fraenkel, Wallen, and Hyun (2015).

Table 11

Descriptive Statistics: Enrollment and School District Spending on Connectivity

Variable	N	Mean	Std. Deviation
2012			
E-rate Commitment	66	665,971.68	1,208,851.64
Enrollment	66	44,879.92	74,916.84
2013			
E-rate Commitment	67	586,541.85	1,132,984.74
Enrollment	67	45,172.89	75,229.99
2014			
E-rate Commitment	67	579,728.384	1,103,472.38
Enrollment	67	40,406.36	65,541.27
2015			
E-rate Commitment	67	461,034.77	980,901.67
Enrollment	67	40,949.87	66,325.82

Table 12

Regression Statistics: Enrollment and School District Spending on Connectivity

Year	N	Pearson *r* Correlation	Sig. (1-tailed)
2012	66	.669	.000
2013	67	.651	.000
2014	67	.891	.000
2015	67	.811	.000

For each year of study, a regression analysis used enrollment as the independent variable and school district spending on connectivity, defined by E-rate funding commitments, as the dependent variable. Tables of regression analysis coefficients and discussion of ANOVA statistics for each year are presented in Tables 13-16.

For the initial year of study, the unstandardized coefficient, *b*, demonstrated the weight within the formula which sought to predict school district E-rate funding commitments, *b* (65) = 10.801, $p = .00$. The *b* value weights the formula in a positive manner. It is explored later in this chapter whether socio-economic status within the school district affected this weight. Table 13 suggests that enrollment predicted E-rate funding commitments received by school districts in the state of Florida. ANOVA summary table statistics produced through the regression model were $F(2, 65) = 51.950$, $p = .00$. This further determined a statistically significant relationship between enrollment and E-rate funding commitments received.

Table 13

Regression Coefficients: Enrollment and E-rate Funding for 2012

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
1 (Constant)	171,237.625	130,134.504		1.316	.193
enrollment2012	10.801	1.499	.669	7.208	.000

During the second year of the study, the weight decreased by .27 indicating that the importance of enrollment to predict E-rate funding commitment could have been diminishing, although *b* (65)=9.810, $p = .00$, continued to provide weight to the prediction of E-rate funding commitment. As shown in Table 14, ANOVA summary table statistics F(2, 66)=47.908, *p* = .00 continued to support a statistically significant prediction.

Table 14

Regression Coefficients: Enrollment and E-rate Funding for 2013

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
1 (Constant)	143,388.732	123,686.972		1.159	.251
enrollment2013	9.810	1.417	.651	6.922	.000

During the third year of the study, the weight increased significantly. The statistics *b* (65)=13.792, *p* = .00, demonstrated that enrollment continued to predict E-rate funding commitments. As shown in Table 15, ANOVA summary table statistics F(2, 66)=132.578, *p* = .00 further demonstrated a statistically significant prediction.

Table 15

Regression Coefficients: Enrollment and E-rate Funding for 2014

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
1 (Constant)	22,461.890	91,723.792		.245	.807
enrollment2014	13.792	1.198	.819	11.514	.000

During the fourth year of study, the unpredictability of the beta value demonstrated itself again, with a significant decrease in the unstandardized coefficient of 5.495. *b* (65)=8.297, *p* = .00, enrollment continued to predict E-rate funding commitments. As shown in Table 16, ANOVA summary table statistics through the regression provided F(2, 66)=124.575, p = .00 confirmed the statistically significant relationship.

Table 16

Regression Coefficients: Enrollment and E-rate Funding for 2015

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
1 (Constant)	-29,896.241	83,272.514		-.359	.721
enrollment2015	11.989	1.074	.811	11.161	.000

Over the course of the years of study, 2012 through 2015, the researcher found with approximately 100% confidence that enrollment of a school district statistically predicted the school district spending on Internet access for the school district. As a school district grew in number of students, the spending on Internet access should also increase to accommodate the number of students and increased number of school campuses. Interestingly, during the second year of the study, the weight decreased by .27 indicating that the importance of enrollment to predict E-rate funding commitment could have been diminishing; however, in following years it can be noticed that the beta values were quite volatile, consistently changing each year.

In order to adjust for socio-economic status, a multiple regression analysis was used. The intention of using socio-economic status within the model was to determine if SES of a school district affected spending on Internet connectivity. Tables of regression analyses coefficients and discussion of ANOVA statistics for each year are presented in Tables 17-20.

When enrollment and SES were taken into consideration, the beta representing enrollment in 2012 remained unchanged. The statistics for SES represented by *b* (65)=21.360, *p* = .998, indicated that SES did not statistically predict E-rate funding commitments. When these two variables were used together the model demonstrated prediction of the dependent variable, E-rate funding commitments, determined through ANOVA summary statistics F(2, 65) = 25.569, *p* = .00. As shown in Table 17, enrollment was the only variable to reliably predict E-rate funding commitments.

Table 17

Multiple Regression Coefficients: E-rate funding, SES, and Enrollment for 2012

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
1 (Constant)	169,957.507	566,244.995		.300	.765
enrollment2012	10.801	1.510	.669	7.151	.000
ses2012	21.360	9,191.470	.000	.002	.998

During the second year of study, SES again was not statistically significant in predicting E-rate funding commitments, *b* (65) = -81.258, *p* = .992. Further, the beta value during 2013 was negative, indicating if the calculation had been significant the effect would have negatively predicted the E-rate funding commitments. Enrollment was consistent with the previous regression analysis, *b* (65)=9.810, *p* = .00, further confirming that enrollment significantly predicted E-rate funding commitments. When taken again together through ANOVA summary table statistics, both variables predicted E-rate funding commitments; however, as shown in Table 18, SES was not statistically significant, F(2, 66) = 23.586, *p* = .000.

Table 18

Multiple Regression Coefficients: E-rate funding, SES, and Enrollment for 2013

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
1 (Constant)	148,340.528	495,088.237		.300	.765
enrollment2013	9.810	1.428	.651	6.868	.000
ses2013	-81.258	7,862.562	-.001	-.010	.992

During the third year of study, the relationship between SES and E-rate funding increased greatly with significance increasing as well, however not to statistical significance, *b* (66) = 5,804.627, *p* = .323. Enrollment in 2014 continued to remain statistically significant with sizeable weight, *b* (66) = 13.752, *p* = .00. ANOVA calculations continued to demonstrate that when taken together, the variables predict E-rate funding commitments. However, as shown in Table 19, SES was not statistically significant in prediction, F(2, 66) = 66.776, *p* = .00.

Table 19

Multiple Regression Coefficients: E-rate funding, SES, and Enrollment for 2014

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
1 (Constant)	-311,565.230	347,834.666		-.896	.374
enrollment2014	13.752	1.199	.817	11.474	.000
ses2014	5,804.627	5,830.592	.071	.996	.323

During the final year of study, the relationship between SES and E-rate funding weakened. However, as shown in Table 20, significance decreased again, indicating the volatility of this variable, *b* (66) = 38,635.322, p = .140. Enrollment continued to demonstrate statistical significance, *b* (66) = 12.044, p = .00.

Table 20

Multiple Regression Coefficients: E-rate funding, SES, and Enrollment for 2015

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
1 (Constant)	-543,340.13	353,505.268		-1.537	.129
enrollment2015		1.065	.814	11.312	.000
	12.044				
ses2015	8,635.322	5,781.251	.108	1.494	.140

A summary of the multiple regression statistics is provided in Table 21, further demonstrating the statistically significant relationship between enrollment and school district spending on Internet access, defined by p = .00 through all four years of the study, 2012 through 2015. Additionally, the statistical significance of SES is presented to demonstrate the lack of relationship or prediction.

Table 21

Multiple Regression Statistics: Enrollment and School District Spending on Connectivity

Year	N	R^2	*t enrollment*	Sig. *t enrollment*	*t SES*	Sig. *t SES*
2012	66	.448	7.151	.000	.002	.998
2013	67	.424	6.868	.000	-.010	.992
2014	67	.676	11.474	.000	.996	.323
2015	67	.669	11.312	.000	1.494	.140

In an effort to account for school district socio-economic status, a series of multiple regression analyses were conducted. By utilizing two variables within the model, an attempt was made to further predict E-rate funding. Enrollment, as related to school district spending on connectivity, continued to be statistically significant at $p = .00$. Socio-economic status of the school district was not statistically significant when predicting school district spending on connectivity. Over the course of the years studied, the significance of the relationship continued to increase year to year from $p = .998$ in 2012 to $p = .140$ in 2015. If this trend were to continue, the relationship could potentially become significant in the future. The H_{01}, there is no statistical correlation between the student enrollment of a school district and district spending on connectivity, was rejected based on data provided in this analysis. The researcher found a statistical relationship where enrollment of a school district predicted the school district spending on connectivity. Additionally, when SES was added to the multiple regression, the relationship continued to be statistically significant. However, SES did not appear to affect the prediction of the dependent variable, school district spending on Internet access.

Research Question 2

What is the relationship, if any, between the amount of spending on school district based Internet access, and the ratio of Internet connected computers to students within a school district?

A regression model was generated to determine Pearson *r* correlations and levels of significance for school district spending on connectivity and the ratio of Internet connected computers to students within a school district. Table 22 reports descriptive statistics including means and standard deviations for the ratio of students to computers and E-rate funding commitments. Table 23 reports the Pearson *r* correlations and levels of significance per year of the study, 2012 through 2015. Throughout the years of study, the relationship between the ratio of students to computers and school district spending on connectivity diminished from p=.05 in 2012 to p=.428 in 2015. The weak correlation of r=.204 was significant at p=.05 for year one, 2012. The correlation was also significant in year 2, 2013, where *r=.258, p = .019.* Although as time progressed the correlation weakened further and lacked significance. Tables 24-27 provide the regression analysis statistics utilizing school district E-rate funding commitments as the independent variable and student to device ratios as the dependent variable.

Table 22

Descriptive Statistics: Ratio of Student/Computer and School District Spending on Connectivity

Variables by Year	Mean	Std. Deviation
2012		
Student/device	2.74	.69
E-rate commitment	655,971.69	1,208,851.64
2013		
Student/device	2.39	.55
E-rate commitment	587,242.37	1,147,517.19
2014		
Student/device	2.30	.57
E-rate commitment	579,728.38	1,103,472.38
2015		
Student/device	2.60	1.12
E-rate commitment	471,384.24	994,035.10

Table 23

Regression Statistics: Ratio of Student/Computer and School District Spending on Connectivity

Year	N	Pearson *r* Correlation	Sig. (1-tailed)
2012	66	.204	.05
2013	65	.258	.019
2014	67	.142	.126
2015	65	.023	.428

As shown in Table 24, during the initial year of study, the *b* value provided an insignificant weight *b* (65) = 1.159E-7, *p* = .101 and only approached the level of significance. ANOVA summary table statistics further confirmed this providing F(65) = 2.777, *p* = .101. During the first year of study, calculations determined there was not a statistically significant relationship between school district E-rate funding and the ratio of students to Internet connected devices.

Table 24

Regression Statistics: E-rate Spending and Student/Device for 2012

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
1 (Constant)	2.661	.095		27.98	.000
E-rate Spending 2012	1.159E-7	.000	.204	1.666	.101

Note. Dependent Variable = Student/Device Ratio 2012

During the second year of study, the *b* value continued to provide a minor weight, while *t* decreased and the level of significance increased indicating the relationship to be significant in

2013, *b*(64) = .258, *t*(64) = 2.116, *p* = .038. ANOVA summary table statistics confirmed results for 2013, F(2, 64) = 4.477, *p* = .038. As shown in Table 25, during the year 2013, a statistically significant relationship was present. However, the weight was shown to be weak, indicating a weak predictive relationship between school district E-rate funding and the ratio of students to Internet connected devices.

Table 25

Regression Statistics: E-rate Spending and Student/Device for 2013

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
1 (Constant)	2.316	.074		31.192	.000
E-rate Spending 2013	1.226E-7	.000	.258	2.116	.038

Note. Dependent Variable = Student/Device Ratio 2013

During the third year of the study, the level of significance continued to decrease. This was representative of the lack of a predictive relationship between school district E-rate funding and the ratio of students to Internet connected devices. Although the value of *b* was significant the previous year, it continued to be a trivial weight in 2013. However, it was not statistically significant at *b*(66) = 7.325E-8, *t* = 1.154, *p* = .253. As shown in Table 26, ANOVA summary table statistics confirmed these findings, F(2, 66) = 1.332, *p* = .253. A statistically relevant relationship was not found between E-rate funding and ratio of students to devices during the year 2014.

Table 26

Regression Statistics: E-rate Spending and Student/Device for 2014

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	T	Sig.
1 (Constant)	2.257	.079		28.704	.000
E-rate Spending 2014	7.325E-8	.000	.142	1.154	.253

Note. Dependent Variable = Student/Device Ratio 2014

The level of significance tripled from $p = .25$ in 2014 to $p = .86$ in 2015, indicating continued movement further from a significant relationship between E-rate funding and ratio of students to devices. As shown in Table 27, ANOVA summary table statistics further confirmed the regression results, indicating no relationship or statistical prediction of ratio of students to device by school district spending on Internet access during four years of study.

Table 27

Regression Statistics: E-rate Spending and Student/Device for 2015

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	T	Sig.
1 (Constant)	2.583	.155		16.640	.000
E-rate Spending 2015	2.578E-8	.000	.023	.182	.857

Note. Dependent Variable = Student/Device Ratio 2015

A summary of the regression statistics is provided in Table 28, further demonstrating the lack of a statistically significant relationship between school district spending on Internet access and ratio of students to devices, defined by $p = .101$, $p = .038$, $p = .253$, and $p = .857$. through three of four years of the study, 2012 through 2015. The relationship was statistically significant during 2013. However, the results were inconsistent. The value of *t* throughout the model seemed quite unstable, increasing and decreasing year after year. The inconsistent values further indicated the lack of relationship or statistical prediction of number of Internet connected devices in a school district by school district spending on Internet access.

Table 28

Regression Statistics: School District Spending on Connectivity and Ratio of Students/Devices

Year	N	R^2	*t student/device*	Sig. of *t*
2012	66	.042	1.66	.101
2013	65	.066	2.116	.038
2014	67	.02	1.154	.253
2015	65	.001	.182	.857

Based on the analysis presented, the researcher found that there was not a statistically significant relationship between school district spending on Internet access and ratio of students to devices; and spending did not statistically predict the number of student devices in a Florida school district. Three of four years of study demonstrated no statistically significant relationship, although the relationship during 2013 was statistically significant, albeit weak. Based on this study, the researcher accepted H_{02}, that there was no statistical correlation between the amount of spending on school based Internet access and the number of Internet connected computers within a given Florida school district.

Research Question 3

What is the relationship, if any, of Internet bandwidth, or connectivity and student achievement, as determined by graduation rates?

A regression model was generated to determine Pearson *r* correlations and levels of significance for school district connectivity based on school district bandwidth. During each year of study, the Florida Department of Education presented connectivity in different formats. The 2011-2012 School District Survey simply listed Bandwidth, presented in Mbps. The 2012-2013 School Survey presented the bandwidth based on school speed tests, listed in Mbps. The 2013-2014 School Inventory Summary presented the bandwidth itemized by fiber connection, copper connection, wireless connection, or other connection, listed in Mbps. Finally, the 2014-2015 District Inventory Summary data were based on the school district maximum burstable speed, indicating the highest bandwidth possible through the school district, listed in Mbps. Table 29 reports the descriptive statistics, including mean and standard deviations for bandwidth and graduation rates. The means and standard deviations increased drastically over the course of the study, 2012μ=293.17 to 2015μ=21,009.52, indicating the greater reliance on Internet access in the Florida school districts. Tables 30-33 report the Pearson *r* correlations and levels of significance per year of the study, 2012 through 2015. Throughout the years of study, the relationships between bandwidth connectivity of the school districts were weak or negatively correlated and were not statistically significant.

Table 29

Descriptive Statistics: Bandwidth and Graduation Rates

Variables by Year	N	Mean	Std. Deviation
2012			
Bandwidth	38	293.17	518.73
Graduation rate	38	72.08%	10.05%
2013			
Upspeed average	67	1.2	.36
Downspeed average	67	4.96	1.63
Graduation rate	67	74.00%	10.17%
2014			
Bandwidth fiber	67	27,894.33	64,435.45
Bandwidth copper	67	1,393.34	4,412.35
Bandwidth wireless	67	1,552.48	4,233.91
Bandwidth other	67	322.39	1,023.86
Graduation rate	67	74.60%	8.72%
2015			
Maximum burst speed	67	21,009.52	52,278.82
Graduation rate	67	76.56%	8.66%

Table 30 presents Pearson *r* and level of significance between school district bandwidth and graduation rates for 2012. For this year of the study, 38 of 67 school districts responded to the question regarding bandwidth, which could have greatly decreased the reliability of the analysis. For $r(38) = .021$, $p = .451$, indicating the relationship between the independent and dependent variable, was not statistically significant.

Table 30

Correlation and Significance Between Bandwidth and Graduation Rates for 2012

Year	N	Pearson *r* Correlation	Sig. (1-tailed)
2012	38	.021	.451

Table 31 presents Pearson *r* correlation and level of significance between school district bandwidth and graduation rates for 2013. During this year of study, the number of respondents greatly increased to 67 over the previous year. Based on these data, upspeed demonstrated statistical significance although downspeed did not, *r upspeed*(67) = -.192, *p* = .061 and *r downspeed*(67) = -.082, *p* = .256. The negative, weak correlation between upspeed and graduation rates indicated that as the upload speed of a school district increased, the graduation rates decreased slightly.

Table 31

Correlations and Significance Between Bandwidth and Graduation Rates for 2013

Year	N	Pearson *r* Correlation		Sig. (1-tailed)	
2013	67	Upspeed	Downspeed	Upspeed	Downspeed
		-.192	-.082	.061	.256

Table 32 presents the third year of study Pearson *r* correlations and significance levels between the various bandwidth supplied by the categories of Internet access: fiber, copper, wireless, and other. Although copper approached significance, the relationship was weak and negative, indicating that the connectivity would decrease graduation rates, *r* (67) = -.129, *p* = .149. Additionally, copper, wireless, and other also indicated weak, negative relationships. Only fiber had a weak, positive correlation conversely with the lowest level of significance, *r* (67) = .065, *p* = .301.

Table 32

Correlations and Significance Between Bandwidth and Graduation Rates for 2014

Year	N	Pearson *r* Correlation				Sig. (1-tailed)			
		Fiber	Copper	Wireless	Other	Fiber	Copper	Wireless	Other
2014	67	.065	-.129	-.075	-.085	.301	.149	.274	.247

Table 33 presents the Pearson *r* correlation and significance level between maximum burstable bandwidth and graduation rates during 2015. Based on the data analysis, the researcher failed to find statistical significance for the relationship between the data points, *r* (67) = .077, *p* = .267.

Table 33

Correlations and Significance Between Bandwidth and Graduation Rates for 2015

Year	N	Pearson *r* Correlation	Sig. (1-tailed)
2015	67	.077	.267

Over the four years of study, the statistical significance seemed to generally increase. If this trend continues the relationship could become statistically significant in the future. It is difficult to make inferences year to year due to the diverse data representations. Between 2014 and 2015, however, the trend seems to be approaching statistical significance and there was a slight increase in the Pearson *r* correlation.

Tables 34-37 provide the regression analysis statistics utilizing school district bandwidth as the independent variable and graduation as the dependent variable. During the initial year of the study, the *b* value provided no weight *b* (38) = 0, *p* = .902, with a level of significance virtually confirming a lack of relationship between the variables. This level of significance and lack of weight could be due to the lack of response by the school districts to the Department of Education's survey question regarding bandwidth. As shown in Table 34, ANOVA summary table statistics further explicated this by F(2, 37) = .015, *p* = .902. During the first year of study, the researcher determined there was not a statistically significant relationship between school district connectivity and the level of student achievement, determined by graduation rates.

Table 34

Regression Statistics: Bandwidth and Graduation Rates for 2012

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
1 (Constant)	71.964	1.906		37.756	.000
Bandwidth2012	.000	.003	.021	.124	.902

Note. Dependent Variable = Graduation Rate 2012

Table 35 provides the multiple regression analysis statistics utilizing school district bandwidth, determined by upspeeds and downspeeds, provided through school Internet speed tests as the independent variables and graduation rate as the dependent variable. During the study, the *b* value provided a negative weight for the Upspeed variable, *b* (66) = -6.219, *p* = .148, although the relationship was not statistically significant. If the relationship had been statistically significant, this would have predicted that an increased upspeed of a school district would have resulted in a decrease in graduation rates.

The relationship between downspeed and graduation rates, also was found to lack statistical significance. Conversely, this relationship had less significance than upspeed. However, had the test been significant, downspeed would have had a positive prediction, *b* (67) = .386, p = .684. As shown in Table 35, ANOVA summary table statistics indicated F(2, 66) = 1.296, p = .281. During the second year of study, the researcher determined there was not a statistically significant relationship between school district bandwidth and the student achievement rates as determined by graduation rates.

Table 35

Multiple Regression Statistics: Bandwidth and Graduation Rates for 2013

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
1 (Constant)	78.908	4.341		18.176	.000
Bandwidth Upspeed2013	-6.219	4.244	-.233	-1.465	.148
Bandwidth Downspeed2013	.386	.945	.065	.409	.684

Note. Dependent Variable = Graduation Rates 2013

Table 36 provides the multiple regression analysis statistics utilizing school district bandwidth, determined by bandwidth provided through various modes (fiber, copper, wireless, and other) as the independent variables and graduation rate as the dependent variable. During this year of study, the *b* value provided a weak weight for all of the independent variables. In addition, the relationships were not statistically significant for each Internet access type. As shown in Table 36, ANOVA summary table statistics were F(2, 66) = .835, *p* = .508. During the third year of study, the researcher determined there was not a statistically significant relationship between school district bandwidth and the student achievement rates as determined by graduation rates.

Table 36

Multiple Regression Statistics: Bandwidth and Graduation Rates for 2014

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
1 (Constant)	74.574	1.207		61.783	.000
Bandwidth Fiber2014	2.405E-5	.000	.151	1.024	.310
Bandwidth Copper2014	-.001	.001	-.407	-1.132	.262
Bandwidth Wireless2014	.001	.001	.266	.735	.465
Bandwidth Other2014	-.001	.001	-.102	-.718	.476

Note. Dependent Variable = Graduation Rate 2014

Table 37 provides the regression analysis statistics utilizing 2014-2015 school district bandwidth, determined by maximum burstable speed as the independent variable and graduation rate as the dependent variable. During the year of study, the *b* value provided a weak weight for the maximum burstable speed variable and the standard error was approaching zero, B (67) = -1.208E-5, *p* = .534, although the relationship was not statistically significant. As shown in Table 37, ANOVA summary table statistics supported the regression results F(2, 66) = .390, *p* = .534. During the final year of study, the researcher failed to find a statistically significant relationship between school district bandwidth and the student achievement rates as determined by graduation rates.

Table 37

Regression Statistics: Bandwidth and Graduation Rates for 2015

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1 (Constant)	76.295	1.147		66.531	.000
MaxBurstableSpeed2015	1.208E-5	.000	.077	.625	.534

Dependent Variable = Graduation Rates 2015

Summary statistics for Research Question 3 are presented in Table 38. The researcher found that Internet connectivity and student achievement rates did not have a statistically significant predictive relationship and the variables were not correlated based on the data presented. Based on the data and analysis, the $H_{03,}$ that there is no statistical correlation between Internet bandwidth, or connectivity, and graduation rates in K-12 school districts in the state of Florida, was accepted.

Table 38

Research Question 3: Summary Statistics of the Relationship Between Bandwidth and Graduation Rates

Year	N	R^2	*t bandwidth*	Sig. of *t*
2012	38	.000	.124	.902
2013				
Upspeed	67	.066	-1.465	.148
Downspeed	67	.066	.409	.684
Fiber	67	.02	1.024	.310
Copper	67	.051	-1.132	.262
Wireless	67	.051	.735	.465
Other	67	.051	-.718	.476
2015	67	.006	.625	.534

Research Question 4

What is the relationship, if any, between the amount of spending on school based Internet access and student achievement, as determined by graduation rates?

A regression model was generated to determine Pearson *r* correlations and levels of significance for the amount of spending on school based Internet access and student achievement, as determined by graduation rates. E-rate funding commitments for Internet Access and Telecom were used as the basis for spending on Internet, removing funding for Internal Connections or management costs. Table 39 contains descriptive statistics including means and standard deviations for E-rate funding commitments and graduations rate. Standard deviations for E-rate funding commitments were larger than the means due to the large variance in the funding committed to school districts throughout the state of Florida over the course of the four years of study. Table 40 reports the Pearson *r* correlations and levels of significance per year of the study, 2012 through 2015. Throughout the years of study, the relationship between school district spending on connectivity and graduation rates resulted in weak, negatively correlated Pearson *r* correlations, and the analyses were not statistically significant. Tables 41-44 report regression coefficients and levels of significance for each year of the study.

Table 39

Descriptive Statistics: E-rate Funding Commitments and Graduation Rates

Variables	N	Mean	Std. Deviation
2012			
Graduation Rate	67	71.94%	8.39%
E-rate Commitment	66	655,971.69	1,208,851.64
2013			
Graduation Rate	67	73.39%	9.60%
E-rate Commitment	67	586,541.85	1,132,984.74
2014			
Graduation Rate	67	74.60%	8.72%
E-rate Commitment	67	579,728.38	1,103,472.38
2015			
Graduation Rate	66	76.45%	8.67%
E-rate Commitment	66	468,020.14	986,737.60

Table 40

Correlation Statistics: E-rate Funding Commitments and Graduation Rates

Year	N	Pearson *r* Correlation	Sig. (1-tailed)
2012	66	-.089	.240
2013	67	-.090	.234
2014	67	-.144	.122
2015	66	-.086	.247

A regression model was generated to determine Pearson *r* correlations and levels of significance for school district spending on connectivity and student achievement, determined by graduation rates. Table 41 reports the regression coefficients and levels of significance for the initial year of study, 2012. While the weighting of *b* within the model is weak, the model did not indicate a statistically significant prediction graduation rate when *b*(65) = -6.181E-7, *p* = .479. ANOVA summary table statistics supported the regression results when *p* = .479.

Table 41

Regression Coefficients: E-rate Funding and Graduation Rates for 2012

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
1 (Constant)	72.277	1.188		60.856	.000
E-rate Commitment2012	-6.181E-7	.000	-.089	-.712	.479

A regression model was generated to determine Pearson *r* correlations and levels of significance for school district spending on connectivity and student achievement, determined by graduation rates. Table 42 reports the regression coefficients and levels of significance for the second year of study, 2013. The weighting of *b* within the model was again extremely small, and the model did not indicate a statistical significance in predicting graduation rate when *b* (66) = -7.654E-7, *p* = .468. As shown in Table 42, ANOVA summary table statistics maintained the regression results.

Table 42

Regression Coefficients: E-rate Funding and Graduation Rates for 2013

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	T	Sig.
1 (Constant)	73.839	1.329		55.569	.000
E-rate Commitment2013	-7.654E-7	.000	-.090	-.731	.468

Note. Dependent Variable = Graduation Rates 2013

A regression model was generated to determine Pearson *r* correlations and levels of significance for school district spending on connectivity and student achievement, determined by graduation rates for 2014. Table 43 reports the regression coefficients and levels of significance for 2014. The weighting of *b* within the model was again small and the model did not suggest a statistically significant prediction of graduation rate when *b* (66) = -1.142E-6, $p = .244$. As shown in Table 43, ANOVA summary statistics sustained the regression results when $F(2, 66) = 1.385$, $p = .244$. For the third year of study, the significance began to approach statistical significance.

Table 43

Regression Coefficients: E-rate Funding and Graduation Rates for 2014

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	T	Sig.
1 (Constant)	75.257	1.202		62.599	.000
E-rate Commitment2014	-1.142E-6	.000	-.144	-1.177	.244

Note. Dependent Variable = Graduation Rates 2014

A regression model was generated to determine Pearson *r* correlations and levels of significance for school district spending on connectivity and student achievement as determined by graduation rates for 2015. Table 44 reports the regression coefficients and levels of significance for 2015. The weighting of *b* within the model was again weak. The model did not indicate a statistically significant prediction of graduation rate, $b(65) = -7.516E-7$, $p = .495$. As shown in Table 44, ANOVA summary statistics supported the regression results when $F(2, 65) = .471$, $p = .495$.

Table 44

Regression Coefficients: E-rate Funding and Graduation Rates for 2015

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	T	Sig.
1 (Constant)	76.799	1.188		64.642	.000
E-rate Commitment2015	-7.516E-7	.000	-.086	-.687	.495

Note. Dependent Variable = Graduation Rates 2015

According to regression analyses performed for years 2012, 2013, 2014, and 2015 there was not a statistically significant relationship between the amount a school district spent on Internet connectivity, determined by E-rate funding committed, and graduation rates.

The fourth hypothesis, H_{04}, that there was no statistical relationship between the amount of spending on school based Internet access and student achievement as determined by graduation rates, was accepted due to lack of statistical significance. There was no statistical relationship between school district spending on Internet connectivity and graduation rates based on these data analyses. Summary Statistics are provided in Table 45.

Table 45

Research Question 4: Summary Statistics

Year	N	R^2	t	Sig. of t
2012	67	.08	-.712	.479
2013	67	.008	-.731	.468
2014	67	.021	-1.177	.244
2015	66	.007	-.687	.495

Summary

Multiple regression and regression models were generated to determine predictive relationships between Internet connectivity, Internet access spending, and graduation rates. Based on the data analyses, the following actions were taken regarding the four hypotheses:

H_{01}: There is no statistical correlation between the student enrollment of a school district and district spending on connectivity.

H_{01} was rejected as the researcher found a statistically significant relationship between the enrollment and school district spending on Internet connections during all years of the study.

H_{02}: There is no statistical correlation between the amount of spending on school based Internet access, and the number of Internet connected computers within a given Florida school district.

H_{02} was rejected for Year 2 of the study, 2013, as a statistically significant relationship was established, however, the prediction of the dependent variable, number of Internet connected computers in a school district, was weak.

H_{02} was accepted for Years 1, 3, and 4 of the study, as the researcher failed to find a statistically significant relationship between the variables during these years of the study.

H_{03}: There is no statistical correlation between Internet bandwidth, or connectivity, and graduation rates in K-12 school districts in the state of Florida.

H_{03} was accepted as the researcher failed to find a statistically significant relationship between the variables during any year of the study.

H_{04}: There is no statistical correlation between the amount of spending on school based Internet access and student achievement, as determined by graduation rates.

H_{04} was accepted as the researcher failed to find a statistically significant relationship between the variables during any year of the study.

Table 46 contains a visual summary linking the research questions, variables, data sources, methods of analysis, and results.

Table 46

Summary Table: Research Questions, Variables, Data Sources, Methods of Analysis, and Results

Research Questions	Variables	Data Sources	Analysis	Results
1. What is the relationship, if any, between the student enrollment of a school district and district spending on connectivity?	Dependent: E-rate funding Independent: School district SES School district population	E-rate funding data FDOE	Multiple Regression Pearson *r*	• Decreasing means and standard deviations of E-rate funding indicated decreasing spending on Internet access and flattening of spending across the Florida school districts. • The relationship between E-rate funding commitments and Enrollment was statistically significant each year of study, p =.00. • The relationship between E-rate funding commitments and SES did not demonstrate statistical significance any year of study; however, the values decreased over the four-year time frame, from p=.998 to p=.513. • H_{01} was rejected based on the statistical significance demonstrated, albeit weak relationship.

Research Questions	Variables	Data Sources	Analysis	Results
2. What is the relationship, if any, between the amount of spending on school based Internet access, and the ratio of Internet connected computers to students?	Dependent: Ratio of Internet connected computers to students Independent: E-rate funding	FDOE E-rate funding data	Regression Pearson *r*	• The means and standard deviations decrease over the initial three years indicated the movement to one-to-one learning programs. 2012μ=2.74 to 2013μ=2.30. • The mean and standard deviation increase in 2015 to μ=2.60 indicated some school districts drastically decreased the number of devices in their district. • The relationship between the ratio of students to computers and E-rate funding commitments was statistically significant in 2013, albeit a weak relationship. • H_{02} was accepted, based on the lack of statistical significance over the course of the study.
3. What is the relationship, if any, of Internet bandwidth, or connectivity and student achievement, as determined by graduation rates?	Dependent: Graduation rate Independent: Connectivity of school district	FDOE E-rate funding data	Multiple Regression Pearson *r*	• The means and standard deviations increased drastically over the course of the study, 2012μ=293.17 to 2015μ=21,009.52, indicating the greater reliance on Internet access in the Florida school districts. • H_{03} was accepted based on the lack of statistical significance each year of the study.

Research Questions	Variables	Data Sources	Analysis	Results
4. What is the relationship, if any, between the amount of spending on school based Internet access and student achievement, as determined by graduation rates?	Dependent: Graduation rate Independent: E-rate funding	FDOE E-rate funding data	Regression Pearson *r*	• Graduation rates have increased over the course of the study, 2012μ=71.94% to 2015μ=76.45%. • H_{04} was accepted based on the lack of a statistically significant relationship between the variables.

CHAPTER 5
DISCUSSION

Introduction

This chapter provides a summary of the study including a synopsis of the methodology, the theoretical framework, the research questions, and analysis of the data. The summary has been organized around the four research questions which guided the study using an interpretation of the results of the regression analysis performed to respond to each research question. Implications and recommendations for practice are offered along with recommendations for future research. A final summary statement concludes the chapter.

Summary of the Study

Educational technology tools, methods, and practices have become common place in 21st century schools. These tools, devices, and practices require Internet connectivity to be implemented successfully; however, many school districts throughout the state of Florida lack reliable, high-speed Internet for these tools and devices to function adequately. Specifically, at the time of the present study, only 40% of Florida’s school districts were meeting the ConnectEd minimum required bandwidth (Education Superhighway, 2015). Although few researchers have suggested that home computers and Internet access affect student achievement (Vigdor et al., 2014), studies have been completed that demonstrate positive correlations of computer ownership and graduation rates (Fairlie et al., 2010; T-Mobile, 2012). Although researchers have not unequivocally shown that technology integration and the requisite Internet access increase student achievement, the growing movement of technology integration into the classroom has continued. State departments of education, school districts, and schools have continued to search for ways to prepare their students for the workforce of the future. Currently, the world is technologically driven and students need to be prepared to operate within that world academically and professionally (FDOE, 2015). There has been limited research conducted regarding the connectivity and school district spending on Internet access in K-12 schools and the effects of student achievement. School districts across the state of Florida are implementing digital learning plans and initiatives to support the rise of technology integration in the classroom (Florida Statute, section 1011.62(12)(b)). With this increase in the use of connected devices in the classroom and on campuses, the need has increased for connectivity and bandwidth required by schools and school districts. There has been limited research conducted regarding the effects of increased connectivity, school district spending on Internet access in K-12 schools, and student achievement.

In an effort to support the lack of research regarding K-12 school district spending on Internet access, the researcher sought to determine whether technology, implicated by Internet access, affects student achievement, determined by graduation rates. Data was drawn from multiple sources over a four- year time frame. The researcher also made public records requests to the Florida Department of Education regarding school district bandwidth and the number of Internet connected devices on the school districts' campuses. The findings of the study were meant to inform school districts and policy makers of the relationship of Internet based spending and connectivity to student achievement. The following research questions guided the study:

1. What is the relationship, if any, between the student enrollment of a school district and district spending on connectivity?

H_{01}: There is no statistical correlation between the student enrollment of a school district and district spending on connectivity.

2. What is the relationship, if any, between the amount of spending on school based Internet access, and the ratio of Internet connected computers to students within a school district?

   H_{02}: There is no statistical correlation between the amount of spending on school based Internet access, and the number of Internet connected computers within a given Florida school district.

3. What is the relationship, if any, of Internet bandwidth, or connectivity, and student achievement, as determined by graduation rates?

   H_{03}: There is no statistical correlation between Internet bandwidth, or connectivity, and graduation rates in K-12 school districts in the state of Florida.

4. What is the relationship, if any, between the amount of spending on school based Internet access and student achievement, as determined by graduation rates?

   H_{04}: There is no statistical correlation between the amount of spending on school based Internet access and student achievement, as determined by graduation rates.

Descriptive, regression, and multiple regression statistics were used to answer the four research questions that guided the study. In order to examine Research Questions 1 and 3, a regression and a multiple regression analysis were used to provide statistics for evaluation. A multiple regression was performed for each year to determine correlation and regression statistics over the course of each year and to determine a relationship. Research Question 1 sought to determine if there was a predictive relationship between population size of the school district and school district spending on Internet connectivity. Research Question 3 pursued a predictive relationship between school district Internet connectivity and graduation rates. Research Question 2 used regression analyses to evaluate data concerning ratio of Internet connected computers and school district spending on Internet connectivity. Research Question 4 sought a predictive relationship between school district Internet connectivity and graduation rates. Each of these regression analyses were repeated for each year of study to determine the relationships between variables over time.

Discussion of the Findings

Research Question 1

What is the relationship, if any, between the student enrollment of a school district and district spending on connectivity?

Initially, a regression analysis was utilized to determine the relationship, if any, between student enrollment and school district spending on connectivity. Descriptive statistics revealed decreasing means and standard deviations of school district spending on Internet access in Florida. Surprisingly, as the school districts' connectivity needs have increased, spending has decreased. The regression analysis demonstrated a statistically significant relationship between student enrollment and school district spending on connectivity throughout each year of study, $p=.00$. Over the course of the years of study, 2012 through 2015, the researcher found with approximately 100% confidence that enrollment of a school district statistically predicted the school district spending on Internet access for the school district. As a school district grew in number of students, the spending on Internet access also increased to accommodate the number of students and increased number of school campuses. Interestingly, during the second year of the study, the beta value decreased in weight by .27, indicating that the importance of enrollment to predict E-rate funding commitment could have been diminishing; however, in following years it was noticed that the beta values were quite volatile, consistently changing each year.

In an effort to account for school district socio-economic status, a series of multiple regression analyses were conducted. By utilizing two variables within the model, an attempt was made to further predict E-rate funding. Enrollment, as related to school district spending on connectivity, continued to be statistically significant, $p = .00$. Socio-economic status of the school district was not statistically significant when predicting school district spending on connectivity. Over the course of the years studied, the significance of the relationship continued to increase year to year from $p = .998$ in 2012 to $p = .140$ in 2015. If this trend were to continue, the relationship could potentially become significant in the future. The H_{01}, there is no statistical correlation between the student enrollment of a school district and district spending on connectivity, was rejected based on data provided in this analysis. The researcher found a statistical relationship where enrollment of a school district predicted the school district spending on connectivity. Additionally, when SES was added to the multiple regression, the relationship continued to be statistically significant. However, SES did not appear to affect the prediction of the dependent variable, school district spending on Internet access.

Research Question 2

What is the relationship, if any, between the amount of spending on school based Internet access, and the ratio of Internet connected computers to students?

A regression analysis was performed to determine the relationship, if any, between spending on school based Internet access and the ratio of Internet connected computers to students. The descriptive statistics revealed decreasing means of the ratio of students to devices for the first three years of the study and a substantial increase in the final year of the study. The standard deviation between these two years more than doubled from .57 to 1.12. This indicated that some school districts considerably decreased the number of Internet connected computers or devices on their school campuses between 2014 and 2015. This was surprising given the growing movement toward one-to-one learning programs throughout the Florida school districts.

Based on the analysis presented, the researcher found that there was not a statistically significant relationship between school district spending on Internet access and ratio of students to devices; and spending did not statistically predict the number of student devices in a Florida school district. No statistically significant relationship was demonstrated during three of the four years of the study, although the relationship during 2013 was statistically significant, albeit weak. Based on this study, the researcher accepted H_{02}, that there was no statistical correlation between the amount of spending on school based Internet access and the number of Internet connected computers within a given Florida school district.

Research Question 3

What is the relationship, if any, of Internet bandwidth, or connectivity and student achievement, as determined by graduation rates?

A regression model was generated to determine Pearson *r* correlations and levels of significance for school district connectivity based on school district bandwidth. During each year of study, the Florida Department of Education presented connectivity in different formats. The 2011-2012 School District Survey simply listed Bandwidth, presented in Mbps. The 2012-2013 School Survey presented the bandwidth based on school speed tests, listed in Mbps. The 2013-2014 School Inventory Summary presented the bandwidth itemized by fiber connection, copper connection, wireless connection, or other connection, listed in Mbps. Finally, the 2014-2015 District Inventory Summary data were based on the school district maximum burstable speed, indicating the highest bandwidth possible through the school district, listed in Mbps. Throughout the years of study, the relationships between bandwidth connectivity of the school districts were weak or negatively correlated and were not statistically significant.

The researcher found that Internet connectivity and student achievement rates did not have a statistically significant predictive relationship, and the variables were not correlated based on the data presented. Based on the analysis of data, the $H_{03,}$ that there is no statistical correlation between Internet bandwidth, or connectivity, and graduation rates in K-12 school districts in the state of Florida, was accepted.

Research Question 4

What is the relationship, if any, between the amount of spending on school based Internet access and student achievement, as determined by graduation rates?

A regression model was generated to determine Pearson *r* correlations and levels of significance for the amount of spending on school-based Internet access and student achievement, as determined by graduation rates. E-rate funding commitments for Internet Access and Telecom were used as the basis for spending on Internet, removing funding for Internal Connections or management costs. Standard deviations for E-rate funding commitments were larger than the means due to the large variance in the funding committed to school districts throughout the state of Florida over the course of the four years of the study. Throughout the years of study, the relationship between school district spending on connectivity and graduation rates resulted in weak, negatively correlated Pearson *r* correlations, and the analysis was not statistically significant.

According to regression analyses performed for years 2012, 2013, 2014, and 2015, there was not a statistically significant relationship between the amount of school district spending on Internet connectivity, determined by E-rate funding committed, and graduation rates.
The fourth hypothesis, H_{04}, that there was no statistical relationship between the amount of spending on school based Internet access and student achievement as determined by graduation rates, was accepted due to lack of statistical significance. There was no statistical relationship between school district spending on Internet connectivity and graduation rates based on these data analyses.

Implications for Policy and Practice

School districts across the country have been implementing one-to-one learning programs and placing devices in the hands of students to foster a technologically driven learning process. These programs have been put in place to increase students' access to and knowledge of computer programs and to provide additional resources for research and learning while also reducing the reliance on paper and textbooks. These devices and programs require high-speed connectivity to function appropriately. The requirements of a typical school or district with low intensity Internet needs would currently fall in the 100 Kbps range. However, as they move into the future with one-to-one device programs, schools will require 4.3 Mbps per student, or two to three Gbps per school (SETDA, 2016). It will be necessary for school district leaders to determine the balance between spending on technology and Internet access and the level of spending that will make the most sense to meet the needs of enrolled students. Analysis of the amount of bandwidth needed to support the educational technology environment will become a vital task. The major implications that presented themselves throughout the research study are as follows

1. The ConnectED initiative sought to connect 99% of schools to high-speed wireless broadband. The initial goal was 100 Kbps per student, 1 Gbps per school, 1 Gbps inside each school, and a Wi-Fi network capable of supporting one-to-one learning on each school campus. After 2018, each school will have a goal of 1 Mbps per student while maintaining other previous goals for the schools and campuses (Education Superhighway, 2014). Based on the research presented in this study, increasing the bandwidth of a school district in and of itself does not increase graduation rates. Further,

when evaluating the results of the study based on cost-benefit analysis, increasing the bandwidth and Internet spending of a school district to increase student achievement does not yield benefit to the school district, at least not through this lens (Levin, 1983).

2. Although spending on connectivity and bandwidth did not demonstrate a predictive relationship to graduation rates based on this study, public policy has been to support the future economy and to "invest in and develop artificial intelligence for its many benefits, educate and train Americans for the jobs of the future, and aid workers in the transition and empower workers to ensure broadly shared growth" (Executive Office of the President of the United States, 2016, p. 3). Although deployment of additional bandwidth to schools may not predict an increase in graduation rates based on this study, students who have knowledge of, access to, and experience with advanced technologies may be better prepared to succeed and to operate a 21st-century career. Therefore, development of education technology programs may preclude more success in increasing citizenry for students within K-12 schools.
3. A relationship was not demonstrated between increased Internet spending of school districts and bandwidth to graduation rates; however, this study did not address whether students in Florida school districts with greater access to computers, technology, and the requisite Internet access to operate those devices within their schools were better prepared for college and careers. State departments of education, school districts, and schools have continued to search for ways to prepare students for the workforce of the future. The world has become technologically driven and students need to be prepared to operate within that world academically and professionally (FDOE, 2015). These

departments should continue to delve into the changing economic environment to determine how to prepare the students for the future workforce. Factory positions, transportation drivers, and financial advisors may all be employment of the past when the current student population enters the labor market. Many jobs will move to the "gig economy" where individuals are no longer employees of a large organization, but freelancers, consultants, and artists (Manuika et al., 2016; Mulcahy, 2016). School districts and departments of education should keep abreast of these changes and determine where change is needed in the education of students.

4. School districts that seek to provide educational technology opportunities, one-to-one device programs, and bandwidth-rich environments to enable the students of the district to interact with, learn about, and become modernizers of technology can be considered innovators or early adopters in the process of high bandwidth Internet adoption, 1 Gbps or more per school. Further, those schools that lack sufficient Internet access for their students, those that do not meet the 100 Kbps per student goal, can be considered laggards. Rogers (2003) stated "The critical mass occurs at the point at which enough individuals in a system have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining" (p. 344). According to the Education Superhighway (2016), 77% of schools were meeting the 100 Kbps per student goal in 2015, compared with 30% of schools not meeting the 100 Kbps goal in 2013. This can inform school leaders when they are near or passing the critical mass point; technological advancements, educational technology, automation, and high-speed Internet are going to continue to grow and affect the way citizens live, work, play, and

learn. Those who are not meeting the requirements and do not provide these opportunities to their students will inevitably perform a disservice to those students and will cause them to lag behind other students who have increased access.

5. When the researcher requested public records from the FDOE, the data proved to be inconsistent from year to year. When gathering data from school districts, departments of education should categorize data in consistent formats to enable the department of education and researchers to analyze and study changes more effectively and efficiently. Creating a study on Internet bandwidth of the school districts proved to be difficult for the Florida school districts when the data were represented inconsistently every year of the study. The researcher would recommend using the same technology inventory survey for school districts each year, adding or subtracting questions from the survey based on new or antiquated technologies. The FDOE, and other departments of education, should consider cataloguing these data in an annual benchmarking study in an effort to compare school districts' network capabilities, bandwidth usage, and technology programs. This benchmarking report could then be shared with school districts across the state to communicate various districts' best practices. This could provide more streamlined data along with meaningful information to school district leaders across the state.
6. The researcher reviewed 10 Digital Classroom Plans from select school districts in Florida in an effort to learn how the school districts plan for Internet access. Within the Digital Classroom Plans, eight of 10 did not provide detail regarding how they would increase the bandwidth of their lacking schools. Columbia County School District noted

that they were in the process of planning to build a fiber broadband network with a target of 2025 (CCSD, 2014), and Broward elaborated that it would implement one access point in every classroom, a LAN network enabling 2 Gbps as a campus backbone, WAN circuits increased to 1 Gbps to the district core, and upgrades to network electronics which would produce future speeds of 40-80 Gbps based on a utilization analysis (BCPS, 2014). The Digital Classroom Plan should be more than an exercise and should include a formal section regarding an assessment of the bandwidth needs of each school and the district based on number of computers and devices on campuses along with other bandwidth intensive programs that may be implemented. This assessment can then be used in development of programs to ensure that the schools have the bandwidth they need to be connected.

7. Upon reviewing the E-rate funding commitments of the 67 Florida school districts, the researcher observed large standard deviations and variance of the data points. This was related to a broad range of funding subsidies going to school districts in Florida and could be due to the size of the school district or the lack of knowledge of the E-rate and USAC funding program and processes. In order for school districts with smaller organizations to manage the E-rate funding process, they should either provide staff opportunities for training and professional development or look to consultants for assistance in managing the processes.

8. For those school districts that lack significant connectivity or options for broadband Internet access, the administration can look to consultants for assistance in building fiber broadband networks to connect their schools and buildings. As of 2016, the FCC and

USAC realized significant trends of school districts to request funding for leased dark fiber (113) and lit fiber (342), self-provisions networks (236), and state funding matches (87) [Wilkens, 2017). School district administrators may not be aware of the changes to the E-rate funding system which have begun to grant significant funds to the construction and management of fiber-optic broadband networks to provide the highest level of connectivity for the students and teachers within school districts. E-rate can also provide allocations for consultants to assist in the development of the projects which could significantly benefit the school districts.

Recommendations for Further Research

1. Although this study did not demonstrate a statistically significant relationship between Internet access and student achievement, determined by graduation rates, the researcher would recommend conducting another study where the data for spending and bandwidth would be gathered from public records requests of the school districts, rather than E-rate and FDOE. The FDOE data were gathered through surveys, and the bandwidth data were presented inconsistently. Gathering the data directly from the source could prove to be more accurate and may change results of the study.
2. The researcher did not find a predictive relationship between Internet spending or bandwidth and student achievement, based on graduation rates. However, it could be beneficial to determine whether students learning in a bandwidth rich environment are more successful in college and/or their careers. The researcher recommends development of a measurement tool to determine success in college and career based on Internet accessibility in the school, rather than success in K-12 education. A study using

such a tool could potentially seek to determine whether present-day schools are effectively preparing the students for future work environments.

3. Findings in one study reviewed in the course of the present study showed a positive correlation between computer ownership and grades and a 6% to 8% higher probability of high school graduation (Fairlie, 2010). Vigdor et al. (2014) found a positive relationship between home computer ownership and student achievement. Further investigation into whether students who have access to computers at home through one-to-one learning, coupled with a bandwidth rich school environment, are more successful than those without in college and career could demonstrate whether technology and bandwidth increase achievement.
4. At the time of the study, the Florida Department of Education had recently changed the state assessments from Florida Comprehensive Assessment Test (FCAT) to the Florida Standards Assessments (FSA). In an effort to more closely align Internet spending and connectivity to student achievement, a study should be conducted utilizing the FSA scores over a four-year time period, rather than graduation rates, to determine a relationship between these variables.
5. A limitation of this study was the sheer amount of variables that affect graduation rates. To account for more of these variables, a multi-level study could be conducted taking into account school or district-based infrastructure, school or district-based demographics, and teacher instruction methodology and pedagogy. This study could contain quantitative and qualitative components, using school or district data, along with teacher and student survey information. This study would be more comprehensive in

scope, accounting for more variables and constructs, allowing for a more complete picture of the effect of the Internet and technological tools used within schools on student engagement and achievement.

6. In the researcher's experience, some educators believe that students are more engaged with course content when technology is used during instruction, while others feel that technology diminishes student engagement. A study could be conducted to add to the body of knowledge and support or refute these claims. A future study could be conducted to determine the relationship between Internet access and student engagement with course content, as determined by the results of student and teacher self-reporting surveys.

Summary

The research presented in this study did not demonstrate statistical significance in showing a relationship between Internet spending or connectivity and student achievement, determined by graduation rates. Cost analysis would purport that increased spending on bandwidth for schools would not be a cost effective means of increasing student achievement. Increased spending on school-based Internet access and connectivity does not predict higher graduation rates. However, these factors may play a role in a student's success after K-12 education or in college and careers. Additional research should be compiled regarding how these economic factors could influence the success of students with and without access to bandwidth-rich school environments.

The economic milieu is evolving, providing for greater automation and technological advances in many career fields changing the way many businesses operate and manage human resources. This may mean loss of job categories in many instances, such as trucking and factory labor. This loss of positions will likely mean that the individuals that would have normally held those positions will need to redefine themselves and find other employment. Many of the occupations of the future are going to require individuals to be able to think critically, be creative, and interact with other people in an effectual manner. In essence, those occupations are going to be those that a computer or a robot cannot perform.

There has also been a substantial growth in the number of individuals who work from home or create their own small company and work from gig to gig, creating a new business model. The careers and workforce of the future will be heavily reliant on technology, computers, and the ability to be able to navigate technology effectively and efficiently. It is likely that whether a citizen works in fast food, a stock brokerage, a hospital, a factory, a farm, or a business office; the school technology, computers, and Internet will affect how the individual completes many of the functions of the position.

Cost benefit analysis may suggest that additional spending on Internet access and connectivity does not benefit graduation rates; however, a wait and see approach most likely is not appropriate either. In order to be successful in the economy moving forward, students will need to have had background knowledge and experience with technology, technology which requires high-speed Internet access to function.

APPENDIX A
PERMISSION TO REPRODUCE FIGURE

SIMON & SCHUSTER

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Permissions Supervisor

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VIA EMAIL

April 10, 2017

Gillian Violette
University of Central Florida
Violette.gill@Knights.ucf.edu

Dear Gillian Violette:

You have our permission to include Figure 1-2: "The Diffusion Process" on p. 11 of our book, DIFFUSION OF INNOVATIONS, 5E by Everett M. Rogers, in your doctoral dissertation entitled "A Study of Internet Spending and Graduation Rates: A Correlational Study."

The following acknowledgment is to be reprinted in all copies of your dissertation:

This permission applies to all copies of your dissertation made to meet the degree requirements at the University of Central Florida. You must re-apply to this department if you wish to include our material in your dissertation for any other purpose. We may require a permission fee at that time.

Sincerely,

Christine J. Lee

Christine J. Lee

AGREED TO AND ACCEPTED

Gillian Violette

APPENDIX B
CONNECTIVITY GOAL COMPARISON OF STATES

Table XX: State by State Comparison of Broadband Access

State	% of districts meeting 100 Kbps goal	% of districts with fiber access	% of districts with WiFi	% of districts meeting $3/Mbps Internet access affordability target
1. Florida	40%	91%	80%	19%
2. Georgia*	88%	95%	74%	30%
3. Alabama*	86%	92%	67%	5%
4. Mississippi*	75%	97%	69%	9%
5. South Carolina*	97%	93%	77%	1%
6. Tennessee	64%	97%	42%	0%
7. North Carolina*	44%	94%	75%	0%
8. Kentucky*	92%	100%	83%	1%
9. Virginia*	46%	94%	64%	5%
10. West Virginia	90%	98%	45%	3%
11. Maryland	38%	88%	63%	44%
12. Illinois*	71%	88%	54%	11%
13. Indiana	69%	87%	41%	1%
14. Ohio*	75%	82%	59%	7%
15. Pennsylvania	76%	81%	45%	29%
16. Delaware	52%	100%	50%	2%
17. New Jersey*	80%	81%	38%	27%
18. New York*	92%	93%	39%	79%
19. Connecticut	97%	88%	37%	NA
20. Vermont	90%	87%	64%	13%
21. Massachusetts*	63%	85%	43%	24%
22. Rhode Island*	76%	98%	22%	6%
23. New Hampshire*	66%	77%	35%	18%
24. Maine	97%	99%	17%	36%
25. Louisiana	67%	98%	78%	9%
26. Arkansas*	79%	82%	58%	4%
27. Missouri	77%	85%	54%	7%
28. Iowa*	87%	72%	37%	2%

29. Michigan*	77%	76%	37%	53%
30. Wisconsin*	76%	90%	58%	14%
31. Minnesota	75%	78%	56%	14%
32. North Dakota	93%	75%	31%	0%
33. South Dakota	98%	76%	30%	0%
34. Nebraska	92%	86%	51%	26%
35. Kansas	82%	72%	53%	5%
36. Oklahoma	85%	77%	66%	3%
37. Texas*	67%	85%	58%	4%
38. New Mexico*	65%	89%	61%	0%
39. Colorado	74%	90%	47%	9%
40. Wyoming*	100%	83%	35%	33%
41. Montana*	78%	65%	23%	22%
42. Idaho*	65%	90%	41%	7%
43. Utah*	89%	100%	49%	NA
44. Arizona	63%	93%	72%	6%
45. Nevada*	47%	94%	59%	35%
46. California*	76%	95%	39%	20%
47. Oregon	75%	88%	43%	29%
48. Washington	88%	83%	55%	29%
49. Hawaii	100%	100%	100%	1%
50. Alaska	42%	97%	57%	0%

*Indicates a Governor Leader

(Education Superhighway, 2016)

APPENDIX C
NAMED DECISIONS REVIEW

Queen of Peace High School Burbank, IL vs. Universal Service, DA 11-1991 (2011).

December 7, 2011, the Federal Communication Commission heard the review of a case regarding Queen of Peace High School in Illinois. When the school submitted the Form 470, the Queen of Peace High School noted a service provider when requesting services. Due to the E-rate competitive bid process, the applicant must accept bids for 28 days prior to making a decision on a service provider. As the applicant was not yet approved for E-rate funding, it should have been impossible for a decision to be made regarding a provider. In another portion of the Form 470, however, the applicant noted that it was seeking bids for web hosting services.

The decision was not to penalize Queen of Peace High School based on the notations made regarding searching for web hosting bids. The high school records also demonstrated that bids were sought after and service provider was chosen based on experience, quality, and cost.

The case notes that past and future applicants will not be penalized for this mistake either, however, Universal Service Administrator will require that if an applicant notes a service provider they will also require them to note "or equivalent," in order to demonstrate that the competitive bidding process is not being jeopardized by the applicant (Queen of Peace High School Burbank, IL vs. Universal Service, 2011).

Macomb Intermediate School District Technology Consortium Clinton Township, MI v. Universal Service, FCC 07-64 (2007).

On April 19, 2007 the Universal Service Administration Company granted in part an appeal of the Macomb Intermediate School District Technology Consortium. The school district filed an appeal based on being denied funding for the year 2005. During that year, the Universal Service Administration Company denied the application for funding based on the applicant stating that they were planning on hiring more than one service provider for T3 lines, doing this violates the rule of duplicative services. However, the applicant was attempting to engage in a strategy called "multihoming", accessing multiple T3 service providers to protect service during power or service outages. This strategy is not eligible through E-rate, so the service was denied.

The appeal is upheld in the fact that the 30% rule is inapplicable, as the applicant is still due E-rate funding for the T3 lines that are more cost effective. However, the other T3 lines would not be covered based on duplicity. While the Universal Service Administration funding will not pay for all T3 lines in support of the "multihoming" strategy, funding should cover the least expensive of the three lines (Macomb Intermediate School District Technology Consortium Clinton Township, MI v. Universal Service, 2007).

Bishop Perry Middle School New Orleans, LA, et al. v. Universal Service, FCC 06-54 (2006).

On May 2, 2006 the Universal Service Administration Company granted 196 appeals to schools and libraries regarding certain clerical or ministerial errors on Form 470. These errors were in reference to timeliness issues, failure to demonstrate certification requirements, or failure to comply with minimum processing standards. The case notes that many organizations deem the process of application for E-rate funding as complicated and difficult and the Universal Service Administration Company hopes to provide relief and promote the statutory requirements of section 254(h) of the Communications Act of 1934, as amended, by helping to ensure that eligible schools and libraries actually obtain access to discounted telecommunications and information services.

The case discussion notes the process of the Forms 470 and 471, along with the competitive bidding process, which require the bids to be posted for 28 days prior to making a selection of a service provider. The “minimum processing standards” of the Universal Service Administration Company require that an incomplete or inaccurate application or form will be returned to the applicant without further review and noted as denied. The “minimum processing standards” are necessary for the organization based on the thousands of requests that they receive. Sixty-three applicants were denied funding on the basis of minor errors when completing one of the necessary forms. In these instances, the organization believes that the denial of these claims places undue hardship on the schools and libraries and will grant the appeals.

One hundred-three applicants filed appeals based on making applications outside of the Universal Service Administration funding time frame. Applicants stated various reasons for filing their forms at the incorrect time or filing late, which ranged from misunderstanding of the procedures to having a staff member that had a family emergency and the form did not get completed and filed on time. The Universal Service Administration Company took into account that these school districts, some small in nature, have limited staff and individuals in charge of filing for E-rate funding may be bookkeepers, teachers, or information technology personnel, these individuals are most likely not trained and hired for grant writing. In each case, the organization has waived the procedural deadline, as the issue is a procedural one and not substantive. Importantly, the Universal Service Administration Company notes that organizations must file their certifications in a timely manner, as this causes the applications being denied based on being incomplete.

From this case comes additional processing directives for the Universal Service Administration Company. First and foremost, the Universal Service Administration will send applicants written notice of denials with a period of time to remedy clerical or ministerial errors. Applicants will have 15 days from the receipt of the notice to make changes or correct forms or certifications. This is applied to past and future applications for funding.

Going forward, the Universal Service Administration will create more elaborate outreach programs to educate and inform applicants of the process, time windows, application requirements, and certification requirements. Educating applicants should assist in making the program easier to navigate and increase the efficacy of the program.

The new directives do not in any way reduce the minimum processing standards or procedures to complete application for the E-rate program. However, these 196 appeals brought difficulties to the attention of the organization. Accommodations to ensure that hardship is not made to the applicants and that schools, libraries, and consortiums continue to receive funding should assist in making the process easier to navigate, but the standards will not be reduced. Accurate, complete data is necessary to process the application by the Universal Service Administration (Bishop Perry Middle School New Orleans, LA, et al. v. Universal Service, 2006).

<u>Fayette County School District v. Universal Service, DA 05-2176 (2005).</u>

A request for the review of the decision of the Universal Service Administration was submitted on July 26, 2005. The School and Libraries division denied the school district on the grounds of a failure to provide sufficient documentation of the eligibility of the services requested. It is noted that the application was not sufficient enough to support the services requested. Documentation and certification is needed in order to gain acceptance of funding.

Upon review of the record, it is noted that Fayette School District properly filed documentation. It was found that the service provider did not specify what documentation was needed for approval. This matter was remanded back to Schools and Libraries division (Fayette County School District v. Universal Service, 2005).

Ysleta Independent School District et al v Universal Service, FCC 03-313 (2003).

Within the notes of the case adopted on December 4, 2003, it is shown that Ysleta Independent School District filed for E-rate funding in the proper manner and noted on forms that it had not prepared an RFP for any services. The school district filed that it would be seeking a Technology Integration and Systems partner to assist in implementing a new information technology plan to be aligned with the new technological advances and directives. Five days after posting the E-rate forms to the Schools and Libraries website, the Ysleta Independent School District posted a request for proposal for the Technology Integration and Systems partner. Among the five companies to submit for bids was IBM. Under the "Pricing Model and Cost Assurances" category, IBM stated that "the only inputs necessary to determine a price are: length of project, number and type of project resources required, and determination of IBM's risk assumption" (Ysleta Independent School District et al v Universal Service, 2003). The only actual prices quoted by IBM were part of a schedule of hourly rates strictly for Systems Integration, ranging from $394 per hour for a Project Executive to $49 per hour for a

Project Administrator. Only after IBM was chosen as the provider did Yselta begin negotiating scope of the project and cost.

Yselta was denied funding by E-rate funds for the following reasons. First, the school district failed to note on the form 470 that they had produced a request for proposal for the projects. Next, Yselta broke rules by not requiring bidders to submit specific proposals with scope of work and definite prices. Yselta was also unable to prove that IBM was the most effective cost-effective program. IBM's final contract included a myriad of ineligible services such as consulting services and teaching training.

It was decided that Yselta Independent School District, along with others who similarly broke rules regarding competitive bidding procedures, may have the filing window waived for the 2002 year and rebid for funding. The competitive bidding procedures for service providers must include accepting five or more bids for services, along with specific proposals with scope of project and prices provided. Also, all eligible services must be included and be bid upon. The decision on a provider must be cost and the number one factor (Ysleta Independent School District et al v Universal Service, 2003).

Appeal Decisions by the Universal Service Administration

Mary Queen of Martyrs Milwaukee, WI et al. v. Universal Service, DA 12-335, (2012).

Request for Waiver and Review of Decisions of the Universal Service Administrator was processed for Mary Queen of Martyrs on March 6, 2012. The Universal Service Administrator denied the schools application because the school failed to produce a letter of agency for the consultative services.

The Commission rules do not require E-rate applicants to have a contract with consultants providing services regarding E-rate funding. A signed agency letter is not required for application for E-rate funding.

This request was processed and remanded back to the Universal Service Administration for full review and an approval or denial should be processed within 90 days of this remand (Mary Queen of Martyrs Milwaukee, WI et al. v. Universal Service, 2012).

Chicago Public Schools, Chicago Il et al. v. Universal Service, (FCC 11-39, 2011).

A request for review of decisions of the Universal Service Administrator was filed for six school districts on March 4, 2011. The request was made based on funding being denied for years 2002, 2004, and 2005. The Universal Service Administrator denied funding based on the services being ineligible because the services went beyond the basic maintenance of internal connections by including ineligible non-basic services in their maintenance agreements; sought discounts for on-site basic maintenance arrangements; or sought discounts on ineligible consulting services.

Three school districts that were denied based on non-eligible maintenance services were allowed to remove any ineligible services and receive funding for those services deemed as eligible. Going forward, Universal Service Administration has determined that it is possible to determine eligible and non-eligible services within a contract and accept those services that are eligible and deny those that are not, without denying an entire application. In the past a complete application would be denied. In the future, notations will be made advising the applicant, which services will be funded.

One school district was denied funding due to using the term “consulting” in a broad manner in respect to maintenance services. The term consulting was used to describe eligible and ineligible services funded by the E-rate program. The school district was allowed to correct the forms to allocate the funding to eligible maintenance services and ineligible consulting services in order to allow the Universal Service Administration to gain clarity and ability to discern which services would be covered and accept those services for the applicant.

Two school districts were denied funding discounts for basic maintenance arrangements. One school was denied for on-site support during 2004, so it requested off-site support during 2005 and was denied a second time. On-site support is typically a more expensive option and is typically denied. The off-site support, however, in this case is two hours away and incurs additional cost in travel time. The second school was denied on-site basic maintenance based on the fact that the district had not proved that it was more cost effective than an off-site choice. Both school districts have been provided the opportunity to further explain their cases to prove that their choices are the most cost effective strategies for basic maintenance. If they can demonstrate that their strategies are the most cost effective, the requests for funding will be granted (Chicago Public Schools, Chicago Il et al. v. Universal Service, 2011).

Abbeville County School District Abbeville, SC v. Universal Service, DA 10-1997, (2010).

A request for waiver was made by three school districts on October 18, 2010. The Universal Service Administration Company denied requests by three school districts to transfer E-rate funding from closed schools to other schools in the districts. The Universal Service Administration found that the allocations did not fit into the categories for transfer.

The funds to be transferred from closed schools would be allocated to the schools where the students from the closed schools had been reassigned. The Commission held that it is "economically rational and consistent with the goals" of the E-rate program to permit school or library applicants to transfer E-rate equipment from a closed facility to another eligible school or library. However, the Universal Service Administration will recalculate the discounts based on the receiving schools' number of students participating in the Free and Reduced Lunch Program (Abbeville County School District Abbeville, SC v. Universal Service, 2010).

Glendale Unified School District v. Universal Service, DA 06-244 (2006)

According to DA 06-244, the request for review and waiver was adopted on February 1, 2006. The matter of the case was clerical errors made by the applicant. In February, 2003 the applicant submitted a Form 471 with an FRN start date of July 1, 2003. On a separate form, the applicant stated a start date of March 8, 2004. In June 2004, the applicant submitted a form requesting reimbursement for work billed November 2003 through May 2004. Since the start date was incorrectly placed as March 8, 2004 rather than July 1, 2003, the request was denied.

The Commission states within the discussion notes that it may waive any provision of its rules on its own motion for good cause shown. It was found that Glendale committed an unintentional, clerical error when it listed the incorrect service start date. They find that the action we take here promotes the statutory requirements of the Communications Act of 1934, by helping to ensure that Glendale obtains access to discounted telecommunication and information services (Glendale Unified School District v. Universal Service, 2006).

APPENDIX D
STUDY SCHOOL DISTRICTS

Florida Public School Districts		
Alachua	Hamilton	Okeechobee
Baker	Hardee	Orange
Bay	Hendry	Osceola
Bradford	Hernando	Palm Beach
Brevard	Highlands	Pasco
Broward	Hillsborough	Pinellas
Calhoun	Holmes	Polk
Charlotte	Indian River	Putnam
Citrus	Jackson	St. Johns
Clay	Jefferson	St. Lucie
Collier	Lafayette	Santa Rosa
Columbia	Lake	Sarasota
Dade	Lee	Seminole
Desoto	Leon	Sumter
Dixie	Levy	Suwannee
Duval	Liberty	Taylor
Escambia	Madison	Union
Flagler	Manatee	Volusia
Franklin	Marion	Wakulla
Gadsden	Martin	Walton
Gilcrest	Monroe	Washington
Glades	Nassau	
Gulf	Okaloosa	

REFERENCES

Adler, E. (2014). The 'Internet of Things' will be bigger than the smartphone, tablet, and PC markets combined. *Business Insider*. Retrieved from http://www.businessinsider.com/growth-in-the-internet-of-things-market-2-2014-2

Aguilera, A. & Barrerra, M. (2016). Technological unemployment: An approximation to the Latin American case. AD-minister. 29, 59-78. Retrieved from http://publicaciones.eafit.edu.co/index.php/administer/article/view/3281

Alachua County Public Schools. (2014). *Digital classroom plan*. Retrieved from http://www.fldoe.org/core/fileparse.php/12098/urlt/AlachuaDCP-1415.pdf

Alexander D., & Alexander K. (2012). *American public school law* (8th ed.). Belmont, CA: Wadsworth Cengage Learning.

American with Disabilities Act of 1990. Pub. L. No. 101-336, 104 Stat. 328 (1990).

Bebell, D., & O'Dwyer, L. (2010). Educational outcomes and research from 1:1 computing settings. *The Journal of Technology, Learning, and Assessment. 9*(1), 5-13. Retrieved from http://ejournals.bc.edu/ojs/index.php/jtla

Bell M., (2010, November/December). What about our digital have-nots? *Multimedia and Internet@Schools.* 6, 24-27. Retrieved from http://eds.a.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=fd892b8c-7c7a-4750-9fb4-c8dff8fdbb76@sessionmgr104&hid=120

Boster, F., Meyer, G., Roberto, A., Lindsey, L., Smith, R., Inge, C., & Strom, R. (2007). The impact of video streaming on mathematics performance. *Communication Education.* 56*(2)*, 134-144. Retrieved from http://eds.a.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=38c85442-4c66-4ea1-af6c-65f33a8d28e6@sessionmgr105&hid=120

Broward County Public Schools. (2014). *Digital classroom plan.* Retrieved from http://www.fldoe.org/core/fileparse.php/12098/urlt/BrowardDCP-1415.pdf

Bruder, I. (1988). Electronic Learning's 8th Annual Survey of the States, 1988. *Electronic Learning,* 8*(2)*. Retrieved from https://login.ezproxy.net.ucf.edu/login?auth=shibb&url=http://go.galegroup.com/ps/i.do?p=CDB&sw=w&u=orla57816&v=2.1&id=GALE%7CA7015939&it=r&asid=8abdbeaea484aa8b27e103e6eeb270cf

Buckely, J. (2012, December 11). *NCES statement on PIRLS 2011 and TIMSS 2011*. Retrieved from https://nces.ed.gov/whatsnew/commissioner/remarks 2012/12_11_2012.asp

Burns, M. (2014). The bandwidth schools have and the bandwidth schools need. *Elearning Industry.* Retrieved from https://elearningindustry.com/bandwidth-schools-bandwidth-need

California Department of Education. Data Reporting Office. (2015). *Selected district level data + 5772702—winters joint unified for the year 2014-2015.* Retrieved from http://dq.cde.ca.gov/dataquest/Cbeds3.asp?FreeLunch=on&cSelect=5772702--Winters+Joint+Unified&cChoice=DstProf1&cYear=2014-15&cLevel=District&cTopic=Profile&myTimeFrame=S&submit1=Submit

Canbeck, N., & Hargis, J. (2015). Is learning effective with social networks? Let's investigate! *International Journal on New Trends in Education and Their Implications, 6*(3), 206-215. Retrieved from http://eds.a.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?sid=63b4545b-0b08-4994-8a1d-cc6c8d1eab84%40sessionmgr103&vid=3&hid=4110

Cash, J., Lee, D., & Frass, L. (2010). Web 2.0: Using Internet resources to increase student achievement among high school students in rural schools. *Journal of Information Systems Technology & Planning, 3*(6), 73-80. Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=caa37d85-c1f1-40a6-89a4-cf77055bc55d@sessionmgr101&hid=120

Carver, L. (2016). Teacher perception of barriers and benefits in K-12 technology usage. *The Turkish Online Journal of Educational Technology, 15*(1), 110-116 Retrieved from http://files.eric.ed.gov/fulltext/EJ1086185.pdf

Cleary, P., Pierce, G., & Trauth, E. (2006). Closing the digital divide: understanding racial, ethnic, social class, gender and geographic disparities in Internet use among school age children in the United States. *Universal Access in the Information Society, 4*(4), 354-373. Retrieved from http://eds.b.ebscohost.com/eds/detail/detail?vid=1&sid=23c3ae92-e996-419c-a50a-a58a653a490e%40sessionmgr120&hid=120&bdata=JnNpdGU9ZWRzLWxpdmUmc2NvcGU9c2l0ZQ%3d%3d#AN=edsgcl.179968920&db=edsgao

Cheung, Alan & Slavin, R. (2013). The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis. *Educational Research Review. 9*, 88-113. Retrieved from http://www.sciencedirect.com.ezproxy.net.ucf.edu/science/article/pii/S1747938X13000031

Children's Internet Protection Act (CIPA). 47 CFR Part 54.

Children's Online Privacy Protection Act (COPPA), 15 USCS § 6501.

Collier County Public Schools. (2014). *Digital classroom plan.* www.fldoe.org/core/fileparse.php/12098/urlt/CollierDCP-1415.pdf

Computers for Learning (2016). *Success stories.* http://computersforlearning.gov/htm/hp_successstories.htm

Cristol, D., & Gimbert, P. (2014). Academic achievement in BYOD classrooms. *Journal of Applied Learning Technology, 4*(1), 24-30. Retrieved from http://eds.a.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=23f1870b-2d0c-4e74-8181-8f3b37ea3ec6@sessionmgr120&hid=120

Cuban, L. (1986). *Teachers and machines: The classroom use of technology since 1920*. New York: Teachers College Press.

Davis, N., Eickelmannt, B., & Zaka, P. (2013). Restructuring of educational systems in the digital age from a co-evolutionary perspective. *Journal of Computer Assisted Learning, 29*, 438-450. Retrieved from http://eds.a.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=4736580f-29f8-43ab-8dbf-0862832233b4@sessionmgr101&hid=120

Deep, D. (1970). The computer can help individualize instruction. *The Elementary School Journal, 70*(7), 351-358. Retrieved from http://www.jstor.org/stable/1000718

Delgado, A., Wardlow., L, McKnight, K., & O'Malley, K. (2015). Educational technology: A review of the integrations, resources, and effectiveness of technology in K-12 classrooms. *Journal of Information Technology Education: Research, 14,* 397-416.

Retrieved from http://www.jite.org/documents/Vol14/JITEv14ResearchP397-416Delgado1829.pdf

DeNisco, A. (2014, June). Navigating ConnectEd and E-rate: What administrators need to know to boost access. *District administration.* Retrieved from https://www.districtadministration.com/article/navigating-connected-and-e-rate

Education Superhighway. (2014, April). *Connecting America's students' opportunities for action: An analysis of spending offers key insights for expanding educational opportunity.* Retrieved from http://cds.educationsuperhighway.org/wp-content/uploads/2014/11/Connecting-Americas-Students-K12-E-rate-Spending-Report-April-2014.pdf.

Education Superhighway (2016). *The promise of digital learning.* Retrieved from http://www.educationsuperhighway.org/why-high-speeds-matter/

Exec. Order No. 12999. (1996). Retrieved from http://www.gsa.gov/portal/content/100841

Electronic Code of Federal Regulations. Universal Service. Title 47. Chapter 1. Subchapter B. Part 54. Retrieved from http://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title47/47cfr54_main_02.tpl

Elementary and Secondary Education Act of 1965. ED 018492. (1965).

E-Rate Central (2016). *State information web portal*. Retrieved from http://e-ratecentral.com/us/stateInformation.asp?state=FL

Family Educational Rights and Privacy Act (FERPA). 20 U.S.C. § 1232g; 34 CFR.

Executive Office of the President of the United States. (2016, December). *Artificial intelligence, automation, and the economy.* Retrieved from https-

//obamawhitehouse.archives.gov/sites/whitehouse.gov/files/documents/Artificial-Intelligence-Automation-Economy.PDF

Fairlie, R., Beltran D., & Kuntal, K. (2010, July). Home computers and educational outcomes: evidence from NLSY97 and CPS*. *Economic Inquiry, 48*(3), 771-792. Retrieved from http://files.eric.ed.gov/fulltext/ED539502.pdf

Federal Communications Commission. (2003, December 4). Order in the matter of requests for review of the decisions of the universal service administrator by Ysleta Independent School District et al. (FCC 03-313). Washington, DC. Retrieved from https://apps.fcc.gov/edocs_public/Query.do;jsessionid=jZzbY5rFp1cp5h01gFVbHJGMSBPdcjLg51WbG2Wj1XtGsn7BKJTp!-1022339476!734755259?mode=advance&rpt=cond

Federal Communications Commission. (2005, July). Order in the matter of requests for review of the decisions of the universal service administrator by Fayetteville County School District, and schools and libraries universal service support mechanism. (DA 05-2176). Washington, DC. Retrieved from https://apps.fcc.gov/edocs_public/Query.do;jsessionid=jZzbY5rFp1cp5h01gFVbHJGMSBPdcjLg51WbG2Wj1XtGsn7BKJTp!-1022339476!734755259?mode=advance&rpt=cond

Federal Communications Commission. (2006a, February 1). Order in the matter of requests for review of the decisions of the universal service administrator by Glendale Unified School District, and schools and libraries universal service support mechanism. (DA 06-244). Washington, DC. Retrieved from https://apps.fcc.gov/edocs_public/Query.do;jsessionid=jZzbY5rFp1cp5h01gFVbHJGMSBPdcjLg51WbG2Wj1XtGsn7BKJTp!-1022339476!734755259?mode=advance&rpt=cond

Federal Communications Commission. (2006b, May 31). Order in the matter of requests for review of the decisions of the universal service administrator by Mary Bishop Perry Middle School New Orleans, LA et al. and schools and libraries universal service support mechanism. (fcc 06-54). Washington, DC. Retrieved from https://apps.fcc.gov/edocs_public/Query.do;jsessionid=jZzbY5rFp1cp5h01gFVbHJGMSBPdcjLg51WbG2Wj1XtGsn7BKJTp!-1022339476!734755259?mode=advance&rpt=cond

Federal Communications Commission. (2007, April 19). Order in the matter of requests for review by Macomb Intermediate School District Technology Consortium, schools and libraries universal service support mechanism. (FCC 07-64). Washington, DC. Retrieved from https://apps.fcc.gov/edocs_public/Query.do;jsessionid=jZzbY5rFp1cp5h01gFVbHJGMSBPdcjLg51WbG2Wj1XtGsn7BKJTp!-1022339476!734755259?mode=advance&rpt=cond

Federal Communications Commission. (2010, October 18). Order in the matter of requests for waiver by Abbeville County School District, Union County School District, Williamsburg County School District, and schools and libraries universal service support mechanism. (FCC 11-39). Washington, DC. Retrieved from https://apps.fcc.gov/edocs_public/Query.do;jsessionid=jZzbY5rFp1cp5h01gFVbHJGM

SBPdcjLg51WbG2Wj1XtGsn7BKJTp!-1022339476!734755259?mode=advance&rpt=cond

Federal Communications Commission. (2011, March 4). Order in the matter of requests for review of the decisions of the universal service administrator by Chicago Public Schools, Coosa County School District, Gallup-McKinley County, Holyoke School District, KIPP Academy, Whitley County School District, and schools and libraries universal service support mechanism. (FCC 11-39). Washington, DC. Retrieved from https://apps.fcc.gov/edocs_public/Query.do;jsessionid=jZzbY5rFp1cp5h01gFVbHJGMSBPdcjLg51WbG2Wj1XtGsn7BKJTp!-1022339476!734755259?mode=advance&rpt=cond

Federal Communications Commission. (2011, March 4). Order in the matter of requests for review of the decisions of the universal service administrator by Queen of Peace High School Burbank, IL and schools and libraries universal service support mechanism. (DA 11-1991). Washington, DC. Retrieved from http://e-ratecentral.com/files/fcc/DA-11-1991A1.pdf

Federal Communications Commission. (2012, March 6). Order in the matter of requests for waiver and review of the decisions of the universal service administrator by Mary Queen of Martyrs et al. and schools and libraries universal service support mechanism. (DA 12-335). Washington, DC. Retrieved from https://apps.fcc.gov/edocs_public/Query.do;jsessionid=jZzbY5rFp1cp5h01gFVbHJGMSBPdcjLg51WbG2Wj1XtGsn7BKJTp!-1022339476!734755259?mode=advance&rpt=cond

Federal Communications Commission. (2013, July 19). Notice of proposed rulemaking in the matter of modernizing the e-rate program for schools and libraries. (FCC 13-100). Washington, DC. Retrieved from https://apps.fcc.gov/edocs_public/Query.do;jsessionid=jZzbY5rFp1cp5h01gFVbHJGMSBPdcjLg51WbG2Wj1XtGsn7BKJTp!-1022339476!734755259?mode=advance&rpt=cond

Federal Communications Commission. (2014a, October 28). Order in the matter of schools and libraries universal service support mechanism, a national broadband for our future, and modernizing the e-rate program for schools and libraries. (DA 14-1556). Washington, DC. Retrieved from https://apps.fcc.gov/edocs_public/Query.do;jsessionid=jZzbY5rFp1cp5h01gFVbHJGMSBPdcjLg51WbG2Wj1XtGsn7BKJTp!-1022339476!734755259?mode=advance&rpt=cond

Federal Communications Commission. (2014b, December 11). *FCC continues E-rate reboot to meet the needs of 21st century digital learning.* Washington, DC. Retrieved from http://www.fcc.gov/document/fcc-continues-e-rate-reboot-meet-nations-digital-learning-needs.

Federal Communications Commission. (2014c, December 11). Second report and order and order on reconsideration in the matter of modernizing the e-rate program for schools and libraries connect America fund. (FCC 14-189). Washington, DC. Retrieved from https://apps.fcc.gov/edocs_public/Query.do;jsessionid=jZzbY5rFp1cp5h01gFVbHJGM

SBPdcjLg51WbG2Wj1XtGsn7BKJTp!-1022339476!734755259?mode=advance&rpt=cond

Federal Communications Commission. (2015a, January 22). *Consumer guide: Children's internet protection guide.* Washington, DC. Retrieved from http://transition.fcc.gov/cgb/consumerfacts/cipa.pdf

Federal Communications Commission. (2015b, May 23). Order in the matter of schools and libraries under universal service support mechanism. (DA 14-712) Washington, DC. Retrieved from https://apps.fcc.gov/edocs_public/Query.do;jsessionid=jZzbY5rFp1cp5h01gFVbHJGMSBPdcjLg51WbG2Wj1XtGsn7BKJTp!-1022339476!734755259?mode=advance&rpt=cond

Federal Communications Commission. (2015c, September 23). *Lifeline for low income consumers*. Retrieved from https://www.fcc.gov/lifeline

Federal Communications Commission. (2016, September 12). *Modernizing the e-rate program for schools and libraries*. (DA-16-1023). Retrieved from https://apps.fcc.gov/edocs_public/Query.do;jsessionid=jZzbY5rFp1cp5h01gFVbHJGMSBPdcjLg51WbG2Wj1XtGsn7BKJTp!-1022339476!734755259?mode=advance&rpt=cond

Felvegi, E., & Matthew, K. (2012). eBooks and Literacy in K-12 Schools. *Computers in Schools, 29*, 40-52. Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=0ad33e98-ddad-4857-8a95-8fe28c5826c8@sessionmgr4006&hid=4110

Finn, J. (1960). Technology and the instructional process. *Phi Delta Kappan, 41*(9), 371-378. Retrieved from http://www.jstor.org/stable/20342458

Flagler County Public Schools. (2015). *Digital classroom plan*. Retrieved from www.fldoe.org/core/fileparse.php/12098/urlt/1516Flagler.pdf

Florida Center for Instructional Technology. (2016). *TIMSS: Levels of technology integration into the curriculum*. Retrieved from http://fcit.usf.edu/matrix/matrix.php

Florida Department of Education. (2014a). *MembershipFPS1415. Student membership PK-12.* Retrieved from http://www.fldoe.org/contact-us/search.stml?q=MembershipFPS1415

Florida Department of Education. (2014b) *SGbasic_2014-1. School Grades. 2013-2014.* http://schoolgrades.fldoe.org/

Florida Department of Education. (2014c). *Strategic technology plan 2014-2019.* Retrieved from http://www.fldoe.org/core/fileparse.php/5658/urlt/0097843-fdoedigitalclassroomsplan.pdf

Florida Department of Education (2014d). *Technology strategic plan.* Retrieved from http://www.fldoe.org/core/fileparse.php/5658/urlt/0097843-fdoedigitalclassroomsplan.pdf

Florida Department of Education (2015). *College and career ready.* Retrieved from http://www.fldoe.org/schools/higher-ed/fl-college-system/college-career-readiness.stml

Florida Department of Education (2016). *FDOE K-12 education information web portal.* Retreived from https://edstats.fldoe.org/SASPortal/main.do

Florida Statutes. Title XLVIII, K-20 Education Code, § 1011.62. Florida digital classrooms allocation. Retrieved from http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&URL=1000-1099/1011/Sections/1011.62.html

Fox, C. Waters, J., Fletcher, G. & Levin, D. (2012). *The broadband imperative: Recommendations to address K-12 education infrastructure needs*. Washington, DC: State Educational Technology Directors Association (SETDA). Retrieved from http://www.setda.org/wp-content/uploads/2013/09/SETDA_BroadbandImperative_May20Final.pdf

Fraenkel, J., Wallen, N., & Hyun, H. (2015) *How to design and evaluate research in education.* (9th ed.). New York: McGraw Hill.

Frankel, C. (1970). Education and telecommunications. *The Journal of Higher Education, 41*(1), 1-15. The Ohio State University Press. Retrieved from http://www.jstor.org/stable/1979603

Freedom of Information Act. 5 U.S.S § 552. (2007).

Frey, C. & Osbourne, M. (2013, September 13). *The future of employment.* Oxford Martin Programme on Technology and Employment. The University of Oxford. Retrieved from http://www.oxfordmartin.ox.ac.uk/downloads/academic/future-of-employment.pdf

Grant, M., Suha, T., Brown, D., Sweeney, J., Ferguson, F. (2015). Teaching and learning mobile computing devices: Case study in K-12 classrooms. *TechTrends, 59*(4) 32-45. Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=63f643f2-59fb-4dd0-9a1c-45d45909831d@sessionmgr102&hid=120

Golden, C. (2015). Challenges of closing the digital divide. *Western City.* Retrieved from http://www.westerncity.com/Western-City/September-2015/Challenges-of-Closing-the-Digital-Divide/

Goodwin, B. (2017, January 24-30). Technology threat to jobs, economies and society in the spotlight at Davos summit. Computer Weekly. Retrieved from http-//eds.a.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=9&sid=067a2916-06a5-428d-9052-fc1f50485218%40sessionmgr4010&hid=4113.pdf

Gros, Begona. (2007). Digital games in education: The design of games-based learning environments. *Journal of Research on Technology in Education, 40*(1) 23-38 Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=fd92c1ee-e2b1-4446-b2bb-0f45669469e3@sessionmgr104&hid=120

Hannafin, R., & Foshay, W. (2008) Computer-based instruction's (CBI) rediscovered role in K-12: An evaluation case study of one of high school's use of CBI to improve pass rates on high-stakes tests. *Education Technology, Research and Development. 56,* 147-160. Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=8e416058-a38d-43b4-b976-c97a3ec4adc4@sessionmgr105&hid=120

Harper, B., & Milman, N. (2016). One-to-one technology in K-12 classrooms: A review of the literature from 2004-2014. *Journal of Research on Technology in Education, (49)*2, 129-142. Retrieved from http://www-tandfonline-com.ezproxy.net.ucf.edu/doi/abs/10.1080/15391523.2016.1146564

Hasler-Waters, L. Barbour, M, & Menchaca, M. (2014). The nature of online charter schools: Evolution and emerging concerns. *Educational Technology & Society, (17)*4, 379-389. Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=0e3fa583-6901-4b6c-ae02-f2ef41875848@sessionmgr104&hid=120

Hillsborough County Public Schools. (2014). *Digital classroom plan*. Retrieved from www.fldoe.org/core/fileparse.php/.../HillsboroughDCP-1415.pdf

Hoos, I. (1975). The costs of efficiency: Implications of educational technology. *The Journal of Higher Education, (46)*2, 141-159. Retrieved from http://www.jstor.org/stable/1980878

Hu, H., & Garimella, U. (2014). iPads for STEM teachers: A case study on perceived usefulness, perceived proficiency, intention to adopt, and integration in K-12 instruction. *Journal of Educational Technology Development and Exchange, (7)*1, 49-66. Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=16eda611-3114-4783-8fea-7a828ea05636@sessionmgr103&hid=120

IRA Computer Technology and Reading Committee. (1984). Guidelines for educators on using computers in schools. *Reading Research Quarterly, (20)*1, 120-128. Retrieved from http://www.jstor.org/stable/747660

Irving, Karen. (2006). The impact of educational technology on student achievement: Assessment of and for learning. *Science Educator, (15)*1, 13-20. Retrieved from http://eds.a.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=9ef89d0b-812e-48aa-842e-6a59ef2726f8@sessionmgr104&hid=120

Johnson, D. (2013a). Power up!/Good technology choices: A team effort. *Educational Leadership*, 80-82. Retrieved from http://eds.a.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=03adca36-2468-45c8-9971-a8167124d442@sessionmgr101&hid=120

Johnson, D. (2015b). Helping to close the digital divide. *Educational Leadership,* 81-82. Retrieved from http://eds.a.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=89972b60-7126-4a16-ac0e-8c27f07d0e99@sessionmgr4008&hid=4110

Karsten J., & West, D. (2015). ConnectHome initiative acknowledges economic necessity of Internet access. *The Brookings Institution.* Retrieved from http://www.brookings.edu/blogs/techtank/posts/2015/07/21-connecthome-initiative

Kimmons, R. (2015). Online system adoption and K-12 academic outcomes. *Journal of Computer Assisted Learning, (31)*1, 378-391. Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=d2a24a16-5f88-412d-8d9e-eb6b10228b46@sessionmgr107&hid=120

Knezek, G., & Christensen, R. (2007). Effect of technology-based programs on first-and second-grade reading achievement. *Computers in Schools, (24)*3, 23-41. Retrieved from http://dx.doi.org/10.1300/J025v24n03_03

Kronholz, J. (2011). Getting at-risk teens to graduate: Blending learning offers a second chance. *Education Next.* 24-31. Retrieved from http://educationnext.org/getting-at-risk-teens-to-graduation/

Lake County Schools. (2014). *Digital classroom plan*. Retrieved from www.fldoe.org/core/fileparse.php/12098/urlt/LakeDCP-1415.pdf

Lei, Jing & Zhao, Y. (2005). Technology uses and student achievement: a longitudinal study. *Computers and Education, 49,* 284-296. Retrieved from http://www.sciencedirect.com.ezproxy.net.ucf.edu/science/article/pii/S036013150500120X

Lepper, M., & Gurtner, J. (1989). Children and computers: Approaching the twenty-first century. *American Psychologist, (44)*2, 170-178. Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=b312873e-a91f-4525-9081-c31066d461e3@sessionmgr103&hid=120

Levin, B., & Schrum, L. (2013) Using systems thinking to leverage technology for improvement: Lessons learning from award-winning secondary schools/districts. *Journal of Research on Technology in Education, (46)*1, 29-51. Retrieved from http://eds.a.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=6&sid=39a484c1-e340-4a54-8921-f91a21571650@sessionmgr102&hid=120

Levin, H. (1983). *Cost effectiveness: A primer new perspectives in evaluation.* Vol. 4. Newbury Park, CA: Sage.

Lipton, Ethan. (2005). President's message: Advancing the tide of technology education. *The Technology Teacher*, 29-36. Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=9d4a2c27-3f05-4727-a538-19948c867c57@sessionmgr101&hid=120

Lobeto, F. (2016). *Ubiquitous computing in public education: The effects of one-to-one computer initiatives on student achievement on Florida standardized assessments.* Unpublished doctoral dissertation. University of Central Florida. Orlando, Florida.

Luehrmann, A. (1985). School of the future = school of the past. Adopting microcomputers in ways that will and won't work. *Peabody Journal of Education, (62)*2. Retrieved from https://eric.ed.gov/?id=EJ328878

Mabry, Linda & Snow, J. (2006). Laptops for high-risk students: empowerment and personalization in a standards-based learning environment. *Studies in Educational* Evaluation, 32, 289-316. Retrieved from http://www.sciencedirect.com.ezproxy.net.ucf.edu/science/article/pii/S0191491X06000514

Magellan Advisors. (2015). *Final Yolo broadband strategic plan*. Retrieved from http://www.yolocounty.org/home/showdocument?id=29078

Manyika, J., Lund, S., Bughin, J., Robinson, K., Mischke, J., & Mahajan, D. (2016, October). *Independent Work: Choice, necessity, and the gig economy*. San Francisco, CA: McKinsey Global Institute. Retrieved from http://www.mckinsey.com/global-themes/employment-and-growth/independent-work-choice-necessity-and-the-gig-economy

Mardis, M. (2016). Beyond the glow: Children's broadband access, digital learning initiatives, and academic achievement in rural Florida. *Journal of Educational Multimedia and Hypermedia, (25)*1, 53-74. Retrieved from http://resolver.flvc.org/ucf?genre=article&atitle=Beyond%20the%20Glow:%20Children

\%27s%20Broadband%20Access,%20Digital%20Learning%20Initiatives,%20and%20Academic%20Achievement%20in%20Rural%20Florida.&title=Journal%20of%20Educational%20Multimedia%20&%20Hypermedia&issn=10558896&isbn=&volume=25&issue=1&date=20160101&aulast=MARDIS%2C%20MARCIA&spage=53&pages=53-74&rft.sid=EBSCO:edo:114109054

Martin, F. & Carr, M. (2015, June). An exploratory study on K-12 teachers' use of technology and multimedia in the classroom. I-manager's Journal of Educational Technology. (12)1, 7-14. Retrieved from https://eric.ed.gov/?id=EJ1098583.

Mather, Y. (2016, May). Automation in the era of economic crisis. *Critique.* 44(1-2, 67-84). Retrieved from http-//www-tandfonline-com.ezproxy.net.ucf.edu/doi/pdf/10.1080/03017605.2016.1173824?needAccess=true.pdf

McLafferty, C. (2000). Technology revolution = Education evolution. *Kappa Delta Phi Record.* Fall, 22-25. Retrieved from http://eds.a.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=48cdf6b4-9497-466d-94c7-667e1ff861ce@sessionmgr4007&hid=4110

McMeekin, R.W., & Dede, C. (1980). American education in the 1980s. *Comparative Education, (16)*3, 225-236. Retrieved from http://www.jstor.org.ezproxy.net.ucf.edu/stable/pdf/3098731.pdf

Mossberger, K., Tolbert, C., Bowen, D., & Jimenez, B. (2012) Unraveling different barriers to Internet use: Urban residents and neighborhood effects. *Urban Affairs Review*, *46*(6). Retrieved from http://uar.sagepub.com.ezproxy.net.ucf.edu/content/48/6/771.full.pdf+html

Mulcahy, D. (2016, October 27). Who wins in the gig economy, and who loses. *Harvard Business Review.* Retrieved from https://hbr.org/2016/10/who-wins-in-the-gig-economy-and-who-loses

National Center for Educational Statistics. (2009). *Teacher's use of educational technology in US public schools: 2009*. Retrieved from http://nces.ed.gov/pubs2010/2010040.pdf

National Telecommunications and Information Administration [NTIA] (2011). *Digital nation: Expanding Internet usage.* NTIA Research Preview. Retrieved from https://www.ntia.doc.gov/files/ntia/publications/ntia_internet_use_report_february_2011.pdf

National Telecommunications and Information Administration [NTIA]. (2015). *NTIA's BroadbandUSA work complementing ConnectHome Initiative*. Retrieved from https://www.ntia.doc.gov/blog/2015/ntia-s-broadbandusa-work-complementing-connecthome-initiative

Norris, P. (2001). *Digital divide: Civic engagement, information poverty, and the Internet worldwide*. Cambridge, UK: Cambridge University Press.

The Office of Educational Technology. (2016). *ConnectEd.* Retrieved from http://tech.ed.gov/connected/

Ohanian, Vera. (January). Educational technology: A critique. *The Elementary School Journa, (71)*4, 182-197 The University of Chicago Press. Retrieved from http://www.jstor.org/stable/1000549

Orange County Public Schools. (2014) *Digital classroom plan*. Retrieved from www.fldoe.org/about-us/division-of-technology.../2015-16.stml

Partnership for Assessment of Readiness for College and Careers [PARCC]. (2016) *Technology Guidelines for PARCC Assessments Version 6.0 – 2016-2017*. Retrieved from http://parcconline.org/

Pierce, G., & Cleary, P. (2014). The K-12 educational technology value chain: apps, for kids, tools for teachers, and levers for reform. *Education Information Technology, (21).* Retrieved from http://resolver.flvc.org/ucf?ID=DOI:10.1007/s10639-014-9357-1&genre=article&atitle=The%20K-12%20educational%20technology%20value%20chain:%20Apps%20for%20kids,%20tools%20for%20teachers%20and%20levers%20for%20reform&title=Education%20and%20Information%20Technologies&issn=13602357&isbn=&volume=21&issue=4&date=20160701&aulast=Pierce%2C%20Glenn%20L.&spage=863&pages=863-880&rft.sid=EBSCO:edsgao:edsgcl.452172238

Planning the school of the future: Proceedings of a national study conference. (1985), 42-51. Retrieved from http://www.jstor.org/stable/1492875

Polk County Public Schools. (2014). *Digital classroom plan*. Retrieved from www.fldoe.org/core/fileparse.php/12098/urlt/PolkDCP-1415.pdf

Resmovitis, J. (2013). Obama ConnectEd Initiative aims to get classrooms online. *Huffington Post.* Retrieved from http://www.huffingtonpost.com/2013/06/06/obama-connected_n_3392817.html

Reid, Karen, Aqui, Y., & Putney, L. (2009). Evaluation of an evolving virtual high school. *Educational Media International, (46)*4, 281-294. Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=71c2648f-989c-463d-a7c1-609245cf1e55@sessionmgr4008&hid=4110

Rogers, Everett. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.

Rotman, D. (2017, February 13). The relentless pace of automation. MIT Technology Review. Retreived from https://www.technologyreview.com/s/603465/the-relentless-pace-of-automation/

Ruiz, R. (2015, May 28). F.C.C. Chief seeks broadband plan to aid the poor. *The New York Times*. Retrieved from http://nyti.ms/1ey6DVZ

Salonmon, Gavriel. (1985). Information technologies: What you see is not (always) what you get. *Educational Psychologist, (20)*4, 207-216. Retrieved from http://www.tandfonline.com/doi/abs/10.1207/s15326985ep2004_5

Sasso, B. (2015). Republicans attack FCC plan to pay for Internet access for the poor. *The National Journal*. Retrieved from http://www.nationaljournal.com/tech/2015/05/28/Republicans-Attack-FCC-Plan-to-Pay-for-Internet-Access-for-the-Poor

Section 508 of the Rehabilitation Act. (1998). 29 U.S.C. 794d. as amended by the Workforce Investment Act of 1998 (P.L. 105-220).

Seminole County Public Schools. (2014). *Digital classroom plan*. Retrieved from www.fldoe.org/core/fileparse.php/12098/.../SeminoleDCP-1415.pdf

Shapely, K., Sheehan, D., Maloney, C., & Caranikas-Walker, F. (2011). Effects of technology immersion on middle school students' learning opportunities. *The Journal of Educational Research*. Retrieved from http://eric.ed.gov/?id=ED536291

Shellabarger, E. (2015). Calculating your school district's bandwidth needs: Network essentials for superintendents. *Education Superhighway*. Retrieved from https://www.educationsuperhighway.org/calculating-your-school-districts-bandwidth-need-network-essentials-for-superintendents/

Stanton, L. (2013). Obama sets ConnectED goal of delivering 100 Mbps to 99% of students in 5 years. *Telecommunications Reports.* Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=4&sid=1cbf7c3d-be72-451e-a321-c494fc76cc88@sessionmgr198&hid=103

State Educational Technology Directors Association [SETDA]. (2016). *Broadband Imperative II: Equitable Access for Learning*. Retrieved from http://www.setda.org/wp-content/uploads/2016/09/SETDA-Broadband-ImperativeII-Full-Document-Sept-8-2016.pdf

Steinberg, W. (2011). *Statistics alive!* (2nd ed.). Thousand Oaks, CA: Sage.

Summers, S. (2015, January 14). Obama aims to protect data with Student Digital Privacy Act. *Education News.* Retrieved from http://www.educationnews.org/technology/obama-aims-to-protect-data-with-student-digital-privacy-act/

Telecommunications Act of 1996. Pub. LA. No. 104-104, 110 Stat. 56 (1996).

T-Mobile USA. (2012, March 29). T-Mobile helping to advance mobile learning and digital education for K-12 Schools in the U.S. *Business Wire*. Retrieved from https://newsroom.t-mobile.com/news-and-blogs/t-mobile-helping-to-advance-mobile-learning-and-digital-education.htm

Universal Service Administration Company [USAC] (2016). Lifeline Program. Retrieved from http://www.lifelinesupport.org/ls/companies/CompanyListing.aspx?state=FL&stateName=Florida

Universal Service Administration Company [USAC] (2016). *Training and Outreach.* Retrieved from http://www.usac.org/sl/about/outreach/default.aspx

U.S. Department of Commerce, National Telecommunications and Information Administration [NTIA] (2002). *A nation online: How Americans are expanding their use of the Internet.* Retrieved from www.ntia.doc.gov/ntiahome/dn/anationonline2.pdf/

U.S. Department of Commerce National Telecommunications and Information Administration. (2011, February). *Digital nation-expanding Internet use. NTIA research preview*. Retrieved from http://www.ntia.doc.gov/files/ntia/publications/ntia_internet use_report_february_ 2011.pdf

U.S. Department of Education. (2013, April 2). *Building the legacy*. Retrieved from http://idea.ed.gov/explore/home

U.S. Department of Education. (2013 April 2). *Protecting students with disabilities*. Retrieved from http://www2.ed.gov/about/offices/list/ocr/504faq.html

U.S. Department of Education. (2015, February 5). *General: Family Educational Rights and Privacy Act.* Retrieved from http://idea.ed.gov/explore/home

U.S. Department of Education. (2015, February 5). *Building a legacy.* Retrieved from http://www2.ed.gov/policy/gen/guid/fpco/ferpa/index.html.

U.S. Department of Education. (2015, March 8). *ConnectEd-Learning basis.* Retrieved from http://www.ed.gov/connected

United States Environmental Protection Agency. (2012, October). *Think 508 First!* Retrieved from https://www.epa.gov/sites/production/files/2013-09/documents/section-508-brochure.pdf

Vargas, Julie. (1986, June). Instructional design flaws in computer-assisted instruction. *The Phi Delta Kappan.* (67)10 738-744. Retrieved from http://www.jstor.org/stable/20403230

Verkroost, Marie-Jose, Meijerink, L., Lintsen, H., & Veen, W. (2008) Finding a balance in dimensions of blended learning. *International Journal on E-Learning.* (7)3 499-522. Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=006cd683-3298-4718-9ef0-209c59622938@sessionmgr106&hid=120

Vigdor, Jacob, Ladd, H., & Martinez, E. (2014, July). Scaling the digital divide: Home computer technology and student achievement. *Economic Inquiry.* (52)3 1103-1119. Retrieved from http://eds.b.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=09c1c671-5640-44a9-befc-40870af08188@sessionmgr106&hid=120

Walton County School District. (2014). *Digital Classroom Plan*. Retrieved from www.fldoe.org/core/fileparse.php/12098/.../WaltonDCP-1415.pdf

Warschauer, Mark & Matuchniak, T. (2010, March). New technology and digital worlds: Analyzing evidence of equity in, access, use, and outcomes. *Review of Research in Education.* (34) 179-225. Retrieved from http://resolver.flvc.org/ucf?genre=article&atitle=New%20Technology%20and%20Digital%20Worlds:%20Analyzing%20Evidence%20of%20Equity%20in%20Access,%20Use,%20and%20Outcomes&title=Review%20of%20Research%20in%20Education&issn=0091732X&isbn=&volume=34&issue=1&date=20100101&aulast=Warschauer%2C%20Mark&spage=&pages=&rft.sid=EBSCO:edsgao:edsgcl.236187716

Webber, A., Troppe, P., Milanowski, A., Gutmann, B., Reisner, E., & Goertz, M. (2014). *State implementation of reforms promoted under the Recovery Act: A report from charting the progress of education reform: An evaluation of the Recovery Act's role.* The U.S. Department of Education. Retrieved from http://files.eric.ed.gov/fulltext/ED544746.pdf

Wilkens, J. (2017, January 18). *E-rate Modernization Progress Report.* FCC Memorandum. Retrieved from https://apps.fcc.gov/edocs_public/attachmatch/DOC-343099A1.pdf

The White House. Office of the Press Secretary. (2013, June 6). *Remarks by the President at Mooresville Middel School – Mooresville, NC. Retrieved from* https://obamawhitehouse.archives.gov/the-press-office/2013/06/06/remarks-president-mooresville-middle-school-mooresville-nc

The White House. (2014, June 14). *ConnectED: A year of action for American students and teachers.* Retrieved from https://obamawhitehouse.archives.gov/blog/2014/06/13/connected-year-action-american-students-and-teachers

The White House. (2014). *ConnectED: President Obama's Plan for Connecting All Schools to the Digital Age*. Retrieved from https://www.whitehouse.gov/sites/default/files/docs/connected_fact_sheet.pdf

The White House. (2015) *Connecting America-What high speed Internet means in the 21st century*. Retrieved from https://www.whitehouse.gov/connect-america

The White House. Office of the Press Secretary. (2015, July 15). *Fact Sheet: ConnectHome: coming together to ensure digital opportunity for all Americans.* Retrieved from https://www.whitehouse.gov/the-press-office/2015/07/15/fact-sheet-connecthome-coming-together-ensure-digital-opportunity-all

Wu, J., & Zhang, Y. (2010, March). Examining potentialities of handheld technology in students' academic attainments. *Educational Media International, (47)*1, 57-67. Retrieved from http://eds.a.ebscohost.com.ezproxy.net.ucf.edu/eds/pdfviewer/pdfviewer?vid=2&sid=8dc09317-6391-492a-b69a-e482abe17837@sessionmgr4007&hid=4110

Yasar, O., Maliekal, J., Little, L., & Veronesi, P. (2014). An interdisciplinary approach to professional development for math, science, and technology teachers. *Computers in Mathematics and Science Teaching, 33*(3), 349-374. Retrieved from http://resolver.flvc.org/ucf?genre=article&atitle=An%20Interdisciplinary%20Approach%20to%20Professional%20Development%20for%20Math,%20Science,%20and%20Technology%20Teachers&title=Journal%20of%20Computers%20in%20Mathematics%20and%20Science%20Teaching&issn=07319258&isbn=&volume=33&issue=3&date=20140701&aulast=Yasar%2C%20Osman&spage=349&pages=349-374&rft.sid=EBSCO:eric:EJ1036561