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Broadband Access for Students at East Tennessee State University

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Broadband Access for Students at East Tennessee State University

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ABSTRACT

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The purpose of this study was to determine the availability of Internet access for students attending East Tennessee State University during the fall semester 2013. It has been unknown to what degree broadband access is available in the East Tennessee State University service area that includes counties in East Tennessee, Southwest Virginia, and Western North Carolina.

The research was conducted during the fall semester 2013 including the months of August, September, and October of 2011. Data were gathered by surveying currently enrolled students of the university. Seven hundred eighty-four students responded to the survey. The survey instrument covered areas of demographics and Internet connection type from home. In addition, the instrument covered usage of 3G/4G Mobile Broadband Service, ETSU computer labs, and high-speed Internet service for coursework.

The results of the data analysis provided insight into the availability, frequency of use, and perceived importance of high-speed Internet access for students at ETSU. For example, over 95% of the respondents had either a high-speed Internet connection or 3G/4G Mobile Broadband Service at their place of residence. Fifteen percent were dissatisfied with their current high-speed Internet service. Approximately 70% reported that high-speed Internet service was very important in completing coursework. This study provided an increase in the body of knowledge related to Internet access for ETSU students and the counties surrounding the university.

DEDICATION

This study is dedicated to my parents Tom and Barbara Sawyer and my two children Jordan and Danielle who have supported throughout this endeavor.

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CHAPTER 1

INTRODUCTION

The overall vision of East Tennessee State University (ETSU) is to become the best regional university in the nation. In supporting that vision, ETSU strives "to provide outstanding programs of study, enhanced access to education, distinctive research opportunities, and a variety of distance education offerings to attract students from around the region and the world" ("ETSU Mission," n.d.). To improve the students' experience, ETSU has incorporated Desire2Learn (D2L) and Banner Self-Service web-based technologies that allow students to access personal data and course content 24 hours a day. ETSU Goldlink Self Service is a component of Banner and allows students to access class lists, course schedules, grades, and financial aid information. Through Goldlink Self Service students can also register for classes and pay fees online without having to stand in long lines.

The D2L online learning management system enables the various departments within ETSU to deliver a course completely online or to enhance aspects of a traditional face-to-face class. The D2L system streamlines the approach by allowing students to find all of their course content online. The online courses offered at ETSU can be delivered in either an asynchronous or synchronous format. In the asynchronous format, students are able to access and download the course syllabus, lecture notes, course readings, lecture videos, and supplemental multimedia content through the D2L portal. There are also D2L dropboxes that students use to upload course assignments. Synchronous online courses are also offered using Wimba Classroom and Adobe Connect. These synchronous courses allow students to join a virtual classroom and connect in real time with the instructor and students in other locations.

At the time of this study, due to the rich content of a lot of the ETSU course material and the bandwidth required to deliver real time streaming video, it is almost a necessity that students have access to broadband internet technology to leverage the faster download speeds. For students who live in on-campus housing, broadband internet is usually furnished and the cost of the service is bundled as part of the overall monthly rent payment. In addition, students living on campus are usually within walking distance of the ETSU computer labs. Many of the off-campus students live in rural or remote areas where there is limited access to broadband internet. Therefore, for many off campus students that need high-speed internet access are forced to drive to campus to use the ETSU computer labs.

Background of the Problem

According to the National Broadband Plan that is overseen by Congress, "the lack of adequate broadband infrastructure is most pressing in rural America, where the cost of serving large geographical areas, coupled with low population densities, often reduce economic incentives for telecommunications providers to invest in and maintain broadband infrastructure" (Gilroy & Kruger, 2012, p. 2).

In June 2011 the Federal Communications Commission (FCC) issued an update to the 2009 Rural Broadband Report. The report stated that Americans living in rural areas should have access to the same robust and affordable broadband services as those living in urban areas. This would allow individuals living in rural areas to take advantage of the many opportunities that are available via broadband access with respect to "consumer welfare, civic participation, public safety and homeland security, community development, healthcare delivery, energy independence and efficiency, education, worker training, private sector investment, entrepreneurial activity, job creation and economic growth, and other national purposes"

(“Bringing Broadband,” 2011, p. 3). In the 2 years since the original 2009 Rural Broadband Report was issued, there have been significant strides in the deployment of broadband infrastructure across the nation. These results were made possible through substantial investments from both the public and private sectors. The two government organizations that play a key role in this ongoing effort are the National Telecommunications and Information Administration (NTIA) and Rural Utilities Service (RUS). The two specific programs that expanded deployment and adoption in unserved and underserved areas were the RUS’s Broadband Initiatives Program (BIP) and NTIA’s Broadband Technology Opportunities Program (BTOP).

Although strides have been made, the need is still substantial with respect to broadband deployment and adoption gaps in rural America. As can been seen in Table 1, in June 2010 there were close to 3 out of 10 (or 28.2%) individuals living in rural American who “lacked access to fixed broadband at 3 Mbps/768 kbps or faster, a percentage that is more than nine times as large as the 3.0 percent that lacked access in non-rural areas” (“Bringing Broadband,” 2011, p. 8).

Table 1

Fixed Broadband Availability

Area	Population	Population Without Access to 3 Mbps/768 kbps or Faster Fixed Broadband Service	Percentage of Population Without Access to 3 Mbps/768 kbps or Faster Fixed Broadband Service
Rural Areas	67,224,943	18,974,285	28.2%
Non-Rural Areas	243,181,422	7,186,053	3.0%
All Areas	310,406,365	26,160,338	8.4%
Percentage in Rural Areas	21.7%	72.5%	

Note. SBDD Census Block Data as of June 2010. Guam and the Northern Mariana Islands are not included in the analysis. Reprinted from "Bringing Broadband to Rural America: Update to Report on a Rural Broadband Strategy" (p. 8). Copyright 2011 by the Federal Communications Commission.

This study is specific to East Tennessee State University. East Tennessee State University has campus locations in Johnson City (main campus), Kingsport, and Elizabethton and served 15,404 students during the spring 2013 semester. Of the total number of students who attended ETSU, 11,227 students (or, 72.9%) resided in counties located in the East Tennessee region. At the time of this study, it is not known if the students who attend ETSU have residential access to broadband services or choose not to subscribe due to financial reasons. There appears to be a correlation between family income and the adoption of broadband services. "On average, households in rural areas without access to a 3 Mbps/768 kbps fixed broadband service have an average median household income of $48,331 compared to $57,075 in rural areas with access to such service" (Genachowski, 2011, p.10). In 2011 no county within the East Tennessee region had a median income of more than $50,000 according to the U.S. Census Bureau. In 2013 the two counties in East Tennessee with the highest enrollment at East Tennessee State University were Washington County (3,211 students) and Sullivan County (2,054 students) and these counties had median incomes of $41,256 and $39,957 respectively (U.S. Census Bureau, 2011). If specific data were available on the exact number of people in the East Tennessee region who had access to residential broadband services, East Tennessee State University administrators could use this data as a guideline when assessing the need for expansion of online services.

Research Problem

The problem this study addressed was to determine the availability of broadband access for students attending during fall semester 2013 at East Tennessee State University. The findings from this research determined the percentage of the student body with high-speed access that can take full advantage of the online services offered and what areas are deficient in broadband services.

Research Questions

The following research questions related to residential broadband access for East Tennessee State University students for the fall semester 2013 controlled the direction of the study.

1) Is there a significant relationship between the type of Internet service students have at home and whether they have taken a web-based course?
2) Is there a significant relationship between the type of Internet connection students have at home and whether it has discouraged students from taking an online course or will it in the future?
3) Is there a significant relationship between the type of Internet service students have at home and how often students use or plan to use East Tennessee State University computer labs?

4) Is there a significant relationship between the type of Internet service students have at home and how often students use the Internet for coursework at home?

5) Is there a significant relationship between the type of Internet service students have at home and whether they have used East Tennessee State University computer labs because Internet access is faster on campus?

6) Is there a significant relationship between the type of Internet service students have at home and whether students have problems connecting to D2L?

7) Is there a significant relationship between age and how students connect to the Internet from home?

8) Is there a significant relationship between age and students not having a computer at home as a reason not to connect to the Internet from home?

9) Is there a relationship between age and students not needing Internet access at home as a reason not to connect to the Internet from home?

10) Is there a significant relationship between age and Internet service expense as a reason not to connect to the Internet from home?

11) Is there a significant relationship between age and Internet speed as a reason not to connect to the Internet from home?

12) Is there a significant relationship between age and poor Internet service as a reason not to connect to the Internet from home?

13) Is there a significant relationship between age and any other response as a reason not to connect to the Internet from home?

14) Is there a significant relationship between age and student perceptions of the importance of high-speed Internet access as it relates to their coursework?

15) Is there a significant relationship between age and student perceptions of the importance of high-speed Internet access as it relates to being successful in college?
16) Is there a significant relationship between student financial need (regarding Pell grant funding) and the type of Internet access at home?
17) Is there a significant relationship between age and how often students use or plan to use 3G/4G Mobile Broadband Service (via a Smartphone, Tablet, or Laptop Stick) for their coursework?
18) Is there a significant relationship between student financial need (regarding Pell grant funding) and how often students use or plan to use 3G/4G Mobile Broadband Service (via a Smartphone, Tablet, or Laptop Stick) for their coursework?

Significance of the Study

By deepening the understanding of the how students connect to the Internet, East Tennessee State University administrators can make more informed planning decisions when developing and delivering web-based classes and content. A search of the available databases produced no specific study that exists with quantitative research addressing broadband availability for students currently enrolled at East Tennessee State University. In addition, the database search produced no completed studies related to broadband access by address for the East Tennessee State University service area that includes counties in East Tennessee, Southwest Virginia, and Western North Carolina.

Both state and national coverage maps are available on the Connected Tennessee website that display broadband availability by census block. For example, if broadband service “is available to at least one household in a census block, that census block is reported to have some level of broadband availability. As such, broadband availability at an exact address location cannot be guaranteed" ("Connected Tennessee," 2013, para. 3). These maps may not include enough detailed information for administrators to make decisions related to broadband access. The broadband usability data that will be provided from the survey instrument administered to East Tennessee State University students attending the fall semester 2013 will greatly enhance the detail available for broadband access.

Since 2009 NTIA's State Broadband Initiative (SBI) has been working with state entities or nonprofit organizations to implement the joint purposes of the American Recovery and Reinvestment Act (ARRA) and the Broadband Data Improvement Act to help move forward the integration of broadband and information into state and local economies. At the time of this study NTIA has awarded a grant to each of the 50 states, 5 territories, and the District of Columbia. A total of $293 million has been awarded to the 56 grantees that use this funding to support the implementation and creative use of broadband technology to better compete in the digital economy ("BROADBANDUSA Connecting," n.d.).

> These state-created efforts vary depending on local needs but include programs to assist small businesses and community institutions in using technology more effectively, research to investigate barriers to broadband adoption, innovative applications that increase access to government services and information, and state and local task forces to expand broadband access and adoption "(para. 7).

Using the data collected and analyzed from this research study, East Tennessee State University administrators can potentially work with local community leaders to address broadband shortages and lack of adoption in the East Tennessee State University service area. In addition, East Tennessee State University can partner with local governments to submit applications for grants to address the lack of access where current students reside.

The data from this research study may also be used to analyze the usage of the East Tennessee State University computer labs by on campus and off campus students. This information can be used in planning for future expansion of existing computer labs or the establishment of new labs in strategic locations. If the results of the study indicate that lack of adoption is due to some students not having a computer in the home, East Tennessee State University administrators could increase the number of laptops available for checkout as a solution to the issue. Also the findings of this study can help East Tennessee State University administrators in planning for expansion of classrooms in counties with current satellite campuses or possibly looking at expansion into counties without a physical presence.

Definition of Terms

The following terms are included in this study:

Bandwidth: In computer networks the capacity for data transfer of an electronic communication system (Bandwidth, n.d.). This is usually measured by the amount of data that can be transferred from one point to another in a given timeframe. The bandwidth is usually measured in bits of data that can be transferred per second (bps).

Bit: In computer systems “the smallest part of a digital signal, typically called a data bit” (Louis, 2001, p.267).

Blended Learning: “[A] pedagogical approach that combines the effectiveness and socialization opportunities of the classroom with the technologically enhanced active learning possibilities of the online environment” (Dziuban, Hartman, & Moskal, 2004, p. 3). Blended

Learning uses instruction types including web-enhanced and hybrid instruction. Any instruction that includes web-based and classroom instruction includes a blended learning approach.

Broadband: Advanced communications systems capable of providing high-speed transmission of services such as data, voice, and video over the Internet and other networks (Federal Communications Commission, 2008b).

Desire2Learn (D2L): A web-based suite of easy-to-use teaching and learning tools for course development, delivery, and management used by all the Tennessee Board of Regents colleges and universities ("Desire2Learn," n.d.).

Digital Divide: The "perceived gap between those who have access to the latest information technologies and those who do not" (Compaine, 2001, p. ix). Generally, the digital divide exists between people living in cities and people living in rural areas and those who are educated and those who are uneducated. There are other socioeconomic variables such as income and age that are factors related to the digital divide.

Downstream: Data transfer from the Internet to the computer (FCC, 2008a).

Federal Communications Commission (FCC): Independent United States government agency established by the Communications Act of 1934 and charged with regulating interstate and international communications by radio, television, wire, satellite, and cable. The FCC's jurisdiction covers the 50 states, the District of Columbia, and United States possessions (Federal Communications Commission, 2009).

Internet: A global computer network providing electronic information and communication transferred among users (Malhan & Rao, 2006).

Internet Service Provider (ISP): "Vendor that provides access to the Internet and the World Wide Web" (Louis, 2001, p. 287).

Kbps: Kilobits per second. A kilobit is 1,000 bits per second (Philip, 2010).

Laptop Stick: A small mobile Internet modem "that plugs into any laptop with a USB port and allows the computer to connect to the Internet using a cellular carrier's data network" (T-Mobile Devices, 2012).

Mbps: Megabits per second. A megabit is 1,000,000 bits per second (Philip, 2010).

MB: Megabytes per second. A megabyte is 8,000,000 bits per second (Philip, 2010).

*Mobile Broadband: "*Data transmission delivered by the cellular carriers to cell phones and laptops. Speeds are typically less than fixed broadband services, such as cable, DSL, satellite and FiOS. However, 4G cellular service increasingly competes with DSL and low-speed cable and satellite offerings" ("Mobile Broadband," n.d., para. 1).

Organization for Economic Cooperation and Development (OECD): Organization that incorporates the governments of countries committed to democracy and the market economy from around the world (OECD, 2009).

Upstream: Data transfer from the computer to the Internet (FCC, 2008a).

Wi-Fi: "[A] certification mark developed by the Wi-Fi Alliance to indicate that wireless local area network (WLAN) products are based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards" (WiFi Alliance, 2012, para. 6).

Delimitations

The delimitations that existed for this study are listed below. The results may or may not have been impacted by the following:

1. ETSU was the sole university for this study.

2. The survey was electronically created and distributed through the ETSU Goldlink system; therefore, only students who accessed their Goldlink email accounts would have received the survey.
3. Only students who attended ETSU during the fall 2013 semester were surveyed.

Limitations

The limitations that existed for this study are listed below. The results may or may not have been impacted by the following:

1. The sample reflected in this study were those students who self-selected, thereby limiting the results to that given group.
2. Out of the 15,404 students who enrolled in the fall semester 2013, only 784 self-selected to participate.
3. Of those who self-selected to participate, students who did not respond to a specific question were not part of the data analysis for that question.
4. When original response categories had numbers smaller than allowed by statistical analysis, categories were collapsed to form larger categories.

Assumptions

The following assumptions were made for this study:

1. Participants were knowledgeable about the Internet.
2. Participants were knowledgeable about the Pell grant award.
3. Participants were knowledgeable about various degrees of Internet speed.

Overview of the Study

This study has been organized into five distinct chapters. Chapter 1 includes the introduction, statement of the problem, research questions, definitions of terms, and the significance of the study including limitations. Chapter 2 contains a review of the related literature. Chapter 3 explains the research methods of the study including the population, design, data collection, methodology, and data analysis. Chapter 4 presents the findings and the data analyses of the study, and Chapter 5 consists of the summary, findings, conclusions, and recommendations for future research and practice.

CHAPTER 2

REVIEW OF LITERATURE

The purpose of this study was to address the availability of broadband Internet access for students attending the Fall 2013 semester at East Tennessee State University. The findings from this study determined the percentage of students with high-speed Internet access in the home and explored the relationships between residential broadband access and the students' usability practices. The study also explored critical background information related to residential broadband adoption.

Broadband or high-speed Internet access allows users to access services such as data, voice, and video at appreciably higher speeds than services delivered over "dial-up" connections (Federal Communications Commission, 2008a). Biggs and Kelly (2006) developed a list of characteristics that differentiates broadband from other delivery methods:

- Broadband connections suggest that the user is always online; the user does not have to dial-up to an Internet service provider;
- Cost of connection is affordable;
- Pricing is based on a flat-rate;
- Broadband is free of restrictions with respect to the number of downloads permissible within a month;
- Broadband usage is independent of distance pricing. Price is constant within the country irrespective of the location or with whom the subscriber interacts, nationally or internationally. (p. 5)

In May 2010 the Pew Research Center's Internet & American Life Project conducted a survey that revealed 66% of American adults have a home broadband connection. The survey indicated that 5% of the adult population still accesses the Internet via a dial-up connection and 26% had no online connection in the home. The remaining 3% of the adult population were able to go online but were unsure of the type of connection they had in the home. Because many Americans are still not part of the broadband story, the Obama Administration expanded government efforts to promote broadband adoption and set aside $787 billion in federal stimulus money to support the endeavor. The stimulus money was earmarked for grants and mapping efforts designed to target underserved segments of the country (Smith, 2010).

In June 2008 the FCC (2008c) collected subscriber information from broadband service providers that revealed there is at least one high-speed connection in every Zip Code in the United States. According to Bosworth (2006) the reporting of broadband access by Zip Code makes it difficult to assess service gaps in rural or under populated areas. Therefore, the FCC is often criticized for the Zip Code reporting method with respect to pricing and access to broadband services (Bosworth, 2008). In 2009 the National Telecommunications and Information Administration (NTIA) collaborated with the FCC to develop a National Broadband Map that displays broadband availability by census block. The State Broadband Data Development (SBDD) data underlying the National Broadband Map along with subscription data offers the best available information on rural broadband deployment in the United States. The National Broadband Map is limited on granularity related to broadband deployment. If broadband service "is available to at least one household in a census block, that census block is reported to have some level of broadband availability. As such, broadband availability at an exact address location cannot be guaranteed" ("Connected Tennessee," 2013, para. 3).

Per a mandate from Congress in 2010, the FCC produced a 360-page broadband plan that included recommendations as to how government agencies could expand and encourage broadband access. The recommendations also proposed changes "that could allow the Internet to be used to improve Americans' lives in such areas as delivering economic growth, improving healthcare, facilitating advancements in government services, and improving the environment" (Smith, 2010, p. 5).

Broadband Speed Defined

The definition of what constitutes broadband speed is constantly changing with technology advancements. According to the FCC the number of people in the United States that are unserved or underserved by broadband access increases as the definition of minimum broadband speed increases (Wigfield, 2009). As a part of the American Recovery and Reinvestment Act of 2009, the Broadband Technology Opportunities Program (BTOP) provides stimulus money by way of competitive grants for the purpose of providing access to broadband service to consumers who reside in unserved areas of the United States. In addition, stimulus money is also available to provide improved access to broadband services for consumers residing in underserved areas (U.S. Congress, 2009). Because broadband is an evolving service and speeds are rapidly increasing, the members of the Western Telecommunications Alliance (WTA) indicated that a more practical approach needs to be taken when defining broadband for stimulus purposes. Given that there are substantial expenses involved with broadband deployment, the WTA members indicated that broadband should be defined at reasonable and realistic level such as a 768 kb/s transmission speed. Verizon Communications proposed the following definition for policy makers: a broadband service is one that uses a packet-switched or successor technology that is capable of transmitting information at a speed of not less than 384 Kbps in at least one direction or 56 Kbps in both directions (Glover, Evans, Shakin, & Leo, 2001).

The definition of broadband centers around the minimum data transfer speed, but there is not a consensus in the telecommunications community with respect to defining that minimum speed. There have been various definitions of minimum data transfer rates ranging from 64 Kbps up to 4.0 Mbps. In 2006 the Organization for Economic Cooperation and Development (OECD) report defined broadband as providing downstream data transfer rates equal to or faster than 256 Kbps. This definition was based around the Digital Subscriber Line (DSL) downstream speeds that were being offered in most developed countries. The International Telecommunication Union (ITU) defined broadband as proving data transfer speeds equal to or faster than 256 Kbps in either the upstream or downstream direction (Biggs & Kelly, 2006). According to the International Telecommunication Union (2003) the term broadband is continuously evolving and is not tied to a specific speed or certain service. The ITU Standardization Sector did define broadband service as having data rate speeds between 1.5 and 2.0 Mbps. According to Kaplan (2007) the local Internet Service Provider (ISP) controls the speed of the broadband connection. The ISP governs the local signal strength and has agreements with central Internet backbone operators with respect to the data traffic through their routers. A broadband connection may be advertised as a 1.5 Mbps, but a serial router may only yield real world speeds of slightly higher than 200 Kbps.

Per Gubbins (2009) it is difficult to get the major players involved to agree on the minimum data rate speeds for broadband. AT&T suggested sticking with the FCC definition for broadband speeds that are equal to or faster than 768 Kbps for downstream and 200 Kbps or faster upstream. The Communications Workers of America joined the California Public Utilities Commission in a combined effort to push the FCC to up the minimum data rate speeds to 3 Mbps downstream and 1 Mbps upstream. The Wireless Communication Association advocates similar data rate speeds to define underserved areas as areas with less than 3 Mbps downstream and 768 kbps upstream.

The FCC defines advanced telecommunications capability as “high-speed, switched, broadband telecommunications capability that enables users to originate and receive high-quality voice, data, graphics, and video telecommunications using any technology” (Xavier, 2003, p. 8). The FCC has acknowledged that broadband speeds are highly variable which makes it difficult define exact speeds for broadband service. The internet service provider Clearwire proposes that there should be different broadband speed standards for mobile and fixed wireless technologies. “At a minimum, an average actual speed of 3 Mbps download and 768 Kbps upload per end user during peak hours should be required for applicants proposing mobile wireless broadband infrastructure” (Gubbins, 2009, p. 2). While many broadband service providers like Clearwire suggest “average” or “sustainable” speeds, T-Mobile indicated that broadband should be defined by its maximum speeds. The Rural Independent Competitive Alliance proposed that broadband should be defined as “Internet access at a consistent speed no less than that available through DSL technology” (p. 2). HierComm Wireless, a wireless Internet service provider in rural Wisconsin, suggested that the definition of broadband minimum speeds should evolve every few years: from 3 Mbps in 2009 to 15 Mbps in 2010 and reaching 100 Mbps by 2019 (Gubbins, 2009).

Broadband Speeds in U.S.

At the end of 2007 the United States ranked 15th out of 30 countries for broadband penetration (Jones, 2008). From an education standpoint access to high-speed broadband is essential to prepare students for work and life in the 21st century. The FCC’s definition of broadband (200 Kbps in any one direction to a range of 768 Kbps to 1.5 Mbps) is still too slow to “facilitate a robust, interactive learning environment necessary to improve student achievement and create tomorrow’s innovators” (Jones, 2008, p. 4). In 2010 the FCC conducted a survey of E-Rate funded schools in which 80% of the respondents indicated their broadband connections were insufficient in meeting the demands of the interactive learning environment (Fox et al., 2012). The State Educational Technology Directors Association (SETDA) developed a list of benchmarks and goals to help states and school districts implement adequate high-speed broadband access in education. In order to meet the demands of a technology rich learning environment, STEDA recommends that by 2015 educational institutions should have “an external Internet connection to the Internet Service Provider of at least 100 Mbps per 1,000 students/staff” (Jones, 2008, p. 10). “At a time when our country is developing a National Broadband Plan, it absolutely makes sense to have a single definition of the term broadband for regulatory and policy purposes” (Rodriguez, 2009, para. 1). This broadband definition is important for NTIA and RUS funding purposes as way to simply describe the service that is being made available to the customer. The definition should not impose obligations or serve as a constraint on the broadband services offered to customers (Rodriguez, 2009, para. 3).

As of October 2012 the average downstream broadband connection speed in the United States was 6.6 Mbps. This number was up 16% from the previous year and the increase was mainly a result of cable’s investment in DOCSIS 3.0 technology (Bode, 2012). The average broadband download connection speed worldwide is 3.0 Mbps. Although the United States is well above the worldwide average, it trails a number of developed countries in terms of broadband connection speeds (Callaham, 2012). A total of 196.7 million Americans have a broadband Internet connection and the United States is ranked ninth globally in average downstream speed for broadband connections (Molla, 2012). South Korea holds the top spot globally with an average broadband download connection speed of 15.7 Mbps, followed by Japan (10.7 Mbps) and Hong Kong (9.3 Mbps). The latest push in the United States is mainly due to the Internet "speed wars" that are taking everything to a new level as "Verizon FiOS announced a bump to an upper speed limit of 300 Mbps and Comcast is offering a 305 Mbps option in some areas" (Callaham, 2012, para. 4). Google Fiber is working a project in Kansas City that may take broadband connection speeds to 1 Gbps in both directions.

Broadband Speeds in Tennessee

The state of Tennessee has a total population of 6,480,960 with 4,316,526 residents living in urban areas and 2,164,434 living in rural areas. In June 2012 the State Broadband Development and Data Program (SBDD) conducted broadband tests on 10,843 households in the state of Tennessee. The tests revealed that households across the state had a median broadband speed of 7.1 Mbps (National Broadband Map, n.d.).

When both wireline and wireless broadband services are taken into consideration, a study by the SBDD found that 97.2% of Tennessee's population had access to download speeds greater than 3 Mbps and upload speeds greater than 768 Kbps (National Broadband Map, n.d.). This degree of access is not uniform across the state of Tennessee because the study found that only 89.9% of the residents living in rural areas had access to either wireline or wireless broadband access at these speeds. This number is low when compared to the 100% of the urban population that had access to the same wireline or wireless broadband services ("Broadband Statistics," 2013).

The SBDD study found that 58.4% of Tennessee's urban population had wireline access to download speeds greater than 3 Mbps and upload speeds greater than 768 Kbps. In contrast, the study found that only 12.4% of residents living in rural areas of the state had wireline access at these speeds (“Broadband Statistics,” 2013). Bringing broadband Internet services to these rural communities will not only improve the quality of life but will also make the homes in the area more desirable and may increase their value (Peha, 2007).

The SBDD study revealed that 97.3% of Tennessee’s urban population had wireless access to download speeds greater than 3 Mbps and upload speeds greater than 768 Kbps. This is a high access rate when compared to the 71.8% of residents living in rural areas of the state had wireless access at these speeds (“Broadband Statistics,” 2013).

Types of Broadband Connections

Broadband systems allow voice, data, and video to be broadcast simultaneously over the same medium (Broadband Technology, n.d.). Per the Federal Communications Commission (2008a) report, broadband services can be delivered over various transmission platforms that include:

- Digital Subscriber Line (DSL)
- Cable Modem
- Fiber
- Wireless
- Satellite
- Broadband over Powerlines (BPL) (para. 9)

The type of residential broadband connection a subscriber chooses will depend on several factors. Whether a subscriber lives in an urban or rural community may dictate the number of broadband choices available in that service area. The use cases for the consumer may be a determining factor in the minimum speed required for the broadband connection (“Federal

Communications”, 2008a). In Table 2 below, the broadband connection speeds are listed for the various platforms.

Table 2

Broadband Technology Platforms and Connection Speeds

Carrier Technology	Speed
ADSL/DSL	128 Kbps to 8 Mbps
Cable	512 Kbps to 20 Mbps
Fiber	5 Mbps – 150 Mbps
Wireless (LMCS)	30 Mbps or more
4G / LTE	100 Mbps
Satellite	6 Mbps or more
Broadband over Powerline (BPL)	500 Kbps – 3 Mbps

Digital Subscriber Line (DSL)

Digital Subscriber Line (DSL) service transmits data over existing copper telephone lines. The DSL transmission speeds range from 128 Kbps to 8 Mbps. The proximity of the home or business to closest telephone company facility may be a determining factor in the availability and speed of the DSL service. The two types of DSL transmission technologies are Asymmetrical Digital Subscriber Line (ADSL) and Symmetrical Digital Subscriber Line (SDSL). ADSL is the more popular choice among residential subscriber because it allows the user to surf the Internet without disrupting telephone service. In most cases ADSL download speeds will be faster than upload speeds. SDSL is mainly used by businesses that need considerable bandwidth in both directions for applications such as web hosting and videoconferencing ("Types of Broadband," n.d.).

Cable Modem

Cable operators are able to offer cable modem broadband service over the same coaxial that delivers the television signal to your home. Most cable modems have broadband connection speeds of 1.5 Mbps or more. The cable modem broadband service is "always on" and allows the subscriber to access the Internet without having to dial-up an ISP ("Types of Broadband," n.d.).

Fiber Broadband

Fiber broadband technology converts electrical signals carrying data to light pulses that transmitted over small glass fibers. The fiber broadband data rates by far exceed that of DSL or cable modems with speeds ranging from 5 Mbps to 150 Mbps. The ISPs currently "offer fiber broadband in limited areas and have announced plans to expand their fiber networks and offer bundled voice, internet access, and video services" ("Types of Broadband," n.d.).

Wireless Broadband

Wireless broadband uses over the air radio signals to connect the subscriber to the ISP. The wireless broadband service can be either fixed or mobile. Wireless technologies are often used for remote areas where it would not be cost effective to provide DSL or cable modem service. The fixed wireless networks deliver speeds similar to DSL and cable modem services and allow subscribers to access the Internet from a stationary fixed point. Mobile wireless broadband services allow the subscriber to access the Internet over the cellular network using a 3G or 4G mobile device ("Types of Broadband," n.d.).

Satellite

Although satellites have played a strategic role in providing broadband Internet services for unserved areas, the technology has not been as important as telephone and cable lines in delivering high-speed communications services (Holstein, 2007). Satellite service uses the same orbiting satellites that transmit telephone and television service to provide broadband links to subscribers. Satellite broadband can deliver speeds of 6 Mbps or more, but latency issues inherent to the technology make it difficult to use applications such as video streaming and gaming ("Types of Broadband," n.d.).

Broadband over Powerline (BPL)

Broadband over Powerline (BPL) service delivers "broadband over the existing low- and medium-voltage electric power distribution network with speeds comparable to DSL and cable modem speeds" ("Types of Broadband", n.d., para. 19). The BPL service allows the subscriber to connect to the Internet using existing electrical outlets in the home. Although BPL service is only available in limited areas, it has considerable upside potential because the electrical infrastructure is in place with power lines connected to homes and facilities throughout the United States ("Types of Broadband," n.d.).

Types of Broadband in Tennessee

In June 2012 the State Broadband Development and Data Program (SBDD) conducted a broadband study in the state of Tennessee to determine residential broadband access by technology. The study revealed that 88.3% of the state's population had access to DSL and 85.2% had access to cable modem broadband technology. The study also found that that 13.5% of the state's population had access to fiber and 98.6% had access to wireless broadband services (National Broadband Map, n.d.).

Broadband Performance and Reliability

In 2011 the FCC established the Measuring Broadband America program "to conduct an ongoing, rigorous, nationwide study of residential broadband service in the United States" ("Measuring Broadband," 2013, para. 1). These ongoing studies measure the broadband performance delivered by the major Internet Service Providers (ISPs) that provide service for over 80% of the residential broadband market. The studies involve conducting broadband performance tests for thousands of subscribers to determine how well the ISPs are performing to their advertised speeds. The studies were conducted during peak periods when bandwidth is in the highest demand. The peak usage hours are on Monday - Friday nights from 7:00pm – 11:00pm local time. The 2013 Measuring Broadband America February Report, which was based on residential broadband test data collected in September 2012, revealed that the average ISP during the most demanding peak usage periods delivered 97 % of the advertised download speeds. The report also found that five ISPs actually delivered near or over 100% of the advertised download speeds during the demanding peak periods. These results were statistically equivalent to the previous study in April 2012 that found the average ISP delivered 96 % of average download speeds under the same test conditions. The test results related to "sustained download speeds as a percentage of advertised speeds" in the latest report did vary among the different delivery methods. On average, "during peak periods DSL-based services delivered download speeds that were 85 percent of advertised speeds, cable based services delivered 99 percent of advertised speeds, fiber-to-the-home delivered 115 percent of advertised speeds, and satellite delivered 137% of advertised speeds" (para. 14).

The 2013 Measuring Broadband America February Report highlighted a trend of consumers continuing to migrate to higher broadband speed services. Although ISPs offer higher speeds to their customers, the data collected in September 2012 for the first time included download speed tiers up to 75 Mbps. The service providers moving forward will continue to upgrade their networks and increase the speed tiers offered to consumers. As these higher speed options are adopted by subscribers, the test plan will be updated to include faster speed tiers above 75 Mbps.

Importance of Broadband Technology for Education

According to the Pew Research Center's Internet and American Life Project survey results (Smith, 2010), 31% of Americans believe that the lack of high-speed broadband access "is a major disadvantage when it comes to learning new things that might enrich or improve their lives" (p. 3). The results also indicated that 31% believe that lack of broadband internet access is a "minor disadvantage", 32% feel that it is "not a disadvantage", and 6% did not know.

E-Rate Program

There is often a shortage of math and science teachers in rural areas of the United States. Bringing broadband to these rural areas would enable schools to deliver advanced math and science courses to students in these remote regions (Holt & Galligan, 2008). In areas where residential broadband is not available, students are likely to rely on anchor institutions such as schools and libraries to gain access to broadband services. The FCC acknowledged the vital role that anchor institutions play in meeting the broadband needs of unserved and underserved areas. Per the universal service provisions contained in the 1996 act, universal service discounts for advanced telecommunications services were designated for elementary schools, secondary schools, and libraries. The FCC established the "E (education)-Rate" program to administer and comply with these provisions and to extend these discounts at rates that are less than what other parties would pay for similar broadband services (Gilroy & Kruger, 2012). The E-Rate program provides funding associated with four categories of services:

- Telecommunications and dedicated services;
- Internal connections (e.g. wiring, routers, and servers);
- Internet access;
- Basic maintenance of internal connections. (p. 16)

The E-Rate program became effective in 1998 and qualifying schools receive discounts ranging from 20% to 90% for eligible services. The discount rate is based on the poverty level of the school district's population and whether the qualifying anchor institution is located in a high-cost telecommunications area (urban-rural status). Over the years, the FCC has upgraded the E-Rate program to allow the community to use these funded broadband services outside of normal school hours (Gilroy & Kruger, 2012).

Effective Engaging E-Learning Environment for Tennessee (e4TN's)

As part of the American Recovery and Reinvestment Act of 2009, the state of Tennessee was awarded a grant to "expand opportunities for students to enroll and succeed in online courses through the Effective Engaging E-Learning Environment for Tennessee (e4TN's) online learning program" ("ARRA Case Studies," 2011, p. 1). Individual school districts had the flexibility to tailor the program to best fit the needs of their students. The program allowed students to take online courses and gain access to rich content that had not been available in the past. As part of the program school districts like Sumner County Schools used available funds to upgrade networking hardware resources and services. To qualify for the grant money, Sumner County Schools conducted a traffic analysis to show that their schools had maxed out the available bandwidth throughout the day on the existing T1 lines. The existing broadband connection did not allow teachers to efficiently access resources in the classroom. Sumner County used the funds to install fiber connections in all schools and upgraded the bandwidth for its high schools to 100 Mbps. Fletcher (2009), Editorial Director of Technology Horizons in Education, declared that “with the growth of technology use in education, and the increasing demand for digital content in general and bandwidth-eating applications like movie clips and other rich media, schools will need even more bandwidth and they need it now” (para. 5).

Broadband Technology Use in Higher Education

Students in higher education institutions rely on high-speed broadband to improve their productivity and succeed in the physical or virtual classroom. Access to broadband enables students to collaborate and communicate in a technology rich learning environment. The fast download speeds associate with high-speed Internet connections allows students to incorporate audio and video into their multimedia projects and presentations. Students now have access to low-cost notebook computers, tablets, eReaders, and smartphones that extend the teaching and learning process well beyond the traditional class schedules and brick and mortar classrooms (Fox, Waters, Fletcher, & Levin, 2012). A January 2013 Pew Research Center report (Brenner, 2012) revealed that 31% of American adults own a tablet computer. The report also indicated that 26% of American adults on an eReader. Learning management systems (LMS) in most higher education institutions enable students to access their assignments online and communicate with their instructors and other students via wikis and other internet-based applications. In addition, many courses are offered online and often leverage videoconferencing systems to deliver class lecture video in both synchronous and asynchronous formats. With respect to the quality of the learning experience, students and teachers having external access to broadband is now arguably as important as access at school. (Fox et al., 2012). A 2011 Wakefield survey of 500 enrolled college students indicated that 98% of the students owned a digital device. Of the students surveyed, 27% listed their laptop as the most important educational tool in their backpack, which was considerably more that number of students that chose textbooks (10%). The study also revealed that 38% of the students surveyed could not go more than 10 minutes without checking their digital devices such as smartphones and laptops ("Digital Dependence," 2011).

The makeup of the student population has changed and now includes individuals from all age groups. There are now more working adults who often enroll as part-time students and need flexibility to maintain balance in their lives (Yi, 2005). At most institutions of higher learning students are able to access online courses and content on campus or from a broadband Internet connection in their home. This residential broadband access allows students to easily access assignments and collaborate with other students and teachers (Peacock & Middleton, 1999). Many courses are offered in a blended learning environment that includes both face-to-face lectures and online assignments (Alonso, Lopez, Manrique, & Viñes, 2005). The blending learning environment benefits students, because they are able to attend live lectures and leverage innovative technologies to maximize the learning experience (Heilesen & Nielsen, n.d). Instructors who develop and deliver blended learning courses can incorporate a mix of web-based technologies such as virtual classroom and streaming video to create a collaborative learning environment (Driscoll, n.d.). Many higher education institutions have taken and analytical approach to identify critical success factors for online learning initiatives (Hartman, Dziuban, & Moskal, 2007). Educational institutions that offer blended learning courses with these web-based technologies reported that there was better teacher-student interaction, increased learner efficiency, and higher grades when compared to traditional courses (Snyder & Edwards, 2003). In contrast, there are some researchers who are concerned about the unwanted consequences of the online environment related to psychological distance and ethics (Sharma & Maleyeff, 2003).

Broadband availability and bandwidth are key gating factors in determining which content and applications will be used by educators in the online learning environment (Fox et al., 2012). The Wall Street Journal ("Digital Divide," 2013) reported that high-speed Internet connections are now a must have for using online programs in and out of schools. The U.S. government for 2 decades has been attempting to improve the broadband availability picture for students, but legislation like E-Rate and other measures to force telecommunications companies to provide affordable services have not kept pace with the ever changing learning environment. A 2010 FCC survey of E-Rate funded schools (Fox et al., 2012) found that residential broadband adoption rates have not increased since 2009 and have leveled off at approximately 65%. For students who do not have a broadband connection in the home, there are often WiFi hotspots available in their local communities that offer free access. Students who cannot afford broadband services or live in rural areas where broadband remains inaccessible, often drive to the nearest McDonald's or Starbucks to take advantage of the free WiFi service. These establishments that offer free WiFi have become the de facto library for many students. It offers a win-win scenario for both parties because students often buy french fries, sodas, and coffee while accessing the free WiFi service.

Smartphone Use in Higher Education

Smartphones are having an impact on higher education as students use these devices to access the Internet and applications to improve productivity (Meloni, 2009). As the capabilities of smartphones continue to increase, these mobile devices are replacing PCs and becoming the technology of choice for many college students (Yu, 2012). A December 2012 Pew Internet Research Project report (Brenner, 2012) indicated that 87% of American adults have a cell phone and that 45% of those mobile users own a smartphone. The report also revealed that the majority of smartphone users have either an Android or Apple model. Smartphones are currently being used in three major ways by college students. First, students use the smartphone mobile web browser to access course related material on the Internet. Second, mobile applications are downloaded to the smartphone and used to more efficiently access specific types of information on the Internet. Third, students can scan a two-dimensional bar code label on an object to gain specific information about that object (Williams & Pence 2011).

Defining Smartphones

As mobile phone technology continues to evolve, the line between defining "smart" and "dumb" phones continues to blur. For example, many "dumb" phones have now incorporated "smart" features such as touch screens and operating systems. Litchfield (2010) examined the top five most accepted definitions that were being used by analyst, journalists, developers, manufactures, and end users around the globe and concluded there was no universally accepted definition. After a thorough review of these definitions, Litchfield (2010) proposed that the smartphone be defined as a mobile phone that "runs an open (to new apps) operating system and is permanently connected to the Internet" (para. 20).

Mobile Applications vs. Mobile Websites

As the popularity of smartphones continues to grow, "their influence is extending onto college campuses, where they are used for a variety of purposes" (Groux, 2011). A 2011 infographic research study (Alexander, 2011) revealed that 57% of college students own a smart phone. Of the college students surveyed, 40% used their smartphone when preparing for a test. The study also indicated that the students were so attached to their smartphones that 75% of them were literally sleeping next to their phone. A Pew Research Center report (Brenner, 2012) indicated that users are spending more time using mobile applications than the Internet. A June 2011 report from Flurry, a mobile data company, “showed that Americans on average spend 81 minutes a day in mobile applications, compared with Comscore data that shows Americans spend 74 minutes on the internet – on both computers and other mobile devices” (“The Mobile Campus,” 2011, para. 3).

Although mobile applications and mobile websites are both accessed on mobile devices such as smartphones and tablets, there are key differences between the two approaches. Mobile devices usually access the Internet via a WiFi, 3G, or 4G connection. A mobile website has browser-based HTML pages that are accessed over the Internet like any other website. The main difference is that mobile websites are designed to be rendered on smaller handheld displays and touch-screen interfaces. In addition to displaying normal website content, mobile websites allow the user to “access mobile-specific features such as click-to-call (to dial a phone number) or location-based mapping” (Summerfield, 2011, para. 4). Mobile applications are device-specific applications that are purchased and downloaded from online stores such as Android Market and Apple’s App Store. The mobile application can either pull content from the Internet like a standard website or be used in a standalone mode with no Internet connection. The mobile app content and data are rendered in the application’s user interface, rather than within a browser. The advantage of having a mobile website is that the URL can be accessed by any mobile user with a browser and Internet access. This allows the company or institution to reach the widest audience. Mobile applications can be personalized and are often more efficient in accessing and presenting database information to the user. In addition, mobile applications allow the user to access important information without an Internet connection (Summerfield, 2011).

Many software companies develop smartphone apps for college students to facilitate the leaning process. According to a Bloomberg BusinessWeek report (Groux, 2011), one of the more useful apps is MyPocketProf that enables college students to sync their class notes to their smartphones. This allows students to review class notes on the go. Per the report, another popular smartphone app is Wi-Fi Finder, which is a tool that allows college students to find WiFi hotspots. Students can then share the location of WiFi hotspots with other members of their study group. This application is particularly useful when setting up study group meeting off campus. As the popularity of smartphones continues to grow, some higher education institutions are starting to develop their own mobile applications for their students.

East Tennessee State University (ETSU) launched a new mobile application for the campus community in Spring 2013. ETSU has incorporated the online learning environment Desire2Learn (D2L) that allows students to gain access to course content 24 hours a day. ETSU students can access the course syllabus, lecture notes, course readings, lecture videos, and supplemental multimedia content through the D2L portal. The ETSU mobile app allows students with an Android or iPhone mobile device to access D2L and interact with classmates in a mobile friendly format. In addition, students can gain access to the library’s mobile pages to search catalogs and databases through the mobile application. Another feature of the mobile application is the ETSU Live! module that allows the user to live stream ETSU’s radio station. The Videos module enables the mobile user to quickly access ETSU’s YouTube channel. The ETSU mobile application modules are designed to deliver content, features, and services for users who are on the go (“ETSU has,” n.d.).

Smartphone Use in the Classroom

Smartphones are also being used and are a powerful tool in the chemistry classroom. In the new world of "mobile chemistry" students can download low-cost or free applications to assist in the learning process (Williams & Pence, 2011). These smartphone applications allow chemists "to practice their skills, to access tables of chemistry-related data, to sketch small molecules, and to rotate large biomolecules" (para. 3). This information can be accessed using the smartphone web browser, but these lightweight applications are more efficient in accessing the tables and data. The ChemMobi smartphone app enables students to search over 30 million chemicals that are commercially available from over 860 suppliers. The ChemMobi user-friendly interface makes it easy to search by chemical names or identifiers and retrieve information related to chemical structures or calculated properties. To optimize the experience for mobile users, ChemSpider has recently added a mobile web browser that allows students to access information for almost 25 million chemical compounds. Students also have access to publisher sites where they can view the latest science articles and publications. Students can view the article abstract or download the full text version to their smart phone to read later. The American Chemical Society iPhone app allows the student to search over 850,000 scientific research articles and publications. The application's interface enables the user to efficiently search by author, title, keyword, digital object identifier, abstract, or bibliographic citation. In addition to the ability to search for articles and publications, students are also able to view podcasts from scientific organizations such as the Royal Society of Chemistry and the Nature Publishing Group.

The ability of smartphones to scan two-dimensional bar codes is becoming a popular tool in higher education. There are free programs from a variety of companies that convert a website's uniform resource locator (URL), also known as a web address, into a printable barcode label that can be scanned and read by a smartphone. The most prevalent barcode formats are "Quick Response" or QR code, Microsoft tag, and Scanlife code. When navigating the Internet, hyperlinking on a web page is a powerful tool that allows the user to clink on the hyperlink and be directed to a specific new web page of interest. In a comparable scenario a two-dimensional bar code that is placed "on a physical object makes the object clickable to a smartphone, so that it is similarly linked to further information. This creates what is called a smart object" (Williams & Pence, 2011, para. 9). In an educational setting two-dimensional bar code labels can be placed on instruments, bottles of chemicals, or even a sheet of paper. Students can then scan the barcode-labeled smart objects with their smartphones to be directed a specific website or web page that is related to the object. For example, by placing a two-dimensional barcode on an instrument in a chemistry laboratory students could use their smartphone to access a web page that provides step-by-step instructions or a video showing how to properly use the piece of equipment. By placing a two-dimensional barcode on a chemical bottle, students could be directed to a web page that contains the material safety data sheet (MSDS) and information related to the chemical structure.

There are many instructors who ban the use of cell phones and smartphones in the classroom because they fear that students will use valuable class time sending text messages or surfing the Internet for personal or social networking purposes. According to Rheingold (2009) students are often in a state of "continuous partial attention" and adding cell phones to the mix would continue to exacerbate this issue. In order to focus students' attention and make the most constructive use of technology, Rheingold suggests breaking the class time up into "technology on" and "technology off" sessions. Due to the processing capability and high-speed Internet access, the smartphone should be viewed more as a personal computer than a cell phone. In a study conducted by Warschauer (2007) students using laptop computers in the classroom facilitated:

1. More just-in-time learning;
2. More autonomous, individualized learning;
3. A greater ease of conducting research;
4. More empirical investigation;
5. More opportunities for in-depth learning. (p. 7)

Although the Warchauer study was based on laptop use in the classroom, Rheigngold (2009) indicated that many of these characteristics would align with that of a smartphone classroom. The laptop and smartphone use cases differ slightly in that students are always carrying their smartphone and have ubiquitous access to the Internet. Because not all of the students will have access to a smartphone, it probably makes sense to break the college classroom into work groups where at least one member of each group has a smartphone. As the price of smartphones and data plans continue to decrease, this may not be an issue moving forward because a greater number of college students will probably own these powerful mobile devices. With the proliferation of smartphones in the coming years, it is easy to see how these devices may have a greater impact on higher education than the personal computer has had over the past 2 decades.

Although smartphones have many uses in the educational arena, these devices do have limitations when used as the only means of online access in the home. The vast majority of smartphones still run on 3G networks, “where speeds are a fraction of those available over wireline and highly variable depending on location and network congestion” (Horrigan, 2012, p.

5). In addition, many of the data plans offered by mobile carriers have a limit on the amount of data a user can consume on a monthly basis.

Barriers to Broadband Adoption

Broadband adoption is a key component in keeping the U.S. competitive in the global economy. According to the FCC and Connect to Compete (2011) the barriers to broadband adoption include:

- Broadband Access
- Broadband Affordability
- Broadband Utility
- Digital Literacy

Broadband Access

Broadband access is an obstacle for many individuals who live in sparsely populated or rural areas. For many of these regions there is simply no business plan to support an ISP's investment in the wireless or wireline infrastructure necessary to deliver broadband service and still operate at a profit. Lack of broadband access, especially for low-income Americans, can also be attributed to the "specific equipment or set-up requirements imposed by the telecommunications providers, large monthly subscription fees, and ownership of appropriate equipment such as personal computers or smartphones" (Bates, Malakoff, Kane & Pulidini, 2012, p. 2).

Broadband Affordability

According to a 2010 FCC broadband survey (Bates et al., 2012) Americans paid an average monthly service fee of $40.68 for their broadband Internet connection. Broadband affordability is another barrier to residential broadband adoption in that many low-income households cannot afford the monthly service fee. In addition to the recurring monthly service fees, many American's simply do not have the upfront money to purchase a computer or device that is needed to access the Internet. These low-income households, "especially the 46 million that live in poverty, must make choices about how they spend the portion of their income that does not go to the necessities of housing, utilities, food, health care, and transportation" (p. 2). For many of these low-income households the value of having a broadband Internet connection in the home does not justify the cost. For households with an income of less than $25,000, only 43% had a broadband Internet connection in the home in 2010. For those households without a broadband Internet connection 24% indicated they did not subscribe due to the high cost of the service.

Broadband Utility

Broadband utility is another obstacle to broadband adoption because many potential subscribers do not see the benefits from an economic and social standpoint. Many of the nonadopters do not feel the information retrieved online is useful or interesting and see Internet surfing as a "waste of time". The broadband utility barrier has become more prevalent over the past few years with the increased use of broadband Internet for social media, e-commerce, and online entertainment purposes (Bates et al., 2012). The FCC broadband survey in 2010 revealed that approximately 19% of nonadopters "say they do not think digital content delivered over broadband is compelling enough to justify getting broadband service" (Clark, 2012, para. 12).

Digital Literacy

Digital literacy is also a barrier to broadband adoption, because many Americans simply do not know how to perform Internet searches or send and receive emails. Also, a lot of potential broadband subscribers do not know how to complete an online job application or upload a resume. In addition, many nonadopters do not trust online transactions from a privacy and safety standpoint (Gottheimer & Usdan, 2011). The FCC broadband survey in 2010 revealed that approximately 22% of nonadopters indicated that factors related to digital literacy were the main obstacles to broadband adoption. "This group includes those who are uncomfortable using computers and those who are worried about all of the bad things that can happen if they use the Internet" (Clark, 2012, para. 13).

Broadband Adoption

Since the FCC launched the National Broadband Plan in March 2010, broadband adoption rates in the United States have stayed relatively flat since 2009. During that same timeframe, the adoption rate for smartphones has increased dramatically. When the National Broadband Plan was unveiled, the goals included a plan to increase the infrastructure in underserved and unserved regions of the United States and to bring broadband access to the nearly 100 million Americans who did not have broadband access in the home. These were well-intentioned initiatives that have suffered from a lack of program coordination across various levels of government and not enough attention to assessing program outcomes (Horrigan, 2012). A FCC survey in 2009 revealed that 65% of Americans had broadband access in the home. A 2012 Pew Research Center's Internet & American Life Project survey (Horrigan, 2012) found that 65% of Americans have broadband access at home. These surveys clearly indicate that there has not been a significant increase in broadband adoption since 2009.

According to Bråten, Tardy, Nordbotten, Zsombor, and Morozova (n.d.) broadband is a necessary component to economic growth and may be necessary to improve the quality of life on a daily basis. The issue of no significant increases in broadband adoption rates since 2009 can be attributed to several factors. The remaining 35% of Americans without broadband access have many of the same characteristics associated with individuals who are slow to adopt information technology services. These nonadopters tend to be older, poorer, and less educated than the individuals who have broadband access in the home. A 2011 survey conducted by the National Telecommunications and Information Administration (NTIA) revealed that households with annual incomes of less than $25,000 had just a 43% broadband adoption rate. The survey also found the homeowners with less than a high school education had a 46% adoption rate. These adoption rates are relatively low when compared to the national average adoption rate of 65%. The economic recession is another factor that has slowed the rate of broadband adoption. A 2009 Pew Research Center survey revealed the during past year, 16% of households with annual incomes of less than $30,000 had to either cut back or cancel Internet services (Horrigan, 2012). According to Moffett (2011) incomes for middle and low income Americans have been stagnant or falling over the last 5 years and there is simply no money left in the budget for broadband service “after paying for food, shelter, transportation, and healthcare”.

A 2012 Pew Research Center’s Internet & American Life Project survey (Smith, 2012a) found that 88% of American adults own some type of cell phone. Of those cell phone users, 55% use their phone to access the Internet. This is a significant increase from the 31% of cell phone users in April 2009 who used their phones to go online. The study also revealed that 17% of current adult cell phone users mostly use their phone to access and browse the Internet. Another Pew Research Center’s Internet & American Life Project survey (Smith, 2012b) in February 2012 found that 46% of American adults owned a smartphone. This was a significant increase from 17% in late 2009 and 35% in April 2011.

Per the Pew February 2012 survey (Smith, 2012b), the rapid increase in sales of smartphones with 3G or 4G Internet access was not having a significant effect on the stagnant adoption rates for residential broadband. The same survey revealed that 83% of smartphone users also had a broadband connection in the home. This was comparable to a 2011 survey (Horrigan, 2012) that found 82% of smartphone users had broadband at home. The number of nonbroadband users who own smartphones did increase from 16% in April 2011 to 23% in February 2012. If we add the number of "smartphone only" Internet users to the February 2012 residential broadband users, the broadband adoption would increase from 65% to 73%. It should be noted that this 8% increase is limited, because "carriers are instituting caps on the amount of data people may consume on a monthly basis; the smartphone has limited utility as a means of sole online access" (p. 5).

If the number of "cell-mostly internet users" continues to grow, this could have an effect on the residential broadband adoption rate moving forward. The number of cell-mostly internet users continues to grow among young adults and nonwhites. The 2012 Pew Research Center's Internet & American Life Project survey (Smith, 2012a) revealed that 45% of young adult cell Internet users between 18-29 years old mostly used their cell phones to access and browse the Internet. The survey also found that 51% of African-American and 42% of Latino cell Internet users mostly use their cell phone to access the Internet. These percentages are high when compared to the 24% of white cell Internet users who mostly use their phones to go online. It should also be noted that individuals with an "annual household income of less than $50,000 per year and those who have not graduated college are more likely than those with higher levels of income and education to use their cell phones for most of their online browsing" (p. 7). The survey revealed that there were three main reasons why cell Internet users mostly use their phones to access the Internet. First, 64% of those surveyed mentioned using a cell to access the Internet is more convenient than other methods because the cell phone is always available. Second, 18% of those surveyed indicated that cell phones better fit their usage habits and are more efficient than using a personal computer for simple searches and basic activities. Third, 10% of those surveyed mentioned that their cell phones filled access gaps when they had no other means to connect to the Internet (Smith, 2012a).

Closing the Digital Divide

The perceived gap between the haves and have-nots with respect to access to technology and information is often referred to as the digital divide (Huang & Russell, 2006). According to a study conducted by Orszag, Dutz, and Willig (2009), "there is still significant evidence of a digital divide." (para. 3). As part of the American Recovery and Reinvestment Act of 2009, 4.7 billion dollars was made available to the National Telecommunications and Information Administration (NTIA) to establish the Broadband Technology Opportunities Program (BTOP). The BTOP was established to:

- Increase broadband access and adoption;
- Provide broadband training and support to anchor institutions such as schools, libraries, healthcare providers, and other organizations;
- Improve broadband access to public safety agencies;
- Stimulate demand for broadband;

The BTOP appropriated 3.5 billion dollars of the federal grant funds to infrastructure projects designed to upgrade and construct broadband networks. The BTOP established 123 infrastructure projects in 47 states and territories designed "to deploy new or significantly upgrade network miles, connect community anchor institutions, and facilitate enhanced access to broadband

Internet services for households and businesses" ("Broadband Technology," 2012, p. 3). Libraries will benefit from the improved broadband services by working with and connecting to other libraries to aggregate demand (Oder, 2009). As of March 2012, a cumulative total of 45,195 new and upgraded network miles had been deployed to upgrade the U.S. broadband infrastructure. At the end of the first quarter of 2012 a cumulative total of 6,374 anchor institutions across 35 states received connected and/or improved broadband service ("Broadband Technology," 2012).

The BTOP also allocated 201 million dollars for 66 Public Computer Center (PCC) projects to upgrade existing computer public facilities, establish new facilities, and provide computer training. The goals of the PCC projects are to provide training and improved "broadband access for the general public and vulnerable populations, such as low-income individuals, the unemployed, senior citizens, children, minorities, tribal communities, and people with disabilities" ("Broadband Technology," 2012, p. 6). The computer training is focused on providing individuals with knowledge necessary navigate the Internet, conduct online job searches, complete online job applications, and access online health-related information. As of March 2012 a cumulative total of 29,524 new Public Computer Center workstations were installed across 36 states.

For Americans to compete in this Internet-based economy moving forward, the NTIA feels that all households need broadband access to online employment, educational, and health related information. The BTOP used 251 million dollars of the Federal grant funds to support 44 Sustainable Broadband Adoption (SBA) innovative projects "that promote broadband adoption, especially among vulnerable population groups where broadband technology traditionally has been underutilized" ("Broadband Technology," 2012, p. 2). At the end of the first quarter of

2012, these innovative adoption projects have led to a cumulative total of 260,722 new broadband subscribers.

Connected Tennessee

BTOP Tennessee State Funding projects are designed to improve broadband data collection, infrastructure, public computer centers, and sustainable adoption. The BTOP awarded just under 5.5 million dollars to the Connected Tennessee project. The Connected Tennessee project team members provide technical support to the Tennessee Department of Economic and Community Development. The project team members are responsible for providing infrastructure assessments and cost modeling estimates to local technology planning teams. In addition, the team members conduct state level surveys to identify best practices and broadband availability for economic developers in Tennessee ("Connected Tennessee," 2013).

East Tennessee Middle Mile Fiber Broadband Project

The BTOP awarded over 9.3 million dollars to the East Tennessee Middle Mile Fiber Broadband Project to install a high-capacity fiber-optic broadband Internet network that spanned 544 miles. The goal is to connect more than 50 anchor institutions in the East Tennessee region to the high-speed network. The newly installed network will allow businesses and ISPs to connect to the middle mile network at speeds up to 10 Gbps. Phase I of the project was completed in March 2011 and involved installing a 343-mile fiber-optic broadband Internet network from Nashville to Knoxville and Knoxville to Chattanooga. Deltacom, Inc., which is now a subsidiary of Earthlink Business, completed Phase II of the East Tennessee Middle Mile Fiber Broadband Project in May 2011. The fiber-optic broadband Internet network is now extended "from Knoxville to Bristol, the 131 miles of newly lit fiber-optic cable is part of the BTOP-funded 544-mile network that will allow high-speed broadband connectivity to more than

34,000 households, 5,000 businesses, and 270 anchor institutions, including educational and healthcare facilities" ("East Tennessee," 2011, para. 1). In the final phase which began in July 2011, Deltacom will add new points of interconnection in five East Tennessee underserved counties using the Earthlink IP fiber-optic network. This involved installing strategically positioned interconnection points in Cookeville, Oak Ridge, Cleveland, Sweetwater, and Morristown. By providing affordable high-speed Internet access, the project coordinators indicated that it will promote economic development and job growth in these underserved counties.

Expanding Broadband Access Across Tennessee Project

The BTOP awarded just under 1.3 million dollars to the Expanding Broadband Access Across Tennessee Project to "build four new access points on Level 3's existing broadband network to enable last mile providers to offer affordable high-speed services to underserved areas" ("Expanding Broadband," n.d., para. 1). These new access points will allow last mile Internet service providers to offer broadband speeds between 50 Mbps and 10 Gbps at affordable rates to households, institutions, and businesses in areas between Memphis and Nashville, Nashville and Chattanooga, and Nashville and the Alabama border.

OnWav Five County Broadband Interconnect Training Access Project

The OnWav Five County Broadband Interconnect Training Access project was awarded just under 5.2 million dollars from the BTOP to install three new microwave and WiMax fixed wireless towers to bring broadband Internet services to mountainous and sparsely populated areas of north central Tennessee. The 725 businesses and 4,500 residents living in the counties of Fentess, Pickett, Clay, Jackson, and Overton will have access to affordable middle mile broadband speeds that range from 133 Mbps to 400 Mbps. These increased broadband speeds will allow users to now take advantage of services like VoIP and videoconferencing (“Five County,” n.d.).

United States Unified Community Anchor Network (US UCAN)

The United States Unified Community Anchor Network (US UCAN) was awarded over 62 million dollars from the BTOP for a 50-state widespread network that will benefit 121,000 community institutions. The project involves establishing “a large-scale, public-private partnership to interconnect more than 30 existing research and education networks, creating a dedicated 100-200 Gbps nationwide fiber backbone with 3.2 terabits per second (TBps) total capacity that would enable advanced networking features such as IPv6 and video multicasting” (“United States,” n.d., para. 1). In Tennessee the nationwide fiber backbone will pass through access points in Memphis, Nashville, and Chattanooga. In addition to connecting libraries, universities, and healthcare facilities, this comprehensive network will also benefit vulnerable populations.

Bridging the Gap: Bringing Broadband Technology to Tennessee’s Impoverished and Unemployed Project

The BTOP awarded approximately 557 thousand dollars to the Bridging the Gap: Bringing Broadband Technology to Tennessee’s Impoverished and Unemployed project to expand and upgrade 29 computer centers in the state. In addition, 17 libraries in the state will add staff to provide educational and job-related training for the unemployed, disabled, and individuals living in poverty. The Johnson City Power Board is owned by the City of Johnson City and is a company partner for this project (“Bridging the,” n.d.) .

Project Endeavor

Project Endeavor was awarded just under 15 million dollars to expand broadband adoption for the deaf and hard of hearing. The Communication Service for the Deaf, Inc. (CSD) will provide specialized computers and online tools for this outreach initiative. In addition, the CSD opened a nationwide contact center and will provide discounted broadband service. “Through the center’s American-Sign-Language (ASL)-trained staff, individuals who are deaf and hard of hearing will be able to purchase a video-configured Dell 11z notebook and a 3G/4G wireless internet access plan for $230” (“Project Endeavor,” 2011, para. 2). The goal of the project is to provide individuals who are deaf and hard of hearing with the broadband tools to more effectively communicate and increase their opportunities for employment.

Computer 4 Kids: Preparing Tennessee’s Next Generation for Success Program

The BTOP awarded over 2.2 million dollars to the Computer 4 Kids: Preparing Tennessee’s Next Generation for Success program to provide training, computers, and safe broadband access at Boys & Girls Clubs within the state. Many of the state’s disadvantaged youth do not have computers in the households and this prevents them from participating in educational and economic opportunities. As of December 2011, 1,400 computers have been deployed to 76 Boys & Girls Clubs (BGCs) in the state. The goal of the project is to provide digital literacy training to over 58,000 youth in the state to encourage broadband subscribership. The digital literacy training will be on a “on a wide variety of subjects, including computer basics, web design, digital photography, digital moviemaking, animation, game design, and web safety” (“Computer 4 Kids,” 2012, para. 2).

21st Century Information and Support Ecosystem Project

The 21st Century Information and Support Ecosystem project was awarded over 28.5 million to deploy Digital Connector programs in Tennessee and 30 other states. The purpose of the project is “to implement a comprehensive program of computer training, wireless internet access, broadband awareness marketing, and online content and applications to residents of 159 affordable and public housing developments and low-income communities” (“21st Century,” 2011, para. 1). One Economy Corporation will lead this effort and the plan is to have 2,500 youth attend train-the-trainer programs to become “Digital Connectors” and then provide digital literacy training to their neighbors. The train-the-trainer courses will include subjects such as computer basics, Internet fundamentals, Microsoft Office suite of software products, financial literacy, and how to send and receive emails. Project administrators will also conduct surveys as a metric to determine in the project initiatives have led to increased subscription rates.

Connect2Compete

In November 2011 the FCC partnered with the major cable companies in the U.S. to establish the Connect2Compete to provide free or low-cost broadband Internet service, discounted computer offers, and free digital literacy training to more than 100 million low-income individuals who live in one of 14,000 zip codes across the country. These zip codes are located in counties that have a median income of less than $35,000 per year. In Tennessee, families in participating zip codes with a student who is eligible for the free or reduced school lunch program will have the opportunity to subscribe to 3 MB broadband service for $9.95 per month for a 2-year period. In addition, these families will also have the opportunity to purchase a refurbished computer for $150. At the end of the 2-year period families that wish to continue with the broadband service will have to re-up at the full price. The idea behind the

Connect2Compete program is to improve outcomes and promote sustainable broadband adoption in these disadvantaged areas of the country. If the families participating in the program can learn new digital literacy skills and how to apply for higher paying jobs online, this will improve the likelihood that the participants will become long-time broadband subscribers (“FCC and,” 2011).

Demographics of Broadband Users

Although there is still a limited understanding of what actually drives broadband adoption, we do know that broadband-adopters in the U.S. are made up of all demographic groups (“Digital Nation,” 2011). Per the data reported by the NTIA there are significant demographic disparities in the 65% of American households that have broadband access. The level of education completed is a significant factor in the broadband adoption rate. College educated adults have a broadband adoption rate of 84%, which is considerably higher than the 30% adoption rate for adults who did not complete high school. The annual household income is also a factor that affects the adoption rate. There is a 90% adoption rate for household incomes that exceed $150,000, which is high when compared to the 32% adoption rate for households that have an income of less than $15,000. The adoption rates “for White (68%) and Asian non-Hispanics (69%) exceeded those for Black non-Hispanics (50%) and Hispanics (45%)” (p. 3). The adoption rate is the highest among young adults from the age of 18 to 24, while senior citizens (age 55 or older) had the lowest adoption rate. According to the classic Diffusion of Innovations (DoI) research conducted by Rogers (2003), early adopters of new technologies tend to younger, well-educated, and have higher incomes. The demographics of nonadopters tend to be older, poorer, minorities, and less educated. The NTIA findings related to broadband adoption rates appear to be consistent with this DoI research.

Geographic differences also relate to broadband adoption. Urban areas tend to have a higher broadband adoption rate than rural areas. This discrepancy is due in part to the lack broadband infrastructure in many rural communities. The implementation of broadband infrastructure is considerably different from dial-up Internet service in that it requires “significant outlays of capital to upgrade switching equipment and network infrastructure, and to acquire the appropriate rights-of-way” (Grubesic, 2006, p. 2). In March 2010 the FCC launched the National Broadband Plan to address this issue by implementing and funding an effort to improve and increase the infrastructure in underserved and unserved regions of the United States (Horrigan, 2012).

According to a 2007 NTIA study (Larose et al., 2012), there is also a broadband adoption gap within urban regions between inner-city residents (45%) and individuals who live is suburban communities that have an adoption rate of 51%. Although broadband services are available in most urban regions, many inner-city residents have demographic profiles related to nonadopters of new technologies (Zickuhr & Smith, 2012). The Broadband Technology Opportunities Program (BTOP) is currently using federal grant funds to promote broadband adoption in inner-cities by upgrading anchor institutions and providing digital literacy and job training (“Broadband Technology,” 2012).

Research About Broadband

The FCC Measuring Broadband America study was conducted in September 2012. A single reference month was chosen for the study to represent the usage period for the typical consumer. The FCC plans to repeat this study each September moving forward and will produce an annual report. This will be an “ongoing, rigorous nationwide study of residential broadband performance in the United States that involves actual performance tests for thousands of subscribers of Internet Service Providers (ISPs) serving well over 80 percent of the residential market" ("Measuring Broadband," 2013, p. 1). The sample size of 7,040 participates was drawn from a pool of over 145,000 volunteers. The participants in the study received a "Whitebox" that allowed them to monitor and report on the performance of their broadband service. The sample of volunteers "was organized with the goal of covering major ISPs in the 48 contiguous states across five broadband technologies: DSL, cable, fiber-to-the-home, fixed terrestrial wireless, and satellite" (p. 5). The participants in the study conducted 170,312,285 unique tests that produced a total of 3,015,160,117 measurements. The September 2012 study revealed that the average ISP during the most demanding peak usage periods delivered 97% of the advertised download speeds.

The Pew Internet Research Center's Internet and American Life Project conducted a study in May 2010 to assess the state of broadband adoption in the United States and to learn more about how American's use the Internet. The results included in the study are based on data acquired on April 29-30, 2010, from telephone interviews conducted by Princeton Survey Research Associates. A sample size of 2,252 adults ages 18 and older were interviewed in English, which included 744 individuals who were reached by cell phone. "For results based on the total sample, one can say with 95% confidence that the error attributable to sampling and other random effects is plus or minus 2.4 percentage points" (Smith, 2010, p. 4). The study revealed that 66% of adults in the United States have a high-speed broadband connection at home. The survey results indicated that 31% of Americans believe that the lack of high-speed broadband access "is a major disadvantage when it comes to learning new things that might enrich or improve their lives" (p. 3). The results also indicated that 31% believe that lack of broadband internet access is a “minor disadvantage”, 32% feel that it is “not a disadvantage”, and 6% did not know.

A 2012 Pew Internet Research Project study (Brenner, 2012) was conducted in the United States. A sample size of 2,261 adults ages 18 and older were interviewed in English and Spanish. The interviews were conducted on both landlines and cell phones and the “margin of error is plus or minus 2.3 percentages points based on all adults” (para. 10). The results of the study indicated that 87% of American adults have a cell phone and that 45% of those mobile users own a smartphone. The report also revealed that the majority of smartphone users have either an Android or Apple model.

Research related to wireline and wireless broadband services in Tennessee was conducted by the National Telecommunications and Information Administration (NTIA) in June 2012. The NTIA report used data “from the June 30, 2012 State Broadband Initiative (SBI) dataset, which is the same data that populates the National Broadband Map (NBM), as well as historical data from June 2010 and June 2011” (“U.S. Broadband,” 2013, p. 2). In each state the NTIA collaborates with the FCC to collect broadband data by census block or road segment. In Tennessee the State Broadband Development and Data Program (SBDD) was designated to conducts tests and collect data related to wireline and wireless broadband services. The SBDD conducted broadband tests on 10,843 households in Tennessee that revealed households across the state had a median broadband speed of 7.1 Mbps. The SBDD also worked with the wireline and wireless service providers in the state to collect service data and validate service offerings. When both wireline and wireless broadband services are taken into consideration, the SBDD found that 97.2% of Tennessee’s population had access to download speeds greater than 3 Mbps and upload speeds greater than 768 Kbps (National Broadband Map, n.d.). This degree of access is not consistent across the state of Tennessee because the study found that only 89.9% of the residents living in rural areas had access to either wireline or wireless broadband access at these speeds.

This study differed from the research conducted by the SBDD in that it was specific to East Tennessee State University. East Tennessee State University has campus locations in Johnson City (main campus), Kingsport, and Elizabethton and serves 14,536 students. The purpose of this study was to examine the availability of residential broadband access for students enrolled in the Fall 2013 semester at East Tennessee State University. Of the total number of students who attend ETSU, 11,227 students (or, 77.2%) reside in counties located in the East Tennessee region. At the time of this study it is not known if the students who attend ETSU have residential access to broadband services or choose not to subscribe due to financial reasons. A search of the available databases produced no specific study that exists with quantitative research addressing broadband availability for students currently enrolled at East Tennessee State University. This nonexperimental research design used an electronic survey with Likert-type questions to evaluate the relationships between the type of residential broadband access and the students' age, financial need, use of ETSU computer labs, and whether the students have taken a web-based course. By deepening the understanding of the how students connect to the Internet, East Tennessee State University administrators can make more informed planning decisions when developing and delivering web-based classes and content.

Summary

Although the definition of what constitutes broadband speeds is constantly evolving, most experts agree that the data transfer speeds are considerably higher than services delivered over dial-up connections. A major advantage of broadband is that the user is always online and does not have to manually dial-up and connect to the Internet service provider. The high-speed broadband Internet connection also allows the user to access content such as high quality voice services, graphics, and live streaming video.

A 2012 Pew Research Center's Internet & American Life Project survey (Horrigan, 2012) revealed that only 65% of Americans have broadband Internet access in the home. There has been no significant increase in broadband adoption since 2009. The major barriers to broadband adoption are broadband access, broadband affordability, broadband utility, and digital literacy. Many sparsely populated or rural areas in the U.S.who do not have the wireline or wireless infrastructure to deliver broadband services to these regions. The average monthly broadband Internet service fee was $40.68. Many low-income households simply cannot afford the monthly service fee. With the increase in popularity of social media, the broadband utility barrier has become more prevalent as many nonadopters view surfing the Internet as a "waste of time" (Bates et al., 2012). Digital literacy is also a barrier because many Americans are uncomfortable using computers and do not know how to perform Internet searches or send and receive emails (Gottheimer & Usdan, 2011).

In higher education students now have access to low-cost notebook computers, tablets, eReaders, and smartphones. These students rely on high-speed broadband Internet service to improve their productivity and excel in the physical or virtual classroom. In most higher education institutions learning management systems allow students to access assignments and communicate with their instructors or other students in an online environment. In addition, instructors can leverage videoconferencing systems to deliver class lecture video in both synchronous and asynchronous formats. Having access to broadband Internet allows students to collaborate and communicate in a technology rich environment.

Since 2009 there have been major efforts by the U.S. government to close the digital divide by reducing the barriers to broadband adoption. As part of the American Recovery and Reinvestment Act of 2009, the Broadband Technology Opportunities Program (BTOP) has appropriated 3.5 billion dollars of the federal grant funds to 123 infrastructure projects in 47 states designed to upgrade and construct broadband networks. The BTOP also allocated 201 million dollars for 66 projects designed to upgrade existing computer facilities, establish new facilities, and provide computer training for the general public and vulnerable populations. There are currently BTOP Tennessee State Funding projects related to improving broadband infrastructure, public computer centers, and sustainable adoption.

From an education standpoint the U.S. government is attempting to improve the broadband availability picture for students by working with telecommunications companies to provide affordable broadband Internet services and keep pace with the ever changing learning environment.

CHAPTER 3

RESEARCH METHODOLOGY

The purpose of this study was to examine the availability of residential broadband access for students enrolled in the fall semester 2013 at East Tennessee State University. This chapter is a description of the research questions and hypotheses and the methodology of this research with specific information on the survey instruments, data collection, sample size, data analyses, and survey procedures.

To thoroughly understand the relationships between residential broadband access and students' usability practices, a nonexperimental quantitative research design was chosen. The goal of quantitative studies is to test predetermined hypotheses and produce generalized results. In quantitative research the researchers know clearly in advance what they are looking for and are focused on establishing relationships and explaining causes through measured social facts (McMillan & Schumacher 2006, p. 13). This nonexperimental research design used an electronic survey with Likert-type questions to evaluate the relationships between the type of residential broadband access and the students' age, financial need, use of ETSU computer labs, and whether the students have taken a web-based course.

Research Questions and Null Hypotheses

The following research questions related to residential broadband access for East Tennessee State students for the 2013 fall semester controlled the direction of the study:

1. Is there a significant relationship between the type of Internet service students have at home and whether they have taken a web-based course?

   $Ho1_1$: There is no significant relationship between the type of Internet service students have at home and whether they have taken a web-based course.

2. Is there a significant relationship between the type of Internet connection students have at home and whether it has discouraged students from taking an online course or will it in the future?

    $Ho2_1$: There is no significant relationship between the type of Internet connection students have at home and whether it has discouraged students from taking an online course or will it in the future.

3. Is there a significant relationship between the type of Internet service students have at home and how often students use or plan to use East Tennessee State University computer labs?

    $Ho3_1$: There is no significant relationship between the type of Internet service students have at home and how often students use or plan to use East Tennessee State University computer labs.

4. Is there a significant relationship between the type of Internet service students have at home and how often students use the Internet for coursework at home?

    $Ho4_1$: There is no significant relationship between the type of Internet service students have at home and how often students use the Internet for coursework at home.

5. Is there a significant relationship between the type of Internet service students have at home and whether they have used East Tennessee State University computer labs because Internet access is faster on campus?

    $Ho5_1$: There is no significant relationship between the type of Internet service students have at home and whether they have used East Tennessee State University computer labs because Internet access is faster on campus.

6. Is there a significant relationship between the type of Internet service students have at home and whether students have problems connecting to D2L?

    $Ho6_1$: There is no significant relationship between the type of Internet service students have at home and whether students have problems connecting to D2L.

7. Is there a significant relationship between age and how students connect to the Internet from home?

    $Ho7_1$: There is no significant relationship between age and how students connect to the Internet from home.

8. Is there a significant relationship between age and students not having a computer at home as a reason not to connect to the Internet from home?

    $Ho8_1$: There is no significant relationship between age and students not having a computer at home as a reason not to connect to the Internet from home.

9. Is there a relationship between age and students not needing Internet access at home as a reason not to connect to the Internet from home?

    $Ho9_1$: There is no significant relationship between age and students not needing Internet access at home as a reason not to connect to the Internet from home.

10. Is there a significant relationship between age and Internet service expense as a reason not to connect to the Internet from home?

    $Ho10_1$: There is no significant relationship between age and Internet service expense as a reason not to connect to the Internet from home.

11. Is there a significant relationship between age and Internet speed as a reason not to connect to the Internet from home?

$Ho11_1$: There is no significant relationship between age and Internet speed as a reason not to connect to the Internet from home.

12. Is there a significant relationship between age and poor Internet service as a reason not to connect to the Internet from home?

    $Ho12_1$: There is no significant relationship between age and poor Internet service as a reason not to connect to the Internet from home.

13. Is there a significant relationship between age and any other response as a reason not to connect to the Internet from home?

    $Ho13_1$: There is no significant relationship between age and any other response as a reason not to connect to the Internet from home.

14. Is there a significant relationship between age and student perceptions of the importance of high-speed Internet access as it relates to their coursework?

    $Ho14_1$: There is no significant relationship between age and student perceptions of the importance of high-speed Internet access as it relates to their coursework.

15. Is there a significant relationship between age and student perceptions of the importance of high-speed Internet access as it relates to being successful in college?

    $Ho15_1$: There is no significant relationship between age and student perceptions of the importance of high-speed Internet access as it relates to being successful in college.

16. Is there a significant relationship between student financial need (regarding Pell grant funding) and the type of Internet access at home?

    $Ho16_1$: There is no significant relationship between student financial need (regarding Pell grant funding) and the type of Internet access at home.

17. Is there a significant relationship between age and how often students use or plan to use 3G/4G Mobile Broadband Service (via a Smartphone, Tablet, or Laptop Stick) for their coursework?

    $Ho17_1$: There is no significant relationship between age and how often students use or plan to use 3G/4G Mobile Broadband Service (via a Smartphone, Tablet, or Laptop Stick) for their coursework.

18. Is there a significant relationship between student financial need (regarding Pell grant funding) and how often students use or plan to use 3G/4G Mobile Broadband Service (via a Smartphone, Tablet, or Laptop Stick) for their coursework?

    $Ho18_1$: There is no significant relationship between student financial need (regarding Pell grant funding) and how often students use or plan to use 3G/4G Mobile Broadband Service (via a Smartphone, Tablet, or Laptop Stick) for their coursework.

Instrumentation

The survey *ETSU Broadband Internet Access Student Survey* (Appendix C) was used for data collection. The majority of the questions in the survey instrument were used in a similar 2010 study conducted by Hurst. I contacted the author and obtained permission to use the questions in this study. I modified the survey to add questions-selections related to ETSU On-Campus Housing, county of residence, and 3G/4G Mobile Broadband Cellular Service.

The following information was collected from East Tennessee State students: age, whether the student is receiving a Pell grant, county of current residence, zip code of current residence, type of Internet connection at home, reason for no Internet connection at home, how many providers of high-speed Internet in the home region, what company provides high-speed

Internet at home, approximate monthly cost of high-speed Internet a student's home, satisfaction with speed and quality of high-speed Internet connection at home, usage of East Tennessee State computer lab for faster Internet speed, the importance of high-speed Internet in relation to coursework, frequency in using the Internet for coursework, and how often East Tennessee State students plan to use a East Tennessee State computer lab for coursework.

Sample

The *East Tennessee State University Residential Broadband Access Survey* was administered to a sample of students enrolled in classes for the fall semester 2013 at all campus locations, including Johnson City, Kingsport, and Elizabethton and to all students in other locations who enrolled in a web-based course. The target sample group consists of all 15,404 undergraduate, graduate, and professional students enrolled for the fall semester 2013 that have an active student email account. However, only those who accessed their ETSU email accounts during the study period were in the survey population.

Data Collection

Prior to beginning this research project, permission to conduct research was requested from the Institutional Review Board (IRB) of East Tennessee State University. In addition, written permission to collect the data was obtained from the Provost and Vice President for Academic Affairs at East Tennessee State University.

East Tennessee State University did not provide the researcher with a list of participants' names or email addresses. Instead, a survey link was forwarded to a specific point of contact within the institution. The university representative used an internal distribution list to contact potential participants. A sample of the email invitation that was distributed to potential participants can be found in Appendix B. By using an internal email distribution list it augmented the privacy and confidentiality of the participants. The researcher had no way to identify individuals or their responses. It also assisted in reaching the entire targeted population by ensuring that the most up-to-date and accurate email addresses were used to reach participants. An online survey instrument, Survey Monkey, generated an electronic hyper-link to the 19-question survey. An electronic survey administrator, Survey Monkey, was chosen for practicality reasons.

Data Analysis

Data from this research were analyzed through a nonexperimental quantitative methodology. A portion of the survey given to students included questions that provided background information to better understand critical information related to broadband adoption. Descriptive statistics were used to provide an overview of students attending East Tennessee State University for fall semester 2013. To analyze the research questions, SPSS by IBM, version 18 was used. Cross-tabulated tables and chi-square tests were used to evaluate the hypotheses in the study. All data were analyzed at the .05 level of significance.

Summary

Chapter 3 reported the methodology and procedures for conducting this study. After a brief introduction, a description of the research design, selection of population, research questions and null hypothesis, and the consequential data analysis were defined. The results of the survey are presented in the following chapter.

CHAPTER 4

PRESENTATION AND ANALYSIS OF DATA

East Tennessee State University and other higher education institutions funded by the state of Tennessee are continuously exploring ways to trim the operating budget. Many state funded colleges and universities see Internet-based tools as a remedy for reducing overhead expenses. Delivering courses and student services online streamlines the processes and eliminates waste in the system. The financial benefits from these online delivery services should be realized by both students and higher education institutions. As institutions transition to these Internet-based tools, there is a greater need for students to have access to high-speed Internet services to leverage the full benefits of the online learning environment. The purpose of this study was to investigate the access and usage of high-speed Internet for students enrolled at East Tennessee State University.

In this chapter data were presented and analyzed to answer 18 research questions and 18 null hypotheses. An electronic survey with 20 questions was used to capture data. The IBM SPSS computer software program was used to analyze the data.

The nonrandom sample for this study consisted of 784 East Tennessee State University students who enrolled in the fall of 2013. The study focused specifically on those students who had enrolled at East Tennessee State University for the fall semester 2013 and chose to complete the electronic survey. Table 3 includes the age ranges for the survey respondents.

Table 3

Age Ranges of Survey Respondents

Age Range	*N*	%
<20	221	28.2
20-29	375	47.9
30-39	87	11.1
≥40	100	12.8
Total	783	100.0

Note: One survey participant did not respond to this question.

The breakdown of the number of respondents living in on-campus housing and those that reside off-campus is shown in Table 4 below.

Table 4

On-campus vs. Off-campus Housing Breakdown of Survey Respondents

On-Campus Housing	*N*	%
No	520	66.7
Yes	260	33.3
Total	780	100

Note: Four survey participants did not respond to this question.

There were 199 graduate and 584 undergraduate students who responded to the survey. The program levels of the respondents are listed in Table 5 below.

Table 5

Program Level for Population

Program Level	N	%
Bachelor's	584	74.6
Master's	108	13.8
Doctoral	91	11.6
Total	783	100.0

Note: One student did not respond to this question.

As shown in Table 6, the county of residence for the respondents shows that counties with the highest student enrollment at ETSU were represented. The county of residence of the respondents may be an indication of the available Internet service for other ETSU students living in each county indentified in the survey.

Table 6

County of Residence for Population

County of Residence	*N*	%
Anderson	11	1.4
Blount	16	2.0
Carter	44	5.6
Cocke	11	1.4
Greene	24	3.0
Hamblen	14	1.8
Hamilton	24	3.0
Hawkins	21	2.7
Haywood, NC	7	0.9
Johnson	25	3.2
Knox	44	5.6
Scott	7	0.9
Sevier	17	2.2
Sullivan	96	12.2
Washington	258	32.7
Washington, VA	20	2.5
Other	146	19.0
Total	784	100.0

Table 7 below includes information to better understand how prepared students are to leverage Internet-based technologies ETSU may offer in the future.

Table 7

Type of Internet Connection from Home for Population

How Students Connect to Internet at Home	*N*	%
No Internet Service	29	3.7
Dial-up	3	0.4
Cable Modem	301	38.7
DSL Modem	168	21.6
Satellite Modem	19	2.4
ETSU On-Campus High-Speed Internet Access	210	27.0
3G/4G Mobile Broadband Cellular Service (Smartphone, Tablet, or USB Laptop Stick)	48	6.2
Total	778	100.0

Note: Six students did not respond to this question.

The survey asked ETSU students enrolled for fall semester 2013 how satisfied they were with their current Internet service provider. The responses in Table 8 below indicate that unfortunately only 25.1% of the students surveyed were very satisfied with their high-speed Internet service provider.

Table 8

Satisfaction with High-Speed Internet Service from Home

Level of Satisfaction	N	%
Very Dissatisfied	28	5.7
Dissatisfied	53	10.8
Neutral	69	14.1
Satisfied	218	44.3
Very Satisfied	123	25.1
Total	491	100.0

Note: Students with On-Campus High-Speed Internet Access were not included in the table.

Those students who responded that they did not have Internet access at home were asked to identify the reason or reasons for not having Internet service at their place of residence. Table 9 provides the responses students gave as reasons they did not have Internet access at home.

Table 9

Reasons for No Internet Service at Home

Reasons	N	%
No Internet Service Provider	6	11.3
No Computer	2	3.8
Not Needed	1	1.9
Costs Too Much	23	43.4
Speed Too Slow	7	13.2
Service is Poor	9	17.0
Any Other Reason	5	9.4
Total	53	100.0

As higher education institutions transition to offering more courses and services online, there is the assumption the need for high-speed Internet access will increase over time. The students who responded to this survey confirmed that assumption with 70.5% indicating that high-speed Internet access is very important to coursework completion at ETSU as shown in Table 10 below.

Table 10

Importance of High-Speed Internet to Coursework Completion

Importance to Coursework	*N*	%
Not at all Important	9	1.2
Moderately Important	65	8.9
Important	142	19.4
Very Important	516	70.5
Total	732	100.0

Research Question 1

Is there a significant relationship between the type of Internet service students have at home and whether they have taken a web-based course?

To answer this question a cross-tabulated table, chi-square test, and pairwise comparisons were used to evaluate the following hypothesis:

> $Ho1_1$: There is no significant relationship between the type of Internet service students have at home and whether they have taken a web-based course.

Because the number of responses was low in several of the response categories related to type of high-speed Internet in the home, the response categories were collapsed into four categories: (1) High-Speed at Home (Cable, DSL, Satellite); (2) 3G/4G; (3) On-campus High-Speed; and (4) No High-Speed at Home (No Internet, Dial-up).

A 2 x 4 contingency table analysis was conducted to assess the relationship between taking an online course and the type of Internet service students have at home (high speed, 3G/4G, on-campus access, or no high speed). Taking an online course and Internet service type at home were found to be significantly related, Pearson $\chi^2(3, N = 770) = 33.87, p < .001$, Cramer's $V = .21$; therefore, the null hypothesis was rejected. As shown in Table 11, the percentage of students taking online courses tended to be higher for those who had high speed Internet service at home.

Table 11

Comparison of Students Taking an Online Course by Type of Internet Access at Home

	Internet Service Type at Home							
	High Speed at Home		3G/4G		On-campus High Speed		No High Speed at Home	
Taken Online Course(s)	*N*	%	*N*	%	*N*	%	*N*	%
Yes	310	64.2	22	47.8	87	41.6	14	41.6
No	173	35.8	24	52.2	122	58.4	18	58.4
Total	483	100.0	46	100.0	209	100.0	32	100.0

Follow-up pairwise comparisons were conducted to evaluate the differences among these proportions. The Bonferonni method was used to control for Type I error at the .05 level across all comparisons. As shown in Table 12, students with high-speed Internet service at home were significantly more likely to take an online course than students with any other type of Internet access. There were no significant differences between any other groups.

Table 12

Results of Pairwise Comparisons of Internet Access Types Using the Bonferroni Method

Comparison	χ^2	*p*	Cramer's *V*
High speed vs. 3G/4G	4.81	.028*	.10
High speed vs. On-campus	30.35	<.001*	.21
High speed vs. No high speed	5.37	.020*	.10
3G/4G vs. On-campus	0.59	.442	.05
3G/4G vs. No high speed	0.13	.722	.04
On-campus vs. No high speed	0.05	.821	.02

*Significant

Research Question 2

Is there a significant relationship between the type of Internet connection students have at home and whether it has discouraged students from taking an online course or will it in the future?

To answer this question a cross-tabulated table, chi-square test, and pairwise comparisons were used to evaluate the following hypothesis:

> $Ho2_1$: There is no significant relationship between the type of Internet connection students have at home and whether it has discouraged students from taking an online course or will it in the future.

Because the number of responses was low in several of the response categories related to type of high-speed Internet in the home, the response categories were collapsed into four

categories: (1) High-Speed at Home (Cable, DSL, Satellite); (2) 3G/4G; (3) On-campus High-Speed; and (4) No High-Speed at Home (No Internet, Dial-up).

A 2 x 4 contingency table analysis was conducted to assess the relationship between the type of Internet service students have at home (high speed, 3G/4G, on-campus access, or no high speed) and whether they have been discouraged from taking an online course. Internet service type at home and whether students were discouraged from taking an online course were found to be significantly related, Pearson $\chi^2(3, N = 774) = 70.53$, $p < .001$, Cramer's $V = .30$; therefore, the null hypothesis was rejected. As shown in Table 13, the percentage of students without high-speed Internet access at home were more likely to report that they were discouraged from taking an online course.

Table 13

Comparison of Students Discouraged from Taking an Online Course by Type of Internet Service at Home

	Internet Service Type at Home							
	High Speed at Home		3G/4G		On-campus High Speed		No High Speed at Home	
Discouraged from Taking an Online Course	*N*	%	*N*	%	*N*	%	*N*	%
Yes	44	9.1	11	23.4	44	21.1	19	59.4
No	442	89.9	36	76.6	165	78.9	13	40.6
Total	486	100.0	47	100.0	209	100.0	32	100.0

Follow-up pairwise comparisons were conducted to evaluate the differences among these proportions. The Bonferonni method was used to control for Type I error at the .05 level across all comparisons. As shown in Table 14, students with high-speed Internet service at home were significantly less likely to report being discouraged from taking an online course than students with any other type of Internet access. Students without high-speed Internet access at home were significantly more likely to report being discouraged from taking an online course than students with 3G/4G access or those that with on-campus access. There was no significant difference between those with 3G/4G access and those with on-campus access.

Table 14

Results of Pairwise Comparisons of Internet Access Types Using the Bonferroni Method

Comparison	χ^2	*p*	Cramer's *V*
High-speed vs. 3G/4G	9.53	.002*	.10
High-speed vs. On-campus	19.03	<.001*	.17
High-speed vs. No high-speed	70.17	<.001*	.37
3G/4G vs. On-campus	0.13	.723	.02
3G/4G vs. No high-speed	10.46	<.001*	.36
On-campus vs. No high-speed	21.11	<.001*	.30

*Significant

Research Question 3

Is there a significant relationship between the type of Internet service students have at home and how often students use or plan to use East Tennessee State University computer labs?

To answer this question a cross-tabulated table and chi-square test were used to evaluate the following hypothesis:

> $Ho3_1$: There is no significant relationship between the type of Internet service students have at home and how often students use or plan to use East Tennessee State University computer labs.

Because the number of responses was low in several of the response categories related to type of high-speed Internet in the home, the response categories were collapsed into four categories: (1) High-Speed at Home (Cable, DSL, Satellite); (2) 3G/4G; (3) On-campus High-Speed; and (4) No High-Speed at Home (No Internet, Dial-up).

A 4 x 4 contingency table analysis was conducted to assess the relationship between the type of Internet service students have at home (high speed, 3G/4G, on-campus access, or no high speed) and how often students use or plan to use the ETSU computer labs (never, once to a few times a semester, once to a few times per week, daily). Internet service type at home and ETSU computer lab use were found to be significantly related, Pearson $\chi^2(9, N = 772) = 40.57$, $p < .001$, Cramer's $V = .13$; therefore, the null hypothesis was rejected. As shown in Table 15, the percentage of students without high-speed Internet access at home reported that they used or plan to use the ETSU computer labs more frequently than other groups.

Table 15

Comparison of Frequency of ETSU Computer Use by Type of Internet Service at Home

	Internet Service Type at Home							
	High Speed at Home		3G/4G		On-campus High Speed		No High Speed at Home	
Frequency of Computer Lab Use	*N*	%	*N*	%	*N*	%	*N*	%
Never	104	21.5	11	23.4	36	17.2	9	28.1
Once to a few times a semester	200	41.3	16	34.0	79	37.8	3	9.4
Once to a few times per week	143	29.5	16	34.0	73	34.9	8	25.0
Daily	37	7.6	4	8.5	21	10.0	12	37.5
Total	484	100.0	47	100.0	209	100.0	32	100.0

Research Question 4

Is there a significant relationship between the type of Internet service students have at home and how often students use the Internet for coursework at home?

To answer this question a cross-tabulated table and chi-square test were used to evaluate the following hypothesis:

> $Ho4_1$: There is no significant relationship between the type of Internet service students have at home and how often students use the Internet for coursework at home.

Because the number of responses was low in several of the response categories related to type of high-speed Internet in the home, the response categories were collapsed into four

categories: (1) High-Speed at Home (Cable, DSL, Satellite); (2) 3G/4G; (3) On-campus High-Speed; and (4) No High-Speed at Home (No Internet, Dial-up).

A 4x4 contingency table analysis was conducted to evaluate the relationship of type of Internet service students have at home and how often students use the Internet for coursework at home. The crosstabulated table showed violations of chi-square test: 31.3% of the cells had an expected frequency of less than five and the minimum expected frequency was less than one. Therefore, the response categories for the frequency with which students used ETSU computer labs for coursework was collapsed into three categories: (1) a few times per semester or less; (2) once to a few times a week; and (3) daily.

Using the collapsed variable, Internet service type at home and frequency of Internet use for coursework at home were found to be significantly related, Pearson $\chi^2(6, N = 772) = 139.67$, $p < .001$, Cramer's $V = .30$; therefore, the null hypothesis was rejected. As shown in Table 16, the percentage of students without high-speed Internet access at home reported that they used the Internet for coursework at home less frequently than other groups. Also noteworthy, students with 3G/4G access were more likely to report using the Internet at home for coursework once to a few times per week than other groups.

Table 16

Comparison of Frequency of Internet Use at Home for Coursework by Type of Internet Service at Home

	Internet Service Type at Home							
	High-Speed at Home		3G/4G		On-campus High-Speed		No High-Speed at Home	
Frequency of Internet Use at Home	*N*	%	*N*	%	*N*	%	*N*	%
Less than a few times per semester	8	1.6	3	6.3	13	6.3	15	48.4
Once to a few times per week	92	19.0	15	31.3	37	17.8	5	16.1
Daily	385	79.4	30	62.5	158	76.0	11	35.5
Total	485	100.0	48	100.0	208	100.0	32	100.0

Research Question 5

Is there a significant relationship between the type of Internet service students have at home and whether they have used East Tennessee State University computer labs because Internet access is faster on campus?

To answer this question a cross-tabulated table, chi-square test, and pairwise comparisons were used to evaluate the following hypothesis:

> $Ho5_1$: There is no significant relationship between the type of Internet service students have at home and whether they have used East Tennessee State University computer labs because Internet access is faster on campus.

Because the number of responses was low in several of the response categories related to type of high-speed Internet in the home, the response categories were collapsed into four

categories: (1) High-Speed at Home (Cable, DSL, Satellite); (2) 3G/4G; (3) On-campus High-Speed; and (4) No High-Speed at Home (No Internet, Dial-up).

A 4 x 2 contingency table analysis was conducted to assess the relationship between the type of Internet service students have at home (high speed, 3G/4G, on-campus access, or no high speed) and whether they have used ETSU computer labs because Internet access if faster on campus. Internet service type at home and use of ETSU computer labs because Internet access is faster on campus were found to be significantly related, Pearson $\chi^2(3, N = 741) = 18.26, p < .001$, Cramer's $V = .16$; therefore, the null hypothesis was rejected. As shown in Table 17, the percentage of students without high-speed Internet access at home were more likely to report that they used ETSU computer labs because Internet access is faster than at home.

Table 17

Comparison of Students That Use ETSU Computer Labs Due to Faster Internet Connection by Type of Internet Service at Home

	Internet Service Type at Home							
	High-Speed at Home		3G/4G		On-campus High-Speed		No High-Speed at Home	
ETSU Computer Labs Faster	*N*	%	*N*	%	*N*	%	*N*	%
Yes	83	17.2	14	31.8	54	26.5	6	54.5
No	399	82.8	30	68.2	150	73.5	5	45.5
Total	482	100.0	43	100.0	204	100.0	11	100.0

Follow-up pairwise comparisons were conducted to evaluate the differences among these proportions. The Bonferonni method was used to control for Type I error at the .05 level across all comparisons. As shown in Table 18, students with high-speed Internet service at home were significantly less likely to report using the ETSU computer labs due to faster Internet connections than all other groups. Students without high speed Internet access at home were significantly more likely to use the ETSU computer labs due to faster Internet connection than students with 3G/4G access or those that with on-campus access. There was no significant difference between those with 3G/4G access and those with on-campus access.

Table 18

Results of Pairwise Comparisons of Internet Access Types Using the Bonferroni Method

Comparison	χ^2	*p*	Cramer's *V*
High-speed vs. 3G/4G	5.71	.017*	.10
High-speed vs. On-campus	7.68	.006*	.11
High-speed vs. No high-speed	10.13	.001*	.14
3G/4G vs. On-campus	0.52	.471	.05
3G/4G vs. No high-speed	1.96	.161*	.19
On-campus vs. No high-speed	4.09	.043*	.14

*Significant

Research Question 6

Is there a significant relationship between the type of Internet service students have at home and whether students have problems connecting to D2L?

To answer this question a cross-tabulated table, chi-square test, and pairwise comparisons were used to evaluate the following hypothesis:

> $Ho6_1$: There is no significant relationship between the type of Internet service students have at home and whether students have problems connecting to D2L.

Because the number of responses was low in several of the response categories related to type of high-speed Internet in the home, the response categories were collapsed into four

categories: (1) High-Speed at Home (Cable, DSL, Satellite); (2) 3G/4G; (3) On-campus High-Speed; and (4) No High-Speed at Home (No Internet, Dial-up).

A 4 x 2 contingency table analysis was conducted to assess the relationship between the type of Internet service students have at home (high speed, 3G/4G, on-campus access, or no high speed) and whether students have problems connecting to D2L. Internet service type at home and use of ETSU problems connecting to D2L were found to be significantly related, Pearson $\chi^2(3, N = 772) = 130.34$, $p < .001$, Cramer's $V = .41$; therefore, the null hypothesis was rejected. As shown in Table 19, the percentage of students without high speed Internet access at home were more likely to report problems accessing D2L.

Table 19

Comparison of Students with Problems Connecting to D2L by Type of Internet Service at Home

	Internet Service Type at Home							
	High-Speed at Home		3G/4G		On-campus High-Speed		No High-Speed at Home	
Problems Accessing D2L	*N*	%	*N*	%	*N*	%	*N*	%
Yes	31	6.4	8	17.4	31	14.8	23	74.2
No	454	93.6	38	82.6	179	85.2	8	25.8
Total	485	100.0	46	100.0	210	100.0	31	100.0

Follow-up pairwise comparisons were conducted to evaluate the differences among these proportions. The Bonferonni method was used to control for Type I error at the .05 level across all comparisons. As shown in Table 20, students with high-speed Internet service at home were significantly less likely to report problems accessing D2L than all other groups. Students without high-speed Internet access at home were significantly more likely to report problems accessing

D2L than students with 3G/4G access or those that with on-campus access. There was no significant difference between those with 3G/4G access and those with on-campus access.

Table 20

Results of Pairwise Comparisons of Internet Access Types Using the Bonferroni Method

Comparison	χ^2	p	Cramer's V
High-speed vs. 3G/4G	7.47	.006*	.12
High-speed vs. On-campus	12.64	<.001*	.14
High-speed vs. No high-speed	142.96	<.001*	.53
3G/4G vs. On-campus	0.20	.653	.03
3G/4G vs. No high-speed	24.84	<.001*	.57
On-campus vs. No high-speed	54.88	<.001*	.48

*Significant

Research Question 7

Is there a significant relationship between age and how students connect to the Internet from home?

To answer this question a cross-tabulated table and chi-square test were used to evaluate the following hypothesis:

> $Ho7_1$: There is no significant relationship between age and how students connect to the Internet from home.

Because the number of responses was low in several of the response categories related to type of high-speed Internet in the home, the response categories were collapsed into four categories: (1) High-Speed at Home (Cable, DSL, Satellite); (2) 3G/4G; (3) On-campus High-Speed; and (4) No High-Speed at Home (No Internet, Dial-up).

On-campus students were removed from this analysis, because they are more likely to be under the age 20. A 4 x 3 contingency table analysis was conducted to assess the relationship between age and how students connect to the Internet at home (high speed, 3G/4G, on-campus access, or no high speed). Internet service type at home and age were found to be significantly related, Pearson $\chi^2(6, N = 567) = 19.35, p = .004$, Cramer's $V = .13$; therefore, the null hypothesis was rejected. As shown in Table 21, the students under 20 were more likely to use 3G/4G as their primary way to connect to the Internet and to report no high-speed Internet at home.

Table 21

Relationship Between Age and Internet Service Type

	Age							
	<20		20-29		30-39		≥40	
Internet Service Type at Home	*N*	%	*N*	%	*N*	%	*N*	%
High-Speed at Home	75	72.8	250	89.0	76	88.4	87	89.7
3G/4G	18	17.5	18	6.4	5	5.8	6	6.2
No High-Speed at Home	10	9.7	13	4.6	5	5.8	4	4.1
Total	103	100.0	281	100.0	208	100.0	97	100.0

Research Question 8

Is there a significant relationship between age and students not having a computer at home as a reason not to connect to the Internet from home?

> $Ho8_1$: There is no significant relationship between age and students not having a computer at home as a reason not to connect to the Internet from home.

There were only two respondents who reported not having a computer as a reason not to connect to the Internet from home. The 4 x 2 crosstabulated table for $Ho8_1$ showed violations of the assumptions of the chi-square test. Therefore, this hypothesis was not tested.

Research Question 9

Is there a relationship between age and students not needing Internet access at home as a reason not to connect to the Internet from home?

> $Ho9_1$: There is no significant relationship between age and students not needing Internet access at home as a reason not to connect to the Internet from home.

There was only one respondent who reported not needing Internet access at home as a reason not to connect to the Internet from home. The 4 x 2 crosstabulated table for $Ho9_1$ showed violations of the assumptions of the chi-square test. Therefore, this hypothesis was not tested.

Research Question 10

Is there a significant relationship between age and Internet service expense as a reason not to connect to the Internet from home?

To answer this question a cross-tabulated table and chi-square test were used to evaluate the following hypothesis:

> $Ho10_1$: There is no significant relationship between age and Internet service expense as a reason not to connect to the Internet from home.

On-campus students were removed from this analysis, because they are more likely to be under the age 20. A 4 x 2 contingency table analysis was conducted to assess the relationship between age and expense as a reason not to connect from the Internet at home. Age and expense of Internet were found to be significantly related, Pearson $\chi^2(3, N = 567) = 9.77, p < .021$, Cramer's $V = .13$; therefore, the null hypothesis was rejected. As shown in Table 22, the percentage of students aged 30-39 were more likely to list expense as a reason not to connect to the Internet.

Table 22

Relationship Between Age and Expense of Internet

	Age							
	<20		20-29		30-39		≥40	
Internet is too expensive	*N*	%	*N*	%	*N*	%	*N*	%
Yes	5	4.9	9	3.2	9	10.5	2	2.1
No	98	95.1	272	96.8	77	89.5	95	97.9
Total	103	100.0	281	100.0	208	100.0	97	100.0

Research Question 11

Is there a significant relationship between age and Internet speed as a reason not to connect to the Internet from home?

$Ho11_1$: There is no significant relationship between age and Internet speed as a reason not to connect to the Internet from home.

There were only seven respondents who reported Internet speed as a reason not to connect to the Internet from home. The 4 x 2 crosstabulated table for $Ho11_1$ showed violations of the assumptions of the chi-square test. Therefore, this hypothesis was not tested.

Research Question 12

Is there a significant relationship between age and poor Internet service as a reason not to connect to the Internet from home?

Ho12$_1$: There is no significant relationship between age and poor Internet service as a reason not to connect to the Internet from home.

There were only nine respondents who reported poor Internet service as a reason not to connect to the Internet from home. The 4 x 2 crosstabulated table for Ho12$_1$ showed violations of the assumptions of the chi-square test. Therefore, this hypothesis was not tested.

Research Question 13

Is there a significant relationship between age and any other response as a reason not to connect to the Internet from home?

Ho13$_1$: There is no significant relationship between age and any other response as a reason not to connect to the Internet from home.

There were only five respondents who reported any other response as a reason not to connect to the Internet from home. The 4 x 2 crosstabulated table for Ho13$_1$ showed violations of the assumptions of the chi-square test. Therefore, this hypothesis was not tested.

Research Question 14

Is there a significant relationship between age and student perceptions of the importance of high-speed Internet access as it relates to their coursework?

To answer this question a cross-tabulated table and chi-square test were used to evaluate the following hypothesis:

Ho14$_1$: There is no significant relationship between age and student perceptions of the importance of high-speed Internet access as it relates to their coursework.

A 4x4 contingency table analysis was conducted to evaluate the relationship of age and the perceived importance of high-speed Internet access as it pertains to coursework. The chi-square was not significant, $\chi^2(9, N = 776) = 14.34$, $p = .111$, Cramer's $V = .08$; therefore, the null hypothesis was retained. As shown in Table 23, the perceived importance of high-speed Internet access for coursework was similar across the four age categories.

Table 23

Relationship Between Age and Perceived Importance of High-Speed Internet Access for Coursework

	Age							
	<20		20-29		30-39		≥40	
Importance of High-Speed Internet Access	*N*	%	*N*	%	*N*	%	*N*	%
Not at all important	2	0.9	6	1.6	0	0.0	1	1.0
Moderately important	24	10.9	34	9.2	4	4.6	3	3.1
Important	48	21.7	66	17.8	15	17.2	13	13.3
Very important	147	66.5	264	71.4	68	78.2	81	82.7
Total	221	100.0	370	100.0	87	100.0	98	100.0

Research Question 15

Is there a significant relationship between age and student perceptions of the importance of high-speed Internet access as it relates to being successful in college?

To answer this question a cross-tabulated table and chi-square test were used to evaluate the following hypothesis:

> $Ho15_1$: There is no significant relationship between age and student perceptions of the importance of high-speed Internet access as it relates to being successful in college.

A 4x4 contingency table analysis was conducted to evaluate the relationship of age and the perceived importance of high-speed Internet to being successful in college. The chi-square was not significant, $\chi^2(9, N = 778) = 6.95$, $p = .643$, Cramer's $V = .06$; therefore, the null hypothesis was retained. As shown in Table 24, the perceived importance of high-speed Internet access for success in college was similar across the four age categories.

Table 24

Relationship Between Age and Perceived Importance of High-Speed Internet Access for Success in College

	Age							
	<20		20-29		30-39		≥40	
Importance of High-Speed Internet Access	*N*	%	*N*	%	*N*	%	*N*	%
Not at all important	1	0.5	3	0.8	2	2.3	0	0.0
Moderately important	15	6.8	25	6.7	4	4.6	4	4.0
Important	44	20.0	62	16.7	15	17.2	15	15.2
Very important	160	72.7	282	75.8	66	75.9	80	80.8
Total	220	100.0	372	100.0	87	100.0	99	100.0

Research Question 16

Is there a significant relationship between student financial need (regarding Pell grant funding) and the type of Internet access at home?

To answer this question a cross-tabulated table and chi-square test were used to evaluate the following hypothesis:

> $Ho16_1$: There is no significant relationship between student financial need (regarding Pell grant funding) and the type of Internet access at home.

Because the number of responses was low in several of the response categories related to type of high-speed Internet in the home, the response categories were collapsed into four categories: (1) High-Speed at Home (Cable, DSL, Satellite); (2) 3G/4G; (3) On-campus High-Speed; and (4) No High-Speed at Home (No Internet, Dial-up).

A 4x2 contingency table analysis was conducted to evaluate the relationship between Internet service type at home and whether students were Pell Grant recipients. Graduate students were removed for this analysis as they are not eligible for Pell Grants. The chi-square was not significant, $\chi^2(3, N = 580) = 5.81$, $p = .121$, Cramer's $V = .10$; therefore, the null hypothesis was retained. As shown in Table 25, for each Internet service type, the percentages of students receiving Pell Grants were similar.

Table 25

Comparison of Pell Grant Recipients by Type of Internet Service at Home

	Internet Service Type at Home							
	High-Speed at Home		3G/4G		On-campus High-Speed		No High-Speed at Home	
Pell Grant	*N*	%	*N*	%	*N*	%	*N*	%
Yes	150	45.5	14	37.8	67	35.1	8	36.4
No	180	54.5	23	62.2	124	64.9	14	63.6
Total	330	100.0	37	100.0	191	100.0	22	100.0

Research Question 17

Is there a significant relationship between age and how often students use or plan to use 3G/4G Mobile Broadband Service (via a Smartphone, Tablet, or Laptop Stick) for their coursework?

To answer this question a cross-tabulated table and chi-square test were used to evaluate the following hypothesis:

> $Ho17_1$: There is no significant relationship between age and how often students use or plan to use 3G/4G Mobile Broadband Service (via a Smartphone, Tablet, or Laptop Stick) for their coursework.

A 4x4 contingency table analysis was conducted to evaluate the relationship of age and the frequency of student use of 3G/4G mobile services for coursework. The chi-square was not significant, $\chi^2(9, N = 776) = 13.62$, $p = .136$, Cramer's $V = .08$; therefore, the null hypothesis was retained. As shown in Table 26, the planned use of 3G/4G mobile service for coursework was similar across the four age categories.

Table 26

Relationship Between Age and Use of 3G/4G Mobile Broadband Services for Coursework

	Age							
	<20		20-29		30-39		≥40	
Use 3G/4G for Coursework	*N*	%	*N*	%	*N*	%	*N*	%
Never	79	36.1	117	31.5	23	26.4	35	35.7
Once to a few times a semester	32	14.6	75	20.2	24	27.6	26	26.5
Once to a few times a week	55	25.1	101	27.2	19	21.8	21	21.4
Daily	53	24.2	79	21.2	21	24.1	16	16.3
Total	219	100.0	372	100.0	87	100.0	98	100.0

Research Question 18

Is there a significant relationship between student financial need (regarding Pell grant funding) and how often students use or plan to use 3G/4G Mobile Broadband Service (via a Smartphone, Tablet, or Laptop Stick) for their coursework?

To answer this question a cross-tabulated table and chi-square test were used to evaluate the following hypothesis:

> $Ho18_1$: There is no significant relationship between student financial need (regarding Pell grant funding) and how often students use or plan to use 3G/4G Mobile Broadband Service (via a Smartphone, Tablet, or Laptop Stick) for their coursework.

A 4x2 contingency table analysis was conducted to evaluate the relationship frequency of student use of 3G/4G mobile services for coursework and whether students were Pell Grant recipients. Graduate students were removed for this analysis as they are not eligible for Pell Grants. The chi-square was not significant, $\chi^2(3, N = 579) = 1.66$, $p = .645$, Cramer's $V = .05$; therefore, the null hypothesis was retained. As shown in Table 27, the percentages of students receiving Pell Grants were similar across all categories.

Table 27

Comparison of Pell Grant Recipients by Use of 3G/4G Mobile Broadband Services for Coursework

	Use 3G/4G for Coursework							
	Never		Once to a few times a semester		Once to a few times a week		Daily	
Pell Grant	*N*	%	*N*	%	*N*	%	*N*	%
Yes	84	44.7	45	40.2	57	38.0	52	40.3
No	104	55.3	67	59.8	93	62.0	77	59.7
Total	188	100.0	112	100.0	150	100.0	129	100.0

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This chapter contains the findings, conclusions, and recommendations for readers who may use the results as a resource when making planning decisions related to developing and delivering web-based classes and content at an institution of higher education. The purpose of this study was to examine the availability of broadband access for students at East Tennessee State University (ETSU). The study was conducted using data collected through an online survey of ETSU students enrolled in the fall semester 2013.

Summary

The statistical analyses reported in this study were based of 18 research questions presented in Chapters 1 and 3. In Chapter 3, each research questions was supplemented with one null hypothesis. Because the number of respondents for research questions 8, 9, 11, 12, and 13 was low, the 4 x 2 crosstabulated tables for these questions showed violations of the assumptions of the chi-square test. Therefore, these hypotheses were not tested. The remaining 13 research questions were analyzed using a cross-tabulated and chi-square test. The level of significance used in the statistical analysis was .05. In addition, research questions 1, 2, 5, and 6 were also analyzed using pairwise comparisons. For each of these four questions, the Bonferonni method was used to control Type I error at the .05 level across all comparisons. Seven hundred eighty-four questionnaires were captured for this study, which included 260 students living in on-campus housing. Findings indicated that there is a statistically significant relationship between the type of Internet service students have at home and whether they have taken a web-based course. In addition the findings indicated that there is not a significant relationship between student financial need (regarding Pell grant funding) and the type of Internet access at home. For this study findings also indicated that there is a significant relationship between the type of Internet students have at home and how often students use or plan to use ETSU computer labs. Students without high-speed Internet access at home reported that they use or plan to use the ETSU computer labs more frequently than other groups in the study. The findings also indicated that there is a significant relationship between the type of Internet service students have at home and how often students use the Internet for coursework at home. Students without high-speed Internet access at home reported that they used the Internet at home less frequently than other groups. In addition the findings indicate that there is a significant relationship between age and how students connect to the Internet at home. Students under 20 years of age were more likely to use 3G/4G as their primary way to connect to the Internet and to report no high-speed Internet at home. The findings indicated that there is not a significant relationship between age and how often students use or plan to use 3G/4G Mobile Broadband Service (via a smartphone, tablet, or laptop stick) for their coursework. The planned use of 3G/4G mobile service was similar across all age categories. The findings also indicated there in not a significant relationship between age and student perceptions of the importance of high-speed Internet access as it relates to their coursework. The perceived importance of high-speed Internet access was similar across the four age categories.

Conclusions

The purpose this study was to determine the availability of broadband access for students at ETSU and provide insight into the students' perception of the importance high-speed Internet as it relates to their coursework. Specifically, this research addressed the availability of broadband access for 784 students attending during fall semester 2013 at East Tennessee State

University. Because the return rate for this study is approximately 5.1%, it is important to note that the findings of this study may not generalized to other populations.

1. There was a significant relationship between the type of Internet service students have at home and whether they have taken a web-based course. The percentage of students taking online courses tended to be higher for those who had high-speed Internet service at home. Of the 483 students who had high-speed Internet at home, 64.2% had taken an online course. The Hurst (2010) broadband access study at Walter State Community College (WSCC) produced similar results. The WSCC students with faster internet connections at their place of residence were more likely to have taken a web-based course. Among the WSCC students with Internet access at their place of residence, 62.2% of those with cable modem access had taken an online course.
2. Students with high-speed Internet service at home were significantly less likely to report being discouraged from taking an online course than students with any other type of access. Only 9.1% of the students with a high-speed Internet connection at their place of residence reported that their Internet connection would discourage them from taking an online course.
3. Students without high-speed Internet access at home were significantly more likely to use or plan to use ETSU computer labs more frequently than other groups. Of the students without high-speed Internet access at home, 37.5% reported that they used or planned to use ETSU computer labs on a daily basis. The results from the WSCC broadband study also showed a significant relationship between the type of Internet service students have at their place of residence and how often they use the computer

labs for coursework. The WSCC students with slower Internet access at home were more likely to use or plan to use a computer lab more than once per week. Of the students without high-speed, 67.2% of students with no Internet access at home and 45.5% of those with dial-up access at home used WSCC computer labs more than once per week (Hurst, 2010).

4. The percentage of students without high-speed Internet access at home reported that they used the Internet for coursework at home less frequently than other groups. Also noteworthy, students with 3G/4G Mobile Broadband Access were more likely to report using the Internet at home for coursework once to a few times per week than other groups. Of the students with 3G/4G access, 31.3% reported using the Internet at home for coursework once to a few times per week. As noted in the literature review, smartphones are having an impact on higher education as students use these devices to access the Internet and applications to improve productivity (Meloni, 2009).

5. Students with high-speed Internet service at home were significantly less likely to report using the ETSU computer labs due to faster Internet connections than all other groups. Only 17.2% of students with high-speed Internet service at home reported that they use ETSU computer labs specifically because Internet access on campus is faster than the Internet service at their place of residence. Students without high-speed Internet access at home were significantly more likely to use the ETSU computer labs due to faster Internet connection than students with 3G/4G access or those that with on-campus access. There was no significant difference between those with 3G/4G access and those with on-campus access. The WSCC broadband study

revealed that the percentages of students using a campus computer lab because Internet access was faster increased as the speed of their Internet access at their place of residence decreased. Of the WSCC students that participated in the study, 77.3% of students with dial-up access at their place of residence used a campus computer lab due to the faster Internet connection (Hurst, 2010).

6. Students with high-speed Internet service at home were significantly less likely to report problems accessing D2L than all other groups. Only 6.4% of students with high-speed Internet service at home reported having problems accessing D2L. Students without high-speed Internet access at home were significantly more likely to report problems accessing D2L than all other groups. Also noteworthy, there was no significant difference in the percentage of students reporting problems accessing D2L between those with 3G/4G access and those with on-campus access.

7. Students under 20 years of age were significantly more likely to use 3G/4G Mobile Broadband Service as their primary way to connect to the Internet and report no high-speed Internet at home than all other age groups. Of the students under 20 years of age, 17.5% reported using 3G/4G Mobile Broadband as their primary way to connect to the Internet at their place of residence. Per the literature review, as the capabilities of smartphones continue to increase, these mobile devices are becoming the technology of choice for many college students (Yu, 2012).

8. There was a significant relationship between age and Internet service expense as a reason not to connect to the Internet. The percentage of students ages 30-39 were more likely to list expense as a reason not to connect to the Internet. Of the students ages 30-39, 10.5% listed expense as a reason not to connect to the Internet. Per a

previous research study, broadband affordability is a barrier to residential broadband adoption in that many low-income households cannot afford the monthly service fee (Bates et al., 2012).

9. The relationship between age and student perceptions of the importance of high-speed Internet access as it relates to their coursework was not significant. The perceived importance of high-speed Internet access was similar across all age categories. It should be noted that over 88% of students in each age group perceived high-speed Internet as either important or very important as it related to their coursework. The Hurst (2010) broadband study indicated that there was a significant relationship between the age of the WSCC students and the importance of high-speed Internet as it relates to coursework. Of the WSCC students aged 19 or younger, less than 8.2% indicated that high-speed Internet access was not at all important to moderately important. In contrast, 23.9% of students aged 40 or older felt that the importance of high-speed Internet service for completion of coursework was not at all or moderately important.
10. There was not a significant relationship between age and student perceptions of the importance of high-speed Internet access as it relates to being successful in college. The perceived importance of high-speed Internet to being successful in college was similar across all age categories. Also noteworthy, over 92% of students in all age groups perceived high-speed Internet as either important or very important to being successful in college.
11. The relationship between student financial need (regarding Pell Grant funding) and the type of Internet access at home was not significant. For students receiving Pell

Grants, the percentages for each type of Internet service in the home were similar. The Hurst (2010) broadband study at WSCC also revealed that there was not a significant relationship between financial need (regarding Pell Grant funding) and the type of internet access students have at their place of residence.

12. There was not a significant relationship between age and how often students use or plan to use 3G/4G Mobile Broadband Service (via a smartphone, tablet, or laptop stick) for their coursework. The planned use of 3G/4G mobile service was similar across all age categories. There are numerous studies related to the digital divide and adoption rate of new technologies. The adoption rate tends to be the highest among young adults from the age of 18 to 24 and lowest among older adults (Rogers, 2013). The findings in this study do not indicate that older students tend to be nonadopters of new technologies.
13. The relationship between financial need (regarding Pell Grant funding) and how often students use or plan to use 3G/4G Mobile Broadband Service (via a smartphone, tablet, or laptop stick) for their coursework was not significant. For students receiving Pell Grants, the planned use of 3G/4G mobile service was similar across all categories. As noted in the literature review, a 2011 Wakefield survey of 500 enrolled college students indicated that 98% of the students owned a digital device. The study also revealed that 38% of the students surveyed could not go more than 10 minutes without checking their digital devices such as smartphones and laptops ("Digital Dependence," 2011).

Recommendations for Practice

The study provided ongoing recommendations for practice as follows:

1. ETSU should require students to complete a questionnaire as part of the registration process to determine the type of Internet connections students have at their place of residence. This would allow administrators to make informed decisions related to delivering web-based courses and content. It would also help administrators to plan and strategically locate satellite computer labs in unserved and underserved areas.
2. Because most smartphones are Wi-Fi enabled, ETSU should continue to expand the number of Wi-Fi hotspots on campus. This will allow students to have greater access to the Internet without having to pay for the data usage through their wireless carrier.

Recommendations for Future Research

This study provided a broad overview of the access and usage of high-speed Internet for coursework for ETSU students; however, the following represent recommendations for further study:

1. A similar study with research questions specifically related to 3G/4G Mobile Broadband Service should be conducted at other higher education institutions in Tennessee. The study should focus on the use cases and quality of service for 3G/4G Mobile Broadband Service devices and applications in the college environment. In addition, the study should include questions specific to which features of learning management systems are accessible and operable on 3G/4G mobile devices.
2. This study did not focus on synchronous online courses that use applications such as Wimba Classroom and Adobe Connect. These synchronous courses allow students to join a virtual classroom and connect in real time with the instructor and students in other

locations. Therefore, a study should be conducted that focuses on the use cases and issues related to students accessing synchronous online courses over the Internet at their place of residence.

3. This study did not focus on the role 3G/4G mobile devices play in the lives of students in higher education. A study should be conducted to help higher education administrators better understand how students are using 3G/4G mobile devices in their everyday lives to network with other students and facilitate the learning process. The study should focus on exploring the various smartphone applications and social media websites used by college students to interact with classmates, share content, and set up study group meetings.

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APPENDICES

APPENDIX A

Permission to use the ETSU Broadband Internet Access Survey

Email received on 02/09/2012 @ 10:44 AM

Hello:

Thank you for meeting with me yesterday to discuss your dissertation proposal and plans to survey ETSU students. As per our discussion, the survey will be distributed by you via email distribution lists that you create and you are not asking the ETSU administration to distribute your survey but are asking only for permission to survey ETSU students. Based on these facts, Dr. Bert C. Bach, Provost and Vice President for Academic Affairs has approved the survey. Permission to administer this survey does not impact or change the necessary IRB approvals or any other established dissertation protocol defined by the academic department.

Please feel free to contact me if you have additional questions or concerns.

Karen King, PhD
Vice Provost for eLearning
East Tennessee State University

Email sent on 02/06/2012 @10:07 AM

ETSU Broadband Access Survey – Request for Permission

Dr. King,

I am currently a doctoral student in the ELPA department at ETSU. I am in the dissertation phase of the program and would like to conduct a Residential Broadband Access study for both ETSU graduate and undergraduate students. Dr. Lampley suggested that I schedule a meeting with you to discuss the topic in more detail and get your permission to conduct the study. My schedule is flexible, so I can meet at your convenience.

NOTE: I am replicating a study that was conducted a Walter State Community College (see attachment)...the study was conducted to determine the availability and type of broadband access students have in their homes.

Thanks!

Scott Sawyer - Doctoral Fellow

APPENDIX B

Email Invitation Sample to Potential Participants

Dear ETSU Student:

Please take a moment to complete a brief online survey. It takes less than 3 minutes to complete this survey. This research study examines the availability of high-speed Internet access for students enrolled at East Tennessee State University.

By deepening the understanding of how students connect to the Internet, East Tennessee State University administrators can make more informed planning decisions when developing and delivering web-based classes and content.

This survey is completely anonymous and confidential. In other words, there will be no way to connect your name (or other personally identifying information) with your responses. The responses to the Pell Grant award question will be used to determine if there is a relationship between financial need and how students connect to the Internet from home. This survey received IRB approval.

By clicking on the URL link below (which will take you to the survey), you confirm that you have carefully read and understand the above information about the study and that you are 18 years of age or older.

Use this link to access the survey: (Insert URL Address here)

Copy and paste the link to the web browser if you cannot gain access through the link.

If you have any questions or problems, you may contact Scott Sawyer at scott.sawyer@myers-sawyer.com

Your participation in this research survey is voluntary.

Sincerely,

Scott Sawyer
Doctoral Student
Educational Leadership

APPENDIX C

ETSU Broadband Internet Access
Student Survey

This brief survey is designed to gather information regarding East Tennessee State student access to high-speed Internet. Your responses to this questionnaire are strictly confidential. Information regarding the location of your residence is for the purpose of identifying areas where high speed Internet service is unavailable or where the service is poor. Your participation in this survey is greatly appreciated.

1. What is your age? ___________

2. Is this your first semester attending ETSU?
   ___a. No
   ___b. Yes

3. What is your program level?
   ___a. Bachelor's
   ___b. Master's
   ___c. Doctoral
   ___d. Other (Please specify) ____________

4. Are you receiving a Pell Grant award this semester?
   ___a. No
   ___b. Yes

5. What is your county of residence?

___a. Anderson	___ h. Hawkins	___o. Unicoi
___b. Blount	___i. Jefferson	___ p. Washington
___c. Carter	___ j. Johnson	___ q. Washington, VA
___d. Cocke	___ k. Knox	___ r. Other (Please specify) ___________
___e. Greene	___ l. McMinn	
___f. Hamblen	___ m. Sevier	
___g. Hamilton	___ n. Sullivan	

6. What is your home zip code? __________

7. Do you live in ETSU On-Campus Housing? Yes___   No ___

8. How do you primarily connect to the Internet at your place of residence?

___a. I do not have Internet service
___b. Dial-up access
___c. Cable modem
___d. DSL modem
___e. Satellite modem
___f. 3G/4G Mobile Broadband Cellular Service (Smartphone, Tablet, or USB Laptop Stick)
___g. ETSU On-Campus High-Speed Internet Access

9. If you do not have Internet access at your place of residence, please indicate the reason(s). (Check all that apply.)

___a. I have high-speed Internet access at my residence
___b. I have dial-up Internet access at my residence
___c. I don’t have a computer at home
___d. I don’t need Internet access at home
___e. Internet service is too expensive
___f. Internet speed is too slow
___g. Internet service is poor
___g. There are no high-speed Internet providers in my area
___h. Other (please specify) __________________________

10. Approximately how much do you or your parents pay for high-speed Internet service per month?

___ I do not have high-speed Internet access at my residence

Monthly service fee__________

11. How satisfied are you with the speed/quality of the high-speed Internet service at your place of residence?

___a. Very dissatisfied
___b. Dissatisfied
___c. Neutral
___d. Satisfied
___e. Very satisfied
___e. I do not have high-speed Internet access at my residence

12. Do you ever use an East Tennessee State computer lab specifically because Internet access on campus is faster than the Internet service at your place of residence?

___a. No
___b. Yes
___c. I do not have Internet access at my residence

13. Have you ever taken (or are you currently taking) an online course at East Tennessee State University?

___a. No
___b. Yes

14. How important is high-speed Internet as it relates to your coursework?

___a. Not at all important
___b. Moderately important
___c. Important
___d. Very Important

15. How often do you use the Internet for your coursework at home?

___a. Never
___b. Once to a few times a semester
___c. Once to a few times per week
___d. Daily

16. How often do you use or plan to use an ETSU computer lab for coursework?

___a. Never
___b. Once to a few times a semester
___c. Once to a few times per week
___d. Daily

17. How often do you use or plan to use 3G/4G Mobile Broadband Service (via a Smartphone, Tablet, or Laptop Stick) for your coursework?

___a. Never
___b. Once to a few times a semester
___c. Once to a few times per week
___d. Daily

18. Is accessing D2L from your place of residence a problem for you?

___a. No
___b. Yes

19. Has the internet connection at your place of residence discouraged you from taking an online course or would it in the future?

___a. No
___b. Yes

20. How important is a high-speed internet connection to being successful in college?

___a. Not at all important
___b. Moderately important
___c. Important
___d. Very Important

Thank you for your participation!

VITA

THOMAS SCOTT SAWYER

Education:

Ed.D. Educational Leadership, East Tennessee State University, Johnson City, Tennessee, 2013

M.S. Technology, East Tennessee State University, Johnson City, Tennessee, 1994

B.S. Electronics Engineering Technology, East Tennessee State University, 1987

A.S. Electronics Technology, Asheville-Buncombe Technical College, 1985

Professional Experience:

Doctoral Fellow, East Tennessee State University, Johnson City, Tennessee, 2008-2013

Owner/Broker, Myers-Sawyer & Associates, Asheville, North Carolina, 2006-2013

Director of Product Management, MCCI, Research Triangle Park, North Carolina, 2003-2006

Product Manager, Sony Ericsson Mobile Communications, Research Triangle Park, North Carolina, 2000-2003

Product Marketing Manager, Ericsson Enterprise Solutions, Research Triangle Park, North Carolina, 1998-2000

Operations Manager, Philips Components, Columbia, South Carolina, 1996-1998

Manufacturing Manager, Philips Consumer Electronics, Greeneville, Tennessee, 1995-1996

Management Development Program, Philips Consumer Electronics, Greeneville, Tennessee, 1989-1995