Providing Resources for the Advancement of Rural Broadband in Native Communities

An Interactive Qualifying Project
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ABSTRACT

The Pueblo people have existed in the southwestern United States for millennia. Today, the Santa Fe Indian School provides secondary education to children from the 19 remaining Pueblos in New Mexico. Our group worked with Kimball Sekaquaptewa, the school's IT coordinator, to support her broadband upgrade efforts by assessing rural internet availability and exploring ways of encouraging its effective use among pueblo populations. We collected data about the current state of pueblo internet use and attitudes through interviews, surveys, and speed tests. These findings provided a baseline dataset for further tests to build upon, and informed infographics that we created to share our findings among various native constituencies.

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EXECUTIVE SUMMARY

As telecommunications technology advances, broadband internet usage grows across the country: approximately 95% of Americans have at least one type of access to the Internet. This does not mean that 95% of Americans are connected to high-speed services due to limited access and lack of interest. The "digital divide" defines this gap in broadband availability. Demographics such as income, race, age, and education affect the divide. The digital divide affects rural communities in America because internet service providers are less willing to work with rural areas due to the higher cost of installation and a smaller customer base (Dickes et. al. 2016). Without affordable cost, quality speeds, or means of access, rural communities do not have the option to connect even if residents wish to gain the benefits broadband might bring.

We worked with the Santa Fe Indian School (SFIS), the school's information technology (IT) coordinator Kimball Sekaquaptewa, the students, the state IT agencies, tribal libraries, and the 19 Pueblos of New Mexico. This project informs efforts that work to better connect Pueblos through the national program E-Rate. We collected tribal internet usage data and built a knowledge database specific to these communities. Three analytical categories guide our approach to how the digital divide affects the Pueblo peoples: access to internet technology, inclination to adopt it, and knowledge to use it. We created educational resources to foster community discussion of broadband upgrades and provide the critical information for stakeholder groups to make informed decisions.

Methods

We accomplished our project goals by compiling market research, gathering speed test data, and conducting interviews, surveys, and focus groups. We compiled research on rural broadband adoptions and usage to create a data repository. Measuring the levels of internet service in the rural locations of New Mexico analyzes the current available options. Pueblo libraries are often internet hubs thus a good estimate of the community's connection. Tribal librarians conducted speed tests three times a day for one week on both wired and wireless machines. We interviewed librarians to understand tribal libraries as community and computing hubs. Next, we conducted a focus group and survey with SFIS students to collect community opinions on internet upgrades and usage. The project generated a baseline dataset to show growth in these communities as upgrades occur. We created infographics that visually represent the dataset and can be used to support future initiatives.

Findings

After synthesizing the data we collected, we extracted five major conclusions:

1. Although internet use is growing in American society, Native American communities are still behind in both broadband access and utilization.
2. Libraries act as important community hubs by providing educational programs for all ages, safe spaces, and technological resources such as internet and computer access. In some places the libraries are the only places these can be accessed by community members.
3. It is difficult for native communities to get internet access for various reasons: including the reluctance of ISPs and lack of infrastructure, interest, and/or knowledge regarding broadband use.
4. Speeds measured on site may not match those reported by the ISPs, which means that Native community members are not always receiving the speeds they pay for.
5. Some adults and tribal leaders are skeptical of the Internet because of its potential impact on the culture of the Pueblos, but students and librarians recognize its potential to advance many facets of pueblo life, especially education.

Deliverables

Our efforts produced resources to help advance the efforts of improving broadband access for pueblo communities. An annotated bibliography of rural and native connectivity sources provided essential analytical assistance during the project phase, but turned out to be a valuable deliverable in itself. More importantly, project findings informed the five original infographics we created, which address how internet can be used to address digital divide issues in each of the three categories access, inclination and knowledge.

1. Types of Internet Connections: This infographic presents speed, cost, and availability information for the major types of connections available today in an easy to understand format. It also contains the speeds required to do common tasks to give context.
2. Urban vs. Rural Connectivity: Presents information regarding why people choose not to connect to the Internet and what types of connections are most utilized in rural and urban situations while also outlining the digital divide and its effect on rural communities.
3. Tribal Libraries - Community Computing Hubs: We show a model of a typical pueblo library and highlight the services it can provide to show tribal communities the opportunities their libraries hold and bring a discussion on how the tribal community members could improve with upgraded broadband.
4. Broadband as a Tool for Government: This infographic presents to tribal governments concrete ways that better internet can improve how they function to take care of their

community through the services of healthcare, education, public safety, library services, and communication.

5. Online Learning - Education at a Distance: A computer screen with windows representing distance learning tools for students shows the importance of internet for education. Students at SFIS support this statement with data from the student survey.

Recommendations

We provided recommendations for how the pueblos can utilize our deliverables and apply our methods to continue improving the broadband efforts as a community.

1. Establish libraries as 'critical infrastructure' in these tribal communities, resulting in more adequate funding for broadband connections. The E-Rate program connects libraries and schools. When they are connected, the rest of the tribal community can branch off from these institutions.
2. Utilize more focus groups and surveys to help foster a widespread community discussion about broadband adoption. Engaging more community members collects more opinions on broadband and informs the community on the effects of better internet.
3. Complete speed tests as a collaborative effort to create more valuable data and show the effects of future broadband upgrades by taking more speed tests over a longer time scale and by having more individuals participate.

CHAPTER 1: INTRODUCTION

As telecommunications technology advances, broadband internet usage grows across the country. Approximately 95% of Americans have at least one type of access to broadband internet. However, this does not mean that 95% of Americans have high-speed services due to limited access or lack of interest. The digital divide defines this gap in broadband availability and is affected by demographics such as income, race, age, and education. The digital divide affects rural American communities because of higher cost of installation and a smaller customer base for internet service providers (ISP) (Dickes et. al. 2016). Without affordable cost, quality speeds, or means to access broadband internet, these communities do not have the option to connect, even if residents wish to gain the possible benefits of a faster connection.

New Mexico is one of the more rural states in America, with a small percentage of internet users (Reese 2015). Native American Pueblos are more likely to experience the effects of the digital divide than other rural communities. According to the Federal Communications Commission's (FCC's) 2016 Broadband Progress Report, 25% of the state does not have broadband internet while 80% of the pueblo lands do not have access. Factors like physical connections, cost, need/desire, and attitude towards the Internet affect their connectivity. They are grouped into three categories of the digital divide: access to internet technology, inclination to adopt it, and knowledge to use it. Lack of access to internet is driven by cost, availability, quality and speed, and access to equipment (i.e. computers). Pueblo community members' opinions, expectations, and apprehensions about the Internet suggest that there is a significant inclination barrier. Finally, communities might not be equipped with the knowledge and information to effectively utilize broadband internet in a way that aligns with the community's goals.

The FCC reports that from 2015 to 2016 the percentage of tribal communities without broadband access decreased from 89% to 80%. Amongst the Pueblos, some community members see the potential opportunities for empowerment from internet and technology. Increasing grant programs that improve broadband infrastructure led to progress in internet access within American Indian communities. Agencies such as the FCC run programs that provide funding for broadband projects. E-Rate is an FCC program that funds infrastructure development in schools and libraries (NTIA 2015, 8). These projects emphasize the benefits of faster internet connectivity and strive to bring better broadband to the communities that lack the connection because "such a divide cannot

be allowed to continue in Indian Country" (National Indian Telecommunications Institute 2001), as described by a program dedicated to bring technology to Indian communities.

Broadband initiative programs intend to bring advantages of internet to these communities. A small percentage of the tribal communities have broadband access and some have limited speeds within their connection. Each Pueblo has different tribal governments thus no universal solution exist. While programs try to bring internet to rural areas, pueblo communities have concerns about maximum benefits for the tribes: which type of connection is best, worth of cost, safe connection, and skills required (National Indian Telecommunications Institute 2001). Through collaborating with Pueblos, we utilized a different method of communicating the potential benefits of broadband connectivity based on the benefits, needs, hopes, and concerns of the tribes.

This project team worked with Kimball Sekaquaptewa, the information technology coordinator at the Santa Fe Indian School (SFIS), the students at SFIS, the state IT and library agencies, and pueblo communities to explore possible broadband solutions and used interviews to create an education plan to inform pueblo communities about broadband internet options and uses. Ms. Sekaquaptewa helps these communities acquire better broadband internet access and be informed about its usage. The first step for her broadband efforts requires E-Rate to connect the tribal schools and libraries. The fiber infrastructure will act as a backbone to connect other buildings in the Pueblos such as tribal offices and health clinics. In the future, the backbone will extend to connect the rest of the community wirelessly. Ms. Sekaquaptewa and the Santa Fe Indian School focus their endeavors on connecting the Pueblos through community collaboration.

This project helps provide resources for the Santa Fe Indian School's efforts for advancing the broadband opportunities in rural, tribal communities. The Santa Fe Indian School and Ms. Sekaquaptewa want to improve broadband connection in the pueblos to address the digital divide in native communities and bring more opportunities in education, government, and services such as healthcare and public safety. The project-generated infographics that can foster discussions among community members about broadband adoption in the Pueblos and can be used in future initiatives involving broadband advancement.

CHAPTER 2: BACKGROUND

For a variety of reasons, connecting the Pueblos to the Internet can be seen as both an unlikely and partially unwelcome course of action. They have an autonomous government and traditional culture as well as a rural divide, which separates them from the rest of America in many ways. They are disconnected by lifestyle and also in technology, which often includes broadband internet connectivity. The Pueblos have an interest in bringing better broadband connections to their communities in hopes of acquiring better access to tools and services they could not otherwise make use of. This chapter contains research on topics that can inform these efforts, starting with the history, culture, and geographical setting of the tribes. The chapter also provides information on the technological aspects of the project, including internet types and demographics, the digital divide, and different opinions on technological advancement. Lastly, this chapter goes into depth about our sponsor by explaining how the history and current status of the Santa Fe Indian School can inform our project's outcomes.

2.1 History of the Pueblos

While their ancestors have been in the region for millennia, the 19 Pueblo tribes of New Mexico have existed in the southwestern US for over 600 years and are still able to preserve their culture. Figure 1 shows the location of the 19 remaining Pueblos; many are clustered around the two major cities in New Mexico: Santa Fe and Albuquerque. "The Indian people know themselves to be nations, and the demand for self determination and self government is the articulation of that knowledge," (Sando 1998, 5). These sovereign nations make decisions based on their self-determination and the consent of their members. Some have adopted many modern conveniences that would be found throughout the United States; others still lack access to new technology, such as internet connectivity. Additionally, in some traditional villages, the Pueblos have chosen not to use electricity and the services that come with it. With or without these modern technologies, pueblo communities maintain strong ties with their sovereignty, cultures, and traditions.

Figure 1: Map of Pueblo Indian villages.

Received from: http://www.clayhound.us/map-page.htm

2.1.1 History of the Pueblos

The culture of these people grew with an oral system therefore their history is told in stories. "The Pueblos are an ancient people whose history goes back into the farthest reaches of time," (Sando 1998, 21). For a long period of time, the ancient people traveled across the continent, going from place to place. Eventually, they settled in the southwest, "a land where they were safe from catastrophes of nature" and they were able to fulfill their "longing for perfection in their society and harmony with their environment," (Sando 1998, 22). The land provided the Pueblos what they needed to prosper; therefore they permanently settled in the area 800 years ago and remain there to this day.

The modern day Pueblo Indians are descendants of the Ancestral Puebloans, known as the Anasazi, which in Navajo means "ancient enemies." The remaining 19 Pueblos are divided into northern, southern, and western divisions. The Northern Pueblos are Taos, Picuris, Santa Clara, San Juan, Nambe, Pojoaque, San Ildefonso, and Tesuque. Cochiti, Jemez, Sandia, San Felipe, Santa Ana, Santo Domingo, and Zia make up the Southern Pueblos. Finally, Isleta, Acoma, Laguna, and Zuni are the Western Pueblos, (Sando 1998, 7). This divide was formed because of social, cultural, and

language differences. Despite these differences, the 19 Pueblos share a similar lifestyle and philosophy. There are many languages and dialects spoken among the Pueblos. In the past, Pueblo people were multilingual as they communicated across the different communities. Today, only their own tribal language is taught in tribal schools beyond English, which is the shared language (Sando 1998, 9).

Despite different cultural variations in ritual observance practices, the Pueblos share a common traditional native religion. They "carefully memorized prayerful requests for an orderly life, rain, good crops, plentiful game, pleasant days, and protection from the violence and the vicissitudes of nature," (Sando 1998, 32). For the Pueblo people, their religion tries to find a harmonious relationship between man and the world he lives in. Prior to the arrival of the Spanish, the Pueblos lived in a peaceful nature. "Pueblo religion does not proselytize. It is not written, but is enshrined in the heart of the individual," (Sando 1998, 32). "Despite their varied traditions, languages, and observances, they had managed to live peacefully and in a spirit of greatest cooperation, until the Europeans arrived," (Sando 1998, 17). The peaceful way of life these native people have been living for centuries changed drastically when these European foreigners arrived.

The Spanish arrived in the pueblo land in 1540. Over the next century, Spanish asserted their dominance and their Catholic religion. The difference in religion "provided only mild curiosity among the Pueblo people at first, but matters changed radically when it became perfectly clear that the foreigners intended to force the new religion upon the native people," (Sando 1998, 59). There were those who "suffered silently, unreported, and unknown except to their families and the people of their pueblo." There were public hangings and displays of violence against pueblo leaders by Spanish governors, which angered the native people. Afterwards, a man from San Juan "united the Pueblos in an effort to expel the hated Spaniards, resulting in the first American Revolution in 1680," (Sando 1998, 63).

The Pueblo Revolt broke out after years of the tribes being forced to convert to Catholicism and servitude in the encomienda and repartimiento systems. "The Spaniards became repugnant to the people, for their indifference to human suffering, as well as for their ceaseless demand for produce, labor, and services," (Sando 1998, 63). The Pueblos successfully routed the Spanish from the New Mexico territory. The revolt was described as "the single most successful act of resistance by Native American against a European invader" (Hackett and Shelby 1946). The Pueblos were able to restore their own government and religion in their communities. All the Spanish churches were

destroyed. Unfortunately, there were quarrels among the different societies and dry years made the situation worse because food was scarce.

In 1692, the Spanish returned resulting in upraises and a divide between the Pueblos. "Much of that unity that had existed earlier was gone. While some Pueblos still resisted the Spaniards, others cooperated with them," (Sando 1998, 71). By 1700, the number of pueblo villages reduced drastically because people left the area to escape the Spanish reign or were killed. In 1706, the Spanish authorities held a meeting inviting the entire pueblo governors in an attempt to bring the Pueblos into alliance with them. This gathering resulted in good relations between the Spanish authorities and the Pueblos. "And so the alliance between conquerors and conquered was made firm," (Sandos 1998, 79). The two cultures "merged to form a blend of spirituality and tradition" that included symbols and practices from both cultures (United States 2016, 1), providing the unique characteristics that define the southwestern area of the United States today.

2.1.2 Geography of the Pueblo Area

The New Mexico area, similar to most of the southwestern United States, has a dry and arid climate due to the mountains in the northeastern part of the state that prevent the rain clouds from entering the region. In northern New Mexico, there are grasslands, red-rock formations, and bluffs, which are giant rock formations that have been carved out by rivers and glaciers. The desert-like climate and the high elevation are characteristics of New Mexico.

The Rio Grande was a constant and reliable water source for the eastern villages. These tribes were typically farmers who grew mainly corn and cotton. These farms flourished due to the river. Farming was less common in the western villages because there wasn't a reliable water source (Pueblo Indian 2015, 1). "As barren as the desert may appear, and as rugged as the mountains may seem, the ancient ones wrested their livelihood from the land. The secret of their success was simple. They came face to face with nature, but did not exploit it," (Sando 1998, 24). Although the environment was rough, the native people were and are able to work with the earth while living in the area.

2.1.3 Contemporary Pueblo Life

Contemporary pueblos preserve their traditions of "kinship systems, religion, and craft," but have also adopted many modern conveniences (Pueblo Indians 2015, 1). Each Pueblo creates its own system of government and set of rules that must be followed within the Pueblo. Because of this

local sovereignty, any people who do not live in the village are required to abide by all the rules of that Pueblo once they enter. Some examples of rules are: no pets are allowed in the village, obey all posted speed limit signs, and stay off all walls and structures "since some are several hundred years old and can be easily damaged" (United States 2016, 1). These rules can also be found all throughout the United States where cultures are attempting to preserve the historical landmarks, but the tribes' governmental autonomy and history of cultural degradation at the hands of outsiders may serve as additional motivation to uphold these rules.

Modern day pueblo villages act as tourist attractions in addition to homes for many of the native Pueblo people, so some of the governments have enacted restrictions regarding photography in the area. These regulations about photography and video recordings vary from Pueblo to Pueblo. Some Pueblos require you to obtain a permit in the village in order to use the camera or video recorder. However just because one obtains a permit to take photos, they still have to ask permission to take pictures. In 1692, after being harassed by the Spaniards to change religions, the native people eventually adopted their beliefs. Today these observation and camera rules exist because the fear of being submitted to another religion still persists for these cultures (Sando 1998, 30).

The economy in contemporary Pueblos thrives wherever symbiotic relationships have been established with those outside pueblo culture. Many pueblo villages are known for their hand-made artwork, such as pottery, jewelry, baskets, paintings, and other crafts. These items are made in the villages and then sold in the many markets in and around the nearby towns. These markets not only attract tourists to the area, the individuality of the crafts also draws the tourists out of the city to each pueblo village. The capital city, Santa Fe, benefits from the annual Indian market held by the Pueblo Indians. The Indian market contains markets and Indian dances that draw tourists into the city and also advertise for the local pueblo villages. The mutual relationship between the city of Santa Fe and the pueblo tribes is beneficial to both economies (Moke 1946, 148-152), and is something that both the state government and the tribal leaders work to maintain.

Many of the Pueblos' decision-making bodies consist of a tribal council, not an official planning board (Bottom et. al. 2015, 18). Due to the differences between native and mainstream American culture and values, these tribal councils may prioritize different goals than traditional western planning schemes: instead of trying to maximize profit or nurture business opportunities, these councils often place community wellbeing above other concerns. An MIT study (Jojola 1995, 3) condensed these concerns nicely into five basic principles that guide tribal planning:

1. People thrive in community;
2. Ordinary people have all the answers;
3. People have a basic right to determine their own future;
4. Oppression continues to be a force that devastates people; and
5. The people are beautiful, already.

The community-centered axioms listed above demonstrate how these tribal councils value things like autonomy, preservation, cooperation, and group advancement. Values like these lead to starkly different political outcomes in pueblo culture, especially in terms of the timeline of community growth and governance.

While some pueblos have obtained modern conveniences, not all pueblos rely on modern technology and power sources. Many villages have individual websites that share information on the history of their tribe, the government, educational programs, and more. 12 out of the 19 Pueblos advertise a public library on their website which acts as a part of their educational program as well as a hotspot for internet access. However, a few pueblos do not have access to running water or electricity, such as the Acoma Pueblo. Lastly, the per capita income of all 19 Pueblos ranges from $5,000 to $13,000, which leads to some pueblos having stronger economies and utilizing more modern conveniences than others (U.S. Census Bureau 2010, 1).

2.2 Internet

Twenty-first century society has adopted a standard that continuously merges technology into everyday life. Specifically, internet is used as a network system for connections and communication worldwide. The Internet was developed in the second half of the twentieth century as a global communications network that was designed to connect computers, networks, and facilities with information. Today, healthcare systems, banking, businesses, education, and social relationships have all become extremely vulnerable due to their heavy dependence on the Internet. Over the last two decades, internet connections have been enhanced in many ways, leading to a multitude of connection options for customers and an almost limitless amount of content that can be accessed online.

2.2.1 Types of Internet

The simplest internet connection is dial-up, which is named as such because the user must dial a phone number provided by the Internet Service Provider (ISP) to turn it on. This connection uses an analog modem (modulator/demodulator) to convert analog data from phone lines into digital data that computers can read (Kang 2016, 1). It is usually the slowest and cheapest form of Internet that is widely available, but often costs extra in rural areas. Integrated Services Digital Network (ISDN) is more advanced than dial-up because it is always on but isn't fast enough to qualify for broadband and is more expensive.

Digital Subscriber Line (DSL) was one of the earliest types of broadband connections available and uses the maximum phone line capacity for data transfer. DSL has several types including ADSL (asymmetric), which has a faster download speed, and SDSL (symmetric), which has equal upload and download speeds. One downside of DSL service is that it depends on the installation of nearby phone lines, which can be an issue for rural communities as these phone lines would have to cover significant distances (Kang 2016, 4).

Cable connections have the ISP, which in this case is a cable TV company, send a connection to the user's cable modem via TV cables that are all connected in a network. This allows all devices in a neighborhood with these cables to communicate with each other. A cable connection would have speeds comparable to DSL but would depend on the presence of TV cables and how well the network would hold up for multiple users (Kang 2016, 5).

A leased line is a phone internet connection with several channels that is rented directly from the phone company. As a private line, it provides internet connection only to the owner or owners, so it has less interference and is very fast. However, it is very expensive and is meant mainly for businesses, not homes, so it is not usually utilized in more rural areas where the infrastructure is mostly residential.

Wireless connections do not depend on cables being run to individual homes and can be used for "last mile" connectivity, which is defined as the final stretch of telecommunications delivery to customers. Fixed wireless connections are more popular in rural areas because the lack of cables makes them more accessible as well as more convenient. A mobile broadband connection uses a cellular modem to connect devices through the user's cell phone the same way a regular modem connects devices through the phone lines (Kang 2016, 7). Because of the ubiquity of cell phone service now, it is sometimes the only connection available for many rural areas like the Pueblos. Internet through a satellite connection does not require a wired connection either, but it may be

expensive and will not perform well in certain weather conditions such as rain.

The final type of internet access is a fiber-optics line, which converts data into light and runs it through fiber cables. Fiber connections include fiber to the node (FTTN), which has a small amount of fiber and then cheaper cables like copper running to the user, and fiber to the premise (FTTP), which runs fiber the whole way. A fiber connection would be very expensive, but fiber has extremely high bandwidth and can have high-speed access depending on the distance from the ISP. (Federal Communications Commission 2014). Also see Appendix A.1 for more information on the types of internet connections.

2.2.2 Internet Connection Demographics

Over the last 15 years, the number of people using broadband has grown steadily, with this growth concentrated more among 18-24 year olds and less among seniors (55+ year olds). Statistics show that internet usage is proportionate to both income and education. Therefore, people with a higher income and access to higher educations are more likely to have internet access. It also appears that internet usage is highest among whites and Asian Americans, while African Americans, Hispanic Americans, and Native Americans have experienced slower growth for internet usage. In addition, the Internet is used more by families than non-family groups, with unemployed and disabled citizens having the lowest usage amounts. Finally, researchers have detected no difference between genders in internet use (National Telecommunications and Information Administration 2011).

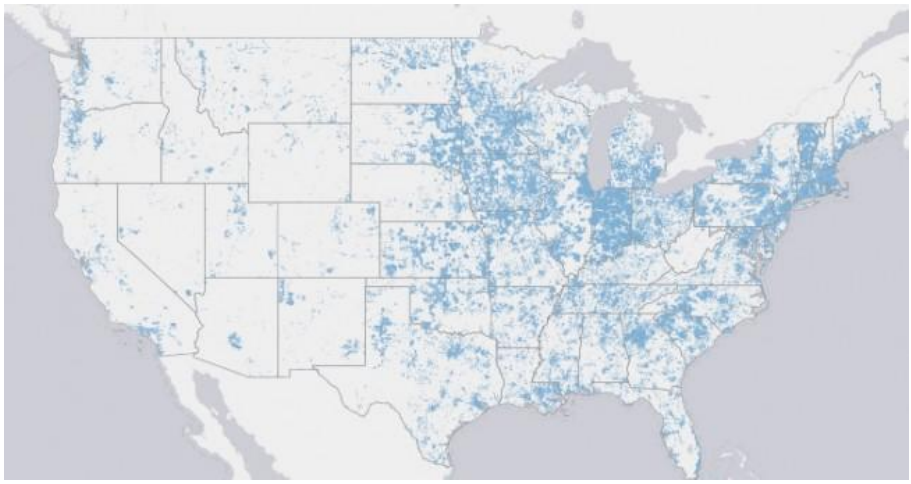

Figure 2: National Broadband Map shows concentrations of Internet connections.

The FCC's broadband adoption data shows how many people adopt a broadband connection, and the National Broadband Map shows details about the Internet availability for specific regions of the United States (shown in Figure 3). The data states that generally, broadband implementation increases jobs, creates economic growth, introduces a larger customer base, and allows businesses to grow. However, sometimes the introduction of broadband to rural areas coincides with a job decline. The reason for this could be that the Internet allows communities to outsource jobs to other areas, taking jobs away from the communities themselves. It could also be that the residents of these communities don't have proper education and training on Internet usage, which could limit the effectiveness of the benefits presented by broadband internet (Whitacre/Strover 2014, 666). However, in general, the Internet has brought many benefits to the communities all over the world.

2.2.3 Internet in New Mexico and Pueblo Villages

New Mexico is the 37th most connected state in the country by percentage of population. The state has a total of 98 broadband providers; in particular, the city of Santa Fe has 27 providers. Even with this seemingly large number of providers, 24% of the New Mexico population still does not have internet access and many others are limited to only one provider. Indigenous communities and other rural New Mexicans belong to this sector of the population (Reese 2015).

The New Mexico Broadband Program (NMBBP) is an initiative proposed by the NTIA and New Mexico Department of Information Technology, whose goal is to survey availability and increase the adoption of broadband in New Mexico. The program's website contains several maps detailing the presence of each type of broadband connection in New Mexico, gathered from ISPs by the Earth Data Analysis Center (EDAC). The NMBB Speed Test is an online test, which can tell users the Internet connection speed at any address in New Mexico. It also supports the Community Anchor Institution Assessment (CASA) by identifying community anchor institutions in New Mexico that need broadband the most. Lastly, it contains demographic surveys that describe the overall internet usage of the state, including applications for telehealth, education, and economics. The NM Community Broadband Master Plan Guidebook helps New Mexico towns improve their internet, while the NMBBP training resources teach computer skills and broadband education for users. In addition to this, it contains a list of potential grant programs that could help improve the Internet in New Mexico (New Mexico Department of Information Technology 2013).

In an IQP entitled "Improving the High Speed Internet Infrastructure in Santa Fe: Analysis of Potential Options", a group of students investigated internet options for the city of Santa Fe. Through collecting internet data from coverage maps and interviewing local businesses, they concluded that a fixed wireless system would make the most sense, as it is relatively low cost and easy installation process (Allison et. al. 2012, 42). While this recommendation may not apply to the pueblo communities, it is worth considering because they are small communities, but a more robust system like fiber may need to be implemented to get the initial connection into the area.

As well as providing a recommendation for which type of internet was best suited for Santa Fe, the 2012 IQP study stressed the importance of an educational program aimed at informing the potential users about their current internet access, their options for upgrading, and why a faster connection could benefit them (Allison et. al. 2012, 43). A similar program will be important in the pueblo communities, as they should be as well informed as possible when they decide if and how to upgrade their connections as well as when they are learning to utilize the better connections.

The pueblos also face a divide: some pueblos are better off than others, and may have more than one ISP to choose from, while others only have one ISP option available to them. Thus if the price is too expensive or the connection is not fast enough, these pueblos do not have another choice and cannot get connected. Finally, some do not have internet access at all. In these cases, those that want internet may have to drive miles away from home to use a public source such as a public library.

The pueblo libraries are the main public internet access points in these communities. Tribal libraries have several responsibilities, including the preservation of language, ways of life, and culturally significant items. However, they are often too remote to get the resources they need and get less funding than other libraries since they are affiliated with tribal governments (ATALM 2014, 2). However, the National Broadband Plan stated in 2010 that libraries can help broadband development by providing access to the Internet and with digital inclusion, or the "ability of individuals and groups to access and use information and communications technologies" (ATALM 2014, 3). As a result, government funding for tribal libraries has increased the amount of them connected to the Internet to 89%. Today, many tribal libraries in New Mexico provide internet access, training, and Wi-Fi or mobile access.

In many of the Pueblos, many private homes do not have internet connections due to the lack of fast or reliable access plans. Most of the Pueblos are at least partially connected though; many, if not all, have mobile communication access via many mobile services. These seem to be

providing good connections according to coverage maps (see Figure 3). Some of the companies providing mobile broadband include AT&T, Verizon, T-Mobile, and sometimes Cricket. Although there is data and internet access on these phones and mobile plans, a phone has its limited uses: certain applications would be better on a computer with more reliable internet access. Also, just as with any other internet method, mobile wireless does involve some significant costs such as buying a mobile wireless equipped phone and purchasing monthly access.

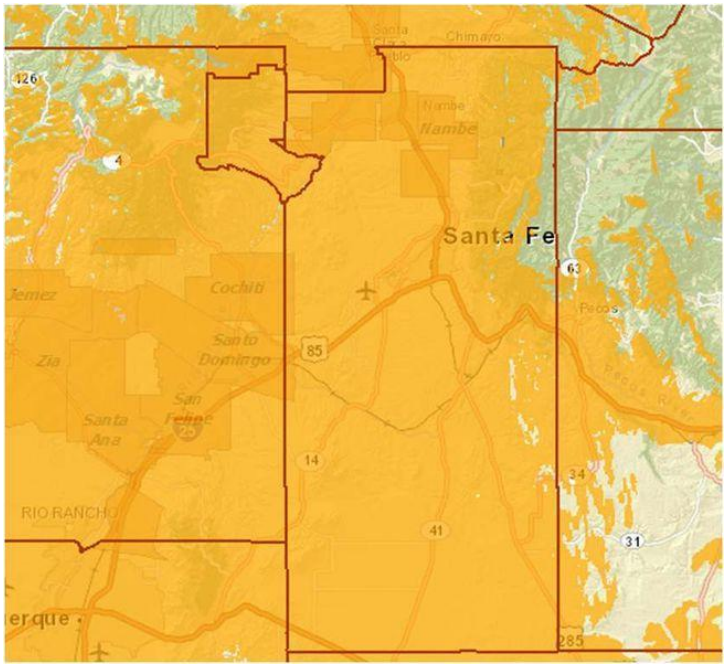

Figure 3: Mobile wireless access in and around Santa Fe County (from SantaFedia).

2.2.4 Grant Programs for Internet Access

In 1996, the Telecommunications Act was passed in the United States; this act allows businesses to compete against each other in the telecommunications market. The goal was to allow consumers to benefit from lower prices and have access to the latest updates in technology. This act has led to programs that give grants in order to help certain communities obtain better access to telecommunication technology such as broadband internet. In addition, in 2009, President Obama passed the American Recovery and Reinvestment Act, which granted $7.2 billion for broadband construction (National Telecommunications and Information Administration 2015, 10) and led to the FCC's National Broadband Plan in 2010 to improve American broadband connections.

Over the last few years, several government organizations have created new opportunities for people to get broadband access. The FCC's E-Rate program provides discounts for broadband connections for public schools in libraries in order to increase access to education (National Telecommunications and Information Administration 2015, 8). The Acoma Pueblo, for instance, has little internet connection aside from its E-Rate sponsored library connection, which is used for everything from homework to health care plans (Wheeler, 2014). The NTIA also set up the Broadband Technology Opportunities Program (BTOP) in order to build new networks. In addition, the Rural Utilities Service (RUS) of the US Department of Agriculture (USDA), which provides several utilities for rural areas, has a number of loan programs to improve the Internet in rural areas (National Telecommunications and Information Administration 2015, 10). Other government organizations, such as the Economic Development Administration and the department of housing, have also begun providing money for connections, and many non-profit organizations have as well.

Grant programs that specifically address rural communities and Native American tribes are actually very common: the U.S. Department of Commerce with the National Telecommunications and Information Administration (NTIA) gives out many grants for broadband advancement in rural areas. Some examples of the NTIA programs are the New Mexico Public Library program (which promotes computer literacy and internet use), University Corporation for Advanced Internet Development, and ZeroDivide (which provides for low-income community children and teens). One project that is specific to Native Tribes is the Navajo Tribal Utility Authority. This project was given more than $30 million to build 550 miles of fiber-optic cables to establish a better broadband connection for the Navajo Tribes, starting in 2010 and ending the reward period in 2013.

A $10.6 million grant in the form of an initiative called 'REDI net' is another outcome of the grant programs. REDI Net is "owned and operated by a consortium of local and tribal governments" (REDI Net, 1). Specifically, it involves the Pueblos of Ohkay Owingeh, Santa Clara, San Ildefonso, Pojoaque, and Tesuque. This group works on providing connections for schools, libraries, hospitals, utilities, public safety entities, and government offices. It is also used as a "last-mile provider," which connects current telecommunications plans to more customers in rural areas that would not have connections otherwise.

2.2.5 Creating and Internet Proposal

Every town must collect data and consider the wishes of the community to come up with a plan for setting up their internet connection. This step is very important because the broadband plan will determine how the town's internet functions, how effective the connection is, and how expensive it will be. In order to determine the best plan, the "connection planners" must inquire directly with ISPs or alternative industry players, identify the current internet infrastructure, inquire with potential funders for the project, determine the best connection option and how the community can install the infrastructure, and come up with a good plan for the community to move forward with this connection.

Connection planners can identify the ISPs best suited to communicate with using interviews, map coverage, and other data. The biggest industry players are the incumbents, or larger ISPs like CenturyLink, AT&T, Verizon, Comcast, and others. These incumbents may be harder to work with because they are less willing to invest money in rural areas, or because they already hold a monopoly on connections in these areas. Planners can also reach out to industry competitors, such as smaller companies looking for business or recipients of government grants, who may be more willing to reach out to rural areas. They can get in contact with providers by using a database of ISPs, or perhaps by contacting the public works department to see who has been interested in building internet infrastructures. They should also look into public infrastructure options like local utilities and non-profit organizations that might be able to build a connection without initial ISP involvement (New Mexico Department of Information Technology 2013, 23-25).

Connection planners may need to examine their infrastructure directly in order to determine how to proceed with the connection. This mainly involves running speed tests on the connections in order to determine how good the current connections are, if any exist. For mobile connections, this may mean identifying cell towers in the area. They may also need to identify local phone, cable, or fiber lines in order to determine whether they can be extended. They could also examine fixed wireless connections to determine their capabilities and whether their reach can be extended. In addition, they may need to look at middle mile (to the general area) connections in the area to determine whether they can add last mile (to specific communities) connections to them.

Outside of native-specific programs, finding potential funders may be the most difficult part of the broadband plan, since the government has such a limited budget for broadband installation. Nevertheless, connection planners should reach out to as many government broadband-funding programs as we can, especially ones that focus on their areas. The town government will probably

end up requesting the funds itself, but planners can still help by making known the challenges faced by the people without internet in today's society to funders while conducting interviews with them. They can also try reaching out to other sources of funding like non-profit organizations and universities to get funding for the project. If the connection involves public ownership of the infrastructure, the town citizens themselves will likely need to pay some of the costs, so planners may need to talk to the town government about how much it is able to spend on this project.

An integral part of choosing the internet connection for the town will be deciding what type of connection model it should use, especially in Indian country where sovereignty and self-determination are very important. The most common model is private ownership of the connection by an ISP, but this is risky since they are less likely to charge fair prices to the town in the interest of profits. It would be ideal to get public ownership of the connection for the town by finding either local utilities or non-profit organizations who could make it, so that the town has more control over the network and its pricing, increasing their sovereignty in a way. Harold Priest of the Chattanooga Electric Power Board said, "Does our community control our own fate, or does someone else control it?" (Mitchell 2010, 3), of why Chattanooga has public ownership of its fiber connection, even though it is more expensive. It may also be worth considering a public-private partnership model so that the ISP provides services but the town maintains control of the network. This assumption of responsibility may prove more desirable to ISPs, although it may also be more costly for the town. One tactic that many rural areas have used is the 'open access model', which allows multiple ISPs to bid on who provides the internet services while the town handles the actual infrastructure. Open access prevents the town from being unfairly charged by a single ISP that may have an effective monopoly in the area. For example, the Utah Telecommunications Open Infrastructure Agency (UTOPIA) is an open access connection with ten different ISPs that provides connection to sixteen cities, despite opposition from incumbent providers and management problems (Mitchell 2010, 38).

After examining existing connections and reviewing options for expanding or replacing them, connection planners should come up with what they think is the best solution and talks it over with the town as well as the local government. They will have to consider the cost of the actual connection, how fast it will be, how much space it will take up, and how much the town will have to pay to subscribe to it. In addition, they need to consider whether they want to build a connection from scratch, use existing architecture, or build a last mile connection to connect to a nearby middle mile connection. They should also help to determine what type of model the town should use for

the connection's infrastructure, whether private, public, public-private, with or without open access, etc. They should then look at funding and determine how everything will be paid for, including how much the town itself will need to contribute. In Princeton, MA, for instance, the subscribers are paying for the infrastructure as an extra monthly cost so that taxpayers who don't want an internet connection won't suffer (O'Brien 2016), but this may not work for other towns if they can't afford it. If necessary, connection planners can see whether the town itself or one of the funders could install some of the infrastructure (phone lines, etc.) themselves to cut down on costs although they may not know how to do this, so it will probably be left to the ISPs. They also need to look out for potential obstacles, such as geographic barriers to cables, and determine a timetable for the project.

2.3 Digital Divide

As internet use grows more prominent in today's society, there are more routes of access for a larger portion of the population. Although these routes exist more now than before, a digital divide still remains. This divide is defined by Jan A.G.M. van Dijk, a professor of communication science at the University of Twente, as the gap between those with access to this technology and those without it. The digital divide is more complex than a yes or no to internet and has a pitfall according to van Dijk where there is an "impression that the divide is about absolute inequality, that is between those included and those excluded" (van Dijk 2006, 222). Not having the physical access to computers and connection technology or not being able to afford them are the most known reasons for why the divide exists. Other reasons for this divide, according to Jan A.G.M. van Dijk and Eszter Hargittai, a team of sociologists from Northwestern University, include differences in motivation, support networks, skills, and why people want to access the Internet. Both sociologists explore a more social approach rather than technical approach to defining the digital divide. For the Pueblos of Santa Fe, there are economical, political, and social reasons that build up their digital divide as only 20% of the communities have internet access. Native American communities remain disconnected from the rest of America in terms of reliance on the Internet and technology.

2.3.1 Introducing the Digital Divide

The United States Census Bureau defined the poverty threshold income in 2014 to be approximately $12,000 for a one-person household and $19,000 for a three-person household for the average household size. The average incomes of the Pueblos, as indicated earlier, range between

$5,000 and $13,000. In 2010, the U.S. census collected that the median income for American Indian and Alaska Native households is $35,062. Based on those census data points, New York journalist and documentary filmmaker Contessa Gayles concluded that "Native Americans have the highest poverty rates by race in the United States, with nearly one-third of those on reservations living below the federal poverty line" (Gayles 2014, 1). For communities and households that have economic issues and live "below the federal poverty line", this makes affording broadband internet more difficult. Thus, financial demographics play a significant role in understanding the digital divide for the pueblo communities.

For the most part, the United States government does not regulate internet markets or intervene with the business of high-speed internet companies (Crawford 2011, 1). Therefore, if there is only one provider in an area and they charge a large price, there is nothing that prevents the company from doing so. Governments in other countries have intervened with the market to make fair prices more accessible by the people, but without this regulation in the United States, especially in rural areas that affect the Pueblo people, the Internet in local communities can get extremely expensive. According to writer Ted Hession, internet providers raise the price of their service because they "don't profit enough to cover the costs of the building and maintaining the physical infrastructure" (Hession 2016, 1). This difference in price can make it difficult for the Pueblo people, as well as other rural communities, to afford high-speed internet. This is one cause of the digital divide: higher prices make it so certain communities (in this case Native American communities) cannot obtain access to broadband internet. This inaccessibility can hold back whole communities from growing financially, educationally, and politically.

Another reason that the pueblo communities and other rural areas have little to no broadband internet access is because it is not an option for them. "The country's major broadband providers tend to pass over rural tribal lands in favor of wiring more densely populated urban areas" (Gayles 2014, 1). The initial cost of laying broadband infrastructure is expensive, and if the customers are spread over the large distances often found in rural America, the project demands more wiring infrastructure and therefore more of an upfront investment. The internet service companies do not see these rural areas as good investments because they would not get their money back fast enough with the limited population they are serving. There are more potential customers to serve and profit from in a larger, closer, or more densely populated community compared to a rural one. Therefore, high-speed internet access is not an option for some pueblos because the

internet providers have not made it an option for them. Or if it is an option, there may only be one or two providers available.

The fact that creating a symbiotic relationship between the providers and the tribes requires a complex solution is another reason the digital divide presents significant challenges. Also, any one solution might not fit all the tribes because each one is unique and has its own hurdles to overcome. This sentiment has been expressed before by those observing tribal issues: "Developing a system of best practices will have to happen on a case-by-case, tribe-by-tribe basis and that will take time" (Gayles 2014, 1).

Many would assume that everyone with internet access uses it, but even if people have access to the Internet, there are reasons that may discourage them from utilizing the connection that go deeper than just cost and connection. "Many of those who remain at the 'wrong' side of the digital divide have motivational problems" (van Dijk 2006, 226). These motivational problems could be because the person in question has no time to use the Internet, does not see the need for access, or lacks the skills to utilize it. Because many rural communities have internet access that is limited to schools or libraries, those who have to travel to these sites often have limited internet experience, which has been shown to influence their perception of internet technology and their confidence in using it. "Self-efficacy is essential to overcome the fear many novice users experience" (Eastin/LaRose, 1). These concerns aside, those who have used the Internet for longer periods of time reported liking the technology more than those without a lot of time online (Bell 2004, 28). One of many concrete examples of how the digital divide can affect these communities is having no motivation or the proper skills to utilize the Internet for their interests.

2.3.2 Urban vs. Rural Internet

According to the FCC, about 95% of Americans have access to at least one form of broadband internet, which is currently defined as 25 Mbps downstream and 3 Mbps upstream. However, only about 73% of urban households and 62% of rural households actually had an internet connection as of 2010 (Stenberg 2013). In addition, many people who have internet access don't have connections that live up to national broadband standards, and some make the choice not to adopt internet at all. These facts have led many people to question the qualities of urban internet connections versus rural internet connections.

Many states have formed advisory boards to oversee internet usage and decrease the digital divide, and they have found some issues with rural broadband installation as opposed to urban.

Rural areas often do not meet the profit expectations of ISPs, meaning that the subscribing population in those regions is too small to justify the cost of connecting them compared to more populous urban areas. Also, many rural areas do not have good internet infrastructure due to bad geography; issues could come from difficult elevation levels or other obstructions that prevent cables from being laid. Urban areas, on the other hand, have already been cleared out and already have infrastructures in place for electricity and other utilities. Therefore, many rural areas rely on connections that do not require physical lines like wireless or satellite internet. In contrast to these obstacles and the policies trying to overcome them, some people do not need or want the Internet, and some people don't get it because it's too expensive or they can use it in other areas, which can make deciding where to move forward with construction difficult (Dickes et. al. 2016). Urban areas, on the other hand, tend to rely a lot more on the Internet to function and therefore have more programs and incentives for people to use the Internet.

Funding from the government or other sources is the main way for rural areas to get internet connections. Urban areas generally have more resources than rural areas because more people live there; so rural areas need help to get their connections up and running (O'Brien 2016). Outside of the physical barriers to getting connected, proper internet education is another important step in the implementation process so the new users know about the potential advantages and how to use internet for their maximum benefit. Public meetings or simple online training programs are some examples of how this can be done (O'Brien 2016). When compared to urban areas, another way rural communities are disadvantaged is through accessibility to these kind of educational resources are.

2.3.3 Why Increase Connectivity?

Increasing the internet access in rural communities has been shown to help boost the economy in those communities and in general. It can give smaller businesses the chance to compete with the larger ones and open up more jobs for people if utilized correctly. For example: Chattanooga, Tennessee was considered a very poor town, but when they upgraded their internet to a high-speed fiber network, it attracted new businesses and entrepreneurs into the town (Obama 2015, 1). This internet access has put Chattanooga on the map and in the economic playing field, and this success could be replicated within the pueblo communities of New Mexico. Having broadband access can improve their economy's potential and encourage business growth for aspiring community members, increasing opportunities for online businesses, citizens working from

home, and new job sectors to flourish. Susan Crawford, former special assistant to President Obama for science, technology, and innovation policy, said in *The New York Times*: "The new digital divide raises important questions about social equity in an information-driven world. But it is also a matter of protecting our economic future. If we want to be competitive in the global economy, we need to make sure every American has truly high-speed wired access to the Internet for a reasonable cost" (Crawford 2011, 1). Many people such as Crawford and the programs that attempt to bring broadband access see the serious effects of the digital divide, and advocate for helping these disadvantaged communities achieve better broadband internet.

Another big issue pertaining to the need for internet access is that the healthcare industry is switching over from paper documents to internet databases for patient files and other medical information. Medical records, prescriptions, and communication with doctors are becoming more internet reliant in most of the country. "Not all health care providers on the Navajo reservation have internet, creating the potential for life-threatening medical errors" (Smith 2012, 1). It is also impractical for a doctor to drive long distance to a patient's home for simple consultations that could have been taken care of on the phone or through a videoconference. These kinds of problems happen because the pueblo communities are in rural areas, which mean that the closest doctor may be many miles away. Broadband access would give the possibility to obtain better health care for patients and give doctors the chance to perform their job as best they can.

Education can be a gateway to success, knowledge, and passions. Today, many classrooms, from elementary schools all the way to college lectures, rely heavily on the Internet. Students now need the Internet to access homework and notes, research and write papers, collaborate with classmates, and keep up with classwork. Wilhelmina Tsosie is a Navajo that shares her story as a student taking classes where all her assignments were online (Smith 2011, 1). She was set back an extra semester because she did not have well enough internet access to complete her assignments on time. These stories are shared by many students in the Native American tribes: the limited connections have set back their education by making it difficult to complete classwork, on-line tests, and homework. Because of these difficulties, the pueblo communities may be held back compared to urban America if their younger generation isn't given the opportunity to gain knowledge and utilize it effectively through broadband internet.

Finally, having internet access in the Native American communities keep them connected with the world. Raleigh Silversmith, a Native American student living on a reservation, was quoted as saying "For a lot of the younger people here, the motivation is 'I want to get out of here so I can

experience what the rest of the world has,'" in the article "On Tribal Lands, Digital Divide Brings New Form Of Isolation" (Smith 2012, 1). The Internet is a telecommunications technology, so it gives the power and opportunity to connect with others elsewhere. Some of the younger pueblo community members, as Silversmith says, want to explore new things, and the Internet can serve as a gateway for increasing their experiences with the rest of the world without having to leave the place they live.

2.4 Benefits and Drawbacks of Internet Access

Many Pueblos have valid concerns about how the introduction of broadband internet could possibly disrupt important pueblo values such as tribal autonomy or cultural preservation. However, past project work suggests that community access to internet would allow for major advancements in education, cultural preservation, environmental sustainability, and other issues important to native communities.

Even though concerns around the Internet exist and affect the implementation of new technologies, some forms of communication have started to become more popular. In an IQP titled "Tribal Broadcasting: Exploring the Success of Low Power FM Radio Broadcasting within Native American Communities", students created recommendations for how to utilize radio to communicate more effectively with other parts of the pueblo area. According to their research, in 2014 there were 130 tribal radio stations in the US (Bredes et. al. 2014, 16). Even though not all of these stations are in the Santa Fe area, this data shows that pueblo communities are utilizing radio broadcasting. Specifically, they "share the common goal of preserving the traditions and culture of their ancestors as well as communicating native issues within tribal communities" (Bredes, Kurtzman, and Zayas 2014, 16). After conducting their research by interviewing local radio stations that were already active, the students presented a plan for the most effective way to utilize radio broadcasting. Their conclusion was that the best way to broadcast effectively would be to start an internet radio station, as it has the least up-front cost and is the easiest to operate (Bredes, Kurtzman, and Zayas 2014, 36). This could lead to, if the community sees success and wants to continue, a more advanced radio station in the future. This project shows the viability of the Internet as a tool for simple and effective tribal communication that aligns with many of the goals tribes already strive to attain.

Another IQP, entitled "Sustainability Education and Awareness for Santa Fe and Native American Communities", compiled resources found online and worked with organizations to try to create a repository for information regarding sustainability and sustainability education specifically meant for the pueblo area. Their work eventually coalesced into two websites, one focused on sustainability resources for the native communities, the other focused on sustainability education in general (Jordan et. al. 2011, 60-61). These websites allow users to reference the compiled research and create plans to implement sustainable practices in their lives. If the people who wish to access this information do not have a reliable internet connection in their communities, it may be underutilized due to lack of access. Having a reliable broadband connection can help everyone in the community learn and share information better in the future.

Although internet connectivity could bring many benefits to rural communities, there are concerns within these communities and elsewhere that the connections brought by the Internet could have negative consequences as well. Many of the perceived benefits of online access revolve around the concept of increased communication: the Internet is a platform that vastly increases individuals' and communities' communicative power. While this access can definitely be a benefit in some scenarios, it can be a cause of concern for some cultures. Because of the Internet's ability to connect those all around the world, "dispersed groups can, with relative ease, stay in close daily contact with each other or with events in their homelands" (Vertovec, 89). This ability would allow those who initially lived in communities that relied on person-to-person communication to branch out and relocate without fear of losing that connection to their roots. However, the Pueblos see this mobility as something that could fracture the community that has stayed physically connected for some time or dilute the culture that is a source of pride to those in their community. This issue is particularly dear to Native American tribes, who have so often been dispersed by American expansion.

In addition to allowing close-knit communities to become less dependent on physical interaction, the Internet's communicative power can be threatening just by existing as a platform for idea exchange. Many cultures, including the Pueblos, have used traditional forms of cultural exchange for a very long time, and the Internet's open forum may inadvertently dethrone those systems, just as cell phones and texting have decreased the use of physical letters. Ron Burnett summarizes this concern well in his study *Communities in Cyberspace*: "When a community worker asks 'How do we create opportunities for culturally diverse groups to speak to each other?' they are, in essence, marginalizing existing forms of communication and exchange" (Burnett 1999, 208). Not

only are traditional methods of communicating between the Pueblos being marginalized, but also the methods of sharing culture within their society (storytelling, dance, art, etc.) may be challenged. Many Pueblos are skeptical of or even opposed to the Internet since they feel their culture is deeply rooted in these unique forms of expression.

Paradoxically, the Internet can provide a solution to the problems it seems to create. While the ease of communication may allow people to disperse or lose touch with their community, it also allows those previously disconnected to reestablish themselves in their culture. "Perhaps virtual connections, which are initially a displacement of geographical boundaries, help to 'relocate' members of the same community by giving them reason to meet within a physical space" (Rheingold 1993). This effect also applies to members of different communities; when connected, these rural communities could use the Internet as a way to work together to preserve their culture, instead of only relying on themselves to figure out a way to situate them in the fast-paced modern world.

While many of the previous sources have explored how the implementation of internet itself will affect native communities, we must consider that the Internet is not a perfect tool. Human connections are still hard to maintain and require personal effort: "the hardware which links people (computers) is ultimately a minor facet of what community members do with the linkages" (Burnett 1999, 212). The people of the community must decide how to use these communicative technologies themselves, and that is why our priority is helping them make an informed decision, taking into account their opinions on the issue, and providing educational resources.

2.5 Santa Fe Indian School

Our sponsor, Ms. Kimball Sekaquaptewa, hails from the Santa Fe Indian School, which is also where a lot of our project work took place. Today, it serves as a boarding school for the 19 Pueblos of New Mexico, where middle and high school students can come to be educated while still remaining in touch with their culture. Although the school draws a great deal of influence from the pueblos, it has its own history, distinct from them, which has great relevance to our project today. In addition, the current issues the school is dealing with provide a great deal of insight as to why our project is necessary.

2.5.1 History of the Santa Fe Indian School

In the late 1800's, the US Government established a total of 15 boarding schools specifically for Native American children with the goals of assimilating the students into the "white man" world and removing the Indian culture. In 1879, General Richard Henry Pratt established the Carlisle Indian School in Pennsylvania, making it the first school of its kind. General Pratt coined the term "Kill the Indian to save the man" in order to promote the American lifestyle and remove the native culture and beliefs. The federal government established the Santa Fe Indian School in 1890.

The traditional atmosphere of the boarding schools for the next couple decades "treated [students] like prison inmates instead of children," (Hyer 1990, 25). Children were forcibly removed from their homes, placed into the schools, and kept away from their tribes for long periods of time. Students were not allowed to speak their native languages, perform traditional dances, wear their clothing, or practice their religion (McGeough 2009, 15). "Paradoxically, although the daily routine was designed to submerge tribal identities, students learned at least as much from each other as they learned from their white teachers. Children who drilled all day and were denied privacy still found time to develop deep friendships that have lasted eighty years or more." (Hyer 1990, 25). Although the physical culture aspects were denied, the bonds between students allowed for the growth of cultural understanding. "I see the worth [of] Indian ways. It was beautiful. I didn't know what it was; nevertheless, it was beautiful," (Hyer 1990, 6), said a SFIS student when she was able to go back home and immerse herself in Indian culture.

In the 1920's and 1930's, the federal government's attitude towards Indian policy shifted the goals of the Santa Fe Indian School, gradually permitting more native culture in the schools. The New Deal prompted a large change in how the schools were run: before, the establishment focused on cultural assimilation, and after, it aimed for Indian rights. Rather than closing the boarding schools, the governors of the Pueblos saw an opportunity for their children to get to know those that come from different pueblos and tribes. The students had to learn English to speak with their friends from other tribes, not to assimilate to the American culture. When the school was first established, students ran away to escape its tyrannical grasp. With the new refinements, students ran away due to homesickness "but fully intended to return to school," (Hyer 1990, 62). By the 1930s, students were coming to the school by choice rather than by the forceful hand of the government.

SFIS gained a reputation as an Indian art school during the 1930s and 1940s. The lessons were inspired by progressive educational policies that emphasized emotional and artistic aspects of student development rather than standardization and memorization because "if we eliminate the

social factor from the child, we are left only with an inert and lifeless mass," (McGeough 2009, 17). The studio program that reintroduced Indian art made the Santa Fe Indian School more popular, attracted other tribes, and helped retain the culture.

However, another shift occurred after World War II, returning the policies of assimilation under the era of Federal Indian policy called 'Termination'. In 1957, however, the school abolished recreational activities such as the art programs. In 1959, the government told students to transfer out of SFIS immediately, moving them to other schools such as the Albuquerque Indian School. The Pueblos and tribes perceived this as another attempt towards cultural assimilation by the government.

Prior to the 1960s, the United States government had not effectively engaged with the tribal governments while working on the preservation of Indian culture. "They must understand tribal government, because it is central to their lives and their communities," (Abeyta 1985, 2). "'One of the saddest things I ever saw, after fifteen years of contact, was how little they [non-Indians] knew about us and our dreams. It was mind-boggling. Many were educated, but their impressions were warped with misinformation,'" (Hyer 1990, 73). To the Pueblos and tribes, self-governance and sovereignty played a large role in preserving their identities, but they felt like the US government did not fully understand that.

The Kennedy administration in the early 1960s tried to make policies that suggested Indian people have greater involvement in decision-making and increased funding for certain programs. The government helped fund the opening of the Rough Rock Demonstration School built on Navajo land. Native Americans fully controlled the boarding school. After seeing the success in student education at the school, a 1969 report known as the Kennedy Report stated that the assimilation policy "of the federal government toward American Indians has had a disastrous effect on the education of Indian children," (American Indian Education Fund 2015, 1). The Indian Education Act of 1972 and the Indian Self Determination and Educational Assistance Act of 1975 (P.L. 93-638) followed the Kennedy report, asserting less of the government power and giving American Indians more power of self-governance and self-determination. In the late 1970's, the All Indian Pueblo Council contracted the Albuquerque Indian School under P.L. 93-638 to take tribal control over the school.

In 2001, the Santa Fe Indian School Act was signed, which held the land in trust for the 19 pueblo governors of New Mexico. The leadership exercised their sovereign authority by demolishing and renovating the school in a process that amounted to "a spiritual cleansing" (Willis 2008, 1). The

governors considered SFIS as the 20th Pueblo of New Mexico. They asserted their right to educate and assess their students as they see appropriate and decided the school's curriculum and goals. External groups do not prioritize or accurately measure the same cultural education the SFIS does. Self-decision of the SFIS prevents external groups' standards from devaluing those of the SFIS. The "Ideal Graduate" from SFIS is described as 'critical, confident, independent and interdependent, life-long learners, and productive workers'. Graduates learn to understand tribal issues, maintain Native American cultural values, participate in the culture, obtain skills that will benefit them, their family, and their people, and are creative problem solvers (Santa Fe Indian School 2011, 1). The Santa Fe Indian School focuses on preserving the pueblos' culture by integrating them into the education curriculum. Working to forward the ideals of resiliency and preservation, the school embodies the push for tribal sovereignty through allowing their own leadership to guide the curriculum that builds the student's education.

2.5.2 Modern Issues at the Santa Fe Indian School

Today the Santa Fe Indian School has arguably more autonomy than ever, but it still faces certain challenges due to the ever-changing nature of education. It still suffers from several gaps in technology and educational resources when compared to the rest of the country. However, there are a few solutions, which could greatly improve the school's standing while keeping the culture and principles of the students intact. These solutions could also have positive impacts on the pueblos, which many of the students hail from.

In terms of modern day self-governance, a reliable communications network could further strengthen tribal sovereignty. "These [telecommunication] policy initiatives could address both the need for and content of a government-wide policy statement and strategy, and specific topics like sovereignty and self-determination, universal access, and strategic partnership," (U.S. Congress 1995, 11). Telecommunication can lead to building political relationships with other leaders and communities through better means of communication. "Tribal governments are engaged in maintaining government-to-government relationships with federal and state governments; working to uphold prior treaties and laws; and developing future laws and agreements," (65). It can connect the pueblo governments by giving them the tools to work effectively as a community.

The Santa Fe Indian School recently upgraded its internet to a fiber connection. The IT department at the school "coordinates other projects that expand the role of technology in teaching and learning," (Santa Fe Indian School 2011, 1). The new fiber internet provides a wider platform

for learning and communicating. "Our goals are to realize the aspirations of the Indian community; to teach our young people to foster and continue the Indian way of life, while participating in the larger society as American citizens; to encourage individual development, but not at the expense of the community; to move toward economic self-sufficiency," (Abeyta 1985, 3). The students can use the new internet connection to bridge their Indian lifestyle and the larger American society. "Many such schools and colleges already make at least some use of instructional [telecommunication] technology (including educational software, film, video, and/or distance-learning videoconferencing), and thus seem to be good candidates for new electronic materials as part of history, culture, and language courses," (U.S. Congress 1995, 30). Telecommunications technology can play a key role in education as a virtual classroom for students.

While the school pushes its students to utilize the benefits of broadband in their education and studies, administrators at the SFIS such as Ms. Kimball Sekaquaptewa advocate for better connections in the Pueblos to match. They have been working with programs such as E-Rate and groups such as Tribal Digital Inclusion to bring awareness on issues of broadband connectivity to the students, communities, and tribal governments to allow them to be better informed when making decisions. If these connections were installed, students would have the same opportunity to do meaningful and desirable work when they go home to their pueblo as well as when they are staying at the Santa Fe Indian School.

Better broadband connections at home in the Pueblos can fill the digital divide gap between the more rural pueblo lands and the more urban school. The Internet allows access to educational tools and new programs that could connect the students at the Santa Fe Indian School back to their pueblos in meaningful ways. For example, the Internet allows video calling to experts, family, and leaders from the Pueblo who cannot come directly to the school. To foster a better holistic community attitude, school events can be broadcasted back to the Pueblos such as sporting events, student news, and community-oriented programs. Typically students stay at the boarding school during the week and go home for the weekend. They could work and research more effectively if they had the tools to follow projects and interests they want to pursue outside of the school. Access to broadband could divert some costs from these communities, as students are sometimes forced to do all their internet related activities on mobile phones (using mobile data rather than wireless internet) due to the lack of reliable connections, which can be difficult, impractical, and expensive.

Administrators at the Santa Fe Indian School anticipate a positive outcome from improving the broadband internet for the Pueblos, affecting areas such as tribal sovereignty, education, health,

safety, environmental protection, community attitude, connection between the students and the pueblo, and the relationship between Native American communities and the larger American society. Broadband internet can be used as a tool to improve those community aspects if harnessed by these groups effectively. Therefore, our project collaborates with the pueblo community to assess the current broadband situation and creates educational tools such as infographics that allow the community to further understand broadband internet connections and how it can benefit from such connections. These resources will enable Native Americans to use the Internet effectively so that they can enjoy its benefits without putting their culture at risk.

CHAPTER 3: METHODOLOGY

This chapter describes our plan for collecting data about pueblo internet experience and views through conducting speed tests and collaborating with different groups in the community through interviews and surveys. We visually designed infographics to display the information. Not all of these plans came to fruition, but we include a complete plan to show our thought process and provide reference for future teams. The objectives and mission statement that guided our methodology are as follows:

Mission Statement:

This project intended to work with the pueblo communities of New Mexico through the Santa Fe Indian School to explore the benefits of reliable and fast broadband internet. We performed a data analysis of the current quality and availability of internet options in the area as well as collaborated with the local communities to determine how they use internet and their opinions on what needs to improve. These data sets were used to bring awareness to the advantages of upgrading broadband service and to create effective resources such as infographics.

Objectives:

1. Measure the current level of service (rates, coverage, speed, etc.) in tribal locations to assess the quality of broadband internet in these communities.
2. Collaborate with the community through meetings and/or interviews to learn how they are approaching this topic and how the broadband connections could be improved.
3. Compile the data collected through these tests as well previous research to act as a knowledge base for future tests in the pueblo communities to show the effectiveness of broadband initiatives.
4. Create infographics based on our data collection that can inform users about safe and effective internet practices, show the impacts and potential benefits of broadband internet access, and assist in the work already being done to upgrade the pueblo connections.

3.1 Measuring Cureent Levels of Internet Service

To characterize internet connectivity for the Pueblos, we evaluated the current internet connections they have. Many internet service providers (ISPs) may be reluctant to talk about the

quality and reach of their services in rural areas. That data is available from the New Mexico Department of Information Technology (NMDot) and through taking direct speed tests. We worked with tribal librarians and took speed test data and cost estimates from the libraries to characterizing pueblo connections.

Users determine whether the benefit of internet is worth the cost based on the monthly rate of an internet connection. BroadbandNow provides the costs of internet service for the Pueblos based on ISPs; we used this as an initial metric. To compare these cost to more developed places, we checked the costs of other internet services in the Santa Fe area. In addition to this research, we asked the pueblo librarians in interviews how much they are paying for service and how affordable the service is for them.

The speed of an internet connection differs from the bandwidth. While internet connection transfers a certain amount of data in one second, the actual amount of data transferred may be less depending on: number of machines connected, time of day, etc. Librarians performed speed tests on library patron computers, a common connection point. An internet speed test involves a packet of data being downloaded from the Internet. Software or hardware tests measure the data transfer in bits per second. Software tests like the FCC's web-based test are easier to use and have a Flash or Java applet download data from the Internet to measure the transfer (Federal Communications Commission). We considered potential issues with software tests such as the effects of the test on the Internet connection and the quality of the computer or network (other devices may be using it). Hardware tests involve physically installing a device and run tests on the Internet. Hardware tests have the advantages of not needing an online connection for the whole day to measure connection speed. Software tests only measure the connection at one time of day. Hardware tests are more expensive than software tests and require the connection user to install the device on the actual connection (Federal Communications Commission). We used software tests for our project, as they were easy, free, and effective within our time restraints. While librarians ran speed tests, they kept the testing apparatus unchanged (use the same computer), kept the connection intact, and prevented other devices from distorting the data.

We ran speed tests at the tribal libraries in each of the individual Pueblos and held interviews with the librarians to collect our data for use in the infographics and report. We coordinated with Alana McGrattan, the New Mexico state tribal libraries program coordinator, to work with the tribal librarians to conduct the tests. We spoke with Gar Clarke of the New Mexico Broadband Program (NMBP) to determine the best way to conduct speed tests. We used the New Mexico Broadband

Program's speed test located at http://nmbbmapping.org/speedtest/. Its crowdsourcing application collects and displays the speed data in an easy-to-view, public way. The pueblo librarians tried to collect the data on-site using the NMBP speed test, but some of the library computers were not able to run the program. In this case they were instructed to use either http://speedtest.net, which runs on Flash, or http://beta.speedtest.net, which runs on HTML5 (no Flash), in order to circumvent any issues. The librarians conducted speed tests when the library opened (8:00 AM-9:00 AM), in the middle of the day (10:00 AM-11:00 AM), and when the students come after school (around 3:30 PM). These times showed us the speeds when the library was under minimum load of patrons, average load, and high load throughout the day. The librarians performed the tests on weekdays during the week of April 11. They measured the upload speed (speed of data being sent from the computer), download speed (data being sent from the computer), and ping (time for the Internet to respond) for both wired and wireless computers. The full instruction sheet we provided to the librarians can be found in Appendix B.

In addition, we met with several tribal librarians to ask them about their internet connections and how more widespread broadband can benefit these communities. The list of librarian questions can be found in Section 3.2.1 "Focus Groups and Interviews".

3.2 Collaborating with the Community

In order to supplement our quantitative data and create effective deliverables, we interacted with the pueblo community in a way that allowed us to learn their views to priorities and incorporate them respectfully into our results and deliverables. We first identified stakeholder groups that may have different and important opinions on internet implementation to bring insight to our project. These groups and their major connections are shown in Figure 4. Of those shown, we selected a few specific groups to focus on and collaborate with through focus groups and surveys.

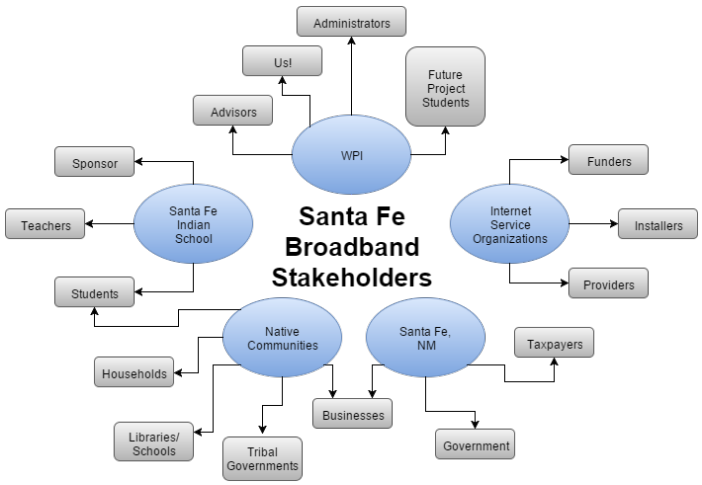

Figure 4: Stakeholder diagram showing specific groups and their larger connections.

We created a list of general questions to ask all stakeholder groups in addition to questions unique to each group. Below, the general questions are listed, each stakeholder group is introduced, their unique viewpoints are explained, and the specific questions we identified are listed. These questions show sentiments shared by the community and sources of disagreement. This information was crucial in crafting an effective educational plan that resonates with the targeted groups. The stakeholder groups described below are in the order would be most effective in obtaining information about their opinions on internet connections. They can ensure we understand and respect tribal rules or cultural norms that could affect our collaboration process.

Interview Questions

1. What is your opinion of the Internet overall?
    a. Do any specific examples or instances influence your answer? Why?
2. Do you think there are any barriers to getting better broadband connections in the pueblo areas?
    a. If so what are they?
    b. How do you think these can be best overcome?
3. Can you think of a few benefits of faster and/or more ubiquitous internet?
    a. How about any potential drawbacks?
4. What do you think is the most important or best use of internet connections?
    a. Why do you think this is important?
    b. Do you think that this is what the Internet is being used for right now?

c. If not what is it being used for?

5. Do you think that with proper education and training, the Internet could have a positive impact on these communities?
    a. If not why?
    b. If so, what specifically do you think will improve?

Contacted Stakeholder Groups

1. Sponsor (Kimball Sekaquaptewa)

Before we talked to any of the outside stakeholder groups, we need to understand what we can from our sponsor, as she is the most specialized source of information for this project. We had discussed many aspects of the project with her previously, but there were some base level questions that are best answered face to face based on her expertise. The topics are covered in the questions listed below are listed below:

1. The SFIS has recently upgraded their internet to a high-speed fiber connection, could you tell us how that process was in terms of funding, installation, and utilization?
2. What made you want to work with the specific Pueblos that this project addresses?
    a. What do you think are the most important uses for broadband in these communities?
    b. And how do you think they can be effectively implemented given the unique nature of the Pueblos?
3. Do you think there are reasons these communities are behind the national average in terms of broadband connectivity?
    a. How can we best confront these barriers in a way that addresses the Pueblos' needs effectively while still taking into account their concerns about implementing new technology?
4. What kind of educational tools do you think will be effective in helping people utilize broadband for maximum benefit?

2. Tribal Librarians

Tribal libraries are often the sole source of a reliable broadband connection in the tribal communities. This situation gives the librarians in the Pueblos a unique view of how internet is used in the surrounding area, which is using the resources available, and what the difficulties they

experience are. Thus, we talked to several of the librarians and asked them what they thought would be the best way to improve broadband connectivity and usage by the community.

1. What kind of internet services do you know of that are available in your area?
    a. Do you think the majority of people know about these options?
    b. Are there any options not available now that you would like to see implemented?
2. How much experience do you have using the Internet?
    a. Where and how do you usually interact online?
    b. How often do you use the Internet (daily, weekly, etc.)?
3. Do you see the need for more ubiquitous broadband in your area?
4. Do you think the library could benefit from more broadband in the Pueblo community?

3. Students at the Santa Fe Indian School

We did most of our work on site at the Santa Fe Indian School (SFIS), which houses students from the 19 Pueblos. We thought it valuable to ask the students their opinions about the Internet in their home pueblos. Students are a part of a generation that has grown with the Internet and generally have more experience with it then the other tribal stakeholder groups. Lastly, students need broadband connections for school and led us to some very important conclusions. Students are often targets of internet misuse such as cyber bullying, scamming, etc., so their experiences will be useful in developing an effective internet education program.

1. What kind of internet services do you know of that are available in your area?
    a. Do you think the majority of people know about these options?
    b. Are there any options not available now that you would like to see implemented?
2. How much experience do you have using the Internet?
    a. Where and how do you usually interact online?
    b. How often do you use the Internet (daily, weekly, etc.)?
3. Do you use the Internet mainly for school or other activities?
    a. Do you think the Internet is an important resource for students looking to do well in their classes?
4. Do you think you have adequate internet access at your home pueblo?

Possible Future Stakeholder Groups

There were other stakeholder groups we identified in the initial phase of our project. These stakeholder groups were not interviewed over the course of the project due to barriers in time, location, communication, etc. We got an idea of how these groups react to issues of broadband tangentially through our interviews with our sponsor, the librarians, the students, and others. These small insights were helpful in that they provided some holistic context over many points of view but did not developed to the point the other opinions were. Even though they did not become a direct part of our analysis, our impression of how their input informs these issue may inform other project groups or persons investigating broadband issues.

Tribal Leaders/Government

Tribal leaders act as the head of government and oversee each pueblo. Due to the unique situation the Native American communities, tribal councils have priorities that are somewhat at odds with Western governing bodies: they value community growth, autonomy, and cultural preservation over profits or business opportunities (Jojola 1995, 3). Their concerns must be addressed when deciding whether or not to implement improved community internet access. Talking with these leaders will provide an idea of what big concerns they want to address, what has been tried, and what they see as potential benefits or drawbacks. All of this information will mold the broadband implementation recommendation and educational plan to work with the goals of these communities.

1. What kind of internet services do you know of that are available in your area?
    a. Do you think the majority of people know about these options?
    b. Are there any options not available now that you would like to see implemented?
2. How much experience do you have using the Internet?
    a. Where and how do you usually interact online?
    b. How often do you use the Internet (daily, weekly, etc.)?
3. Are you aware of any other communities that have recently been connected?
    a. Do you think they are succeeding in their goals?
4. How do you think internet implementation could affect the way you do your job?
5. What are your main concerns or expectations about widespread internet availability?

Internet Service Providers

In any internet installation proposal, the ISP is a major stakeholder because they connect the community in question. Just as the community itself has concerns, ISP has a responsibility to its stockholders and likely has plans at a scope bigger than just one community. The ISP's thoughts on how the proposal should be implemented are instrumental in the success of the plan. Future groups must be prepared to ask questions that help assess their concerns in order to mediate them with the other stakeholders' in an effective way.

1. Are there specific boundaries to getting rural areas such as the Pueblos connected?
    a. Have you encountered any of these?
2. What do you think is the best type of broadband for getting rural areas reliably connected?
    a. Why? And how do you think it would be best utilized?
3. Are you aware of any companies specializing in bringing internet connectivity to rural areas?

New Mexico State Departments/Other Broadband Advancement Groups

In addition to interviewing the ISPs, government and private groups dealing with grants or other internet initiatives could have valuable information on what types of efforts have been done in the past and what kind of efforts are being put forth now. They may recommend strategies on taking and interpreting speed test data effectively and efficiently.

1. What kind of initiatives are you aware of right now that are trying to bring reliable broadband to these communities?
    a. How long have these been running?
    b. Do you know to what degree they have been successful?
2. Do you have any advice about using particular tools or methods for gathering internet connection speed data?
3. Are there any other departments or groups working towards similar goals that you think would be good potential collaborators for us?

Teachers (SFIS or otherwise)

Teachers at the SFIS and other tribal schools may be valuable resources. The Internet has become an important tool in all aspects of classroom and distance learning, from allowing students to do research at home to giving the teachers opportunities to show their students content from all over the world. Teachers in this area would have valuable opinions on what the current internet

landscape is like, how better broadband could be utilized for education, and how people can learn how to safely use online resources.

1. What kind of internet services do you know of that are available in your area?
    a. Do you think the majority of people know about these options?
    b. Are there any options not available now that you would like to see implemented?
2. How much experience do you have using the Internet?
    a. Where and how do you usually interact online?
    b. How often do you use the Internet (daily, weekly, etc.)?
3. How do you think broadband would affect your/the classroom settings?
    a. In particular, what technologies do you think you would utilize or which ones would you stay away from and why?
    b. How do you think students could be positively or negatively be affected by faster and/or more ubiquitous internet?
4. In terms of educating people on how to use the Internet effectively, do you have any recommendations on methods or delivery methods?
    a. Have you done any internet safety/literacy teaching yourself?

People in Pueblo Communities

In outfitting a community with internet, the most important stakeholder group is the people in that community. Community members are going to be affected by the implementation plan, so their thoughts on the issue are critical to bringing the best possible solution for them. In particular, business owners and artisans would be excellent groups to speak with because their work can be affected heavily by the presence of reliable broadband.

1. What kind of internet services do you know of that are available in your area?
    a. Do you think the majority of people know about these options?
    b. Are there any options not available now that you would like to see implemented?
2. How much experience do you have using the Internet?
    a. Where and how do you usually interact online?
    b. How often do you use the Internet (daily, weekly, etc.)?
3. How do you think broadband would affect your/the businesses in the area?
    a. Are there any technologies in particular you are looking forward to or are wary of?

3.2.1 Focus Groups and Interviews

Students

To gain a better sense of the issues and inform our eventual widespread student survey, we convened a focus group with some students to get a beginning insight about their access to internet in the Pueblos and their views of the new internet upgrade. This focus group was conducted with a group of first year leadership group at SFIS to bring in more quantitative data about the connection types, quality, and knowledge of the Internet in the Pueblos.

A focus group is a group interview where the research group frames questions and the participants respond in an open discussion, with a facilitator to keep the conversation flowing (Dick 2002). We encouraged the students to come by providing pizza before the talk and spoke to them initially about their hobbies, studies, and background to create a friendly atmosphere. They discussed their experiences with internets to help us gather information for our deliverables and see how students use the Internet in the Pueblos. An open discussion identified common themes among the students. We discussed why agreements and disagreements exist, which brought additional depth and understanding to our discussion.

Librarians

While we visited the Pueblos with Alana McGrattan, we sat down with the library staff and have a discussion about their views on internet in the community. Since the libraries are sometimes the only reliable access point for internet, we inferred that they would have a good grasp on what the Internet is used for and what kind of services the community wants. We also discussed the libraries as important institutions in the area, but sometimes do not receive attention or funding from their governments to bolster their programs or facilities. In general, the library visits consisted of a tour of the facilities, an explanation of the programs and services offered, and our discussion. The transcript below shows the Statement of Consent and questions for interviewing the librarians.

Statement of Consent:

Hello, we are a group of students from Worcester Polytechnic Institute (WPI) in Massachusetts. We are interviewing pueblo community members and other groups involved in issues concerning tribal broadband use. We hope this research will ultimately improve the knowledge base around what broadband use is like now and how we can collaborate with the community to produce meaningful deliverables and make the connections work better for them.

Your participation in this interview is completely voluntary and you may withdraw at any time. You also may choose for your answers to remain anonymous. No names or identifying information will appear in any of our project reports or publications if you do so, but if not you may be quoted or identified by your title.

This is a collaborative project between the Santa Fe Indian School and WPI, and your participation is greatly appreciated. If interested, we can send you a copy of our results at the conclusion of the study.

Questions:

1. What kinds of internet services are available in your area?
    a. What type of connection does your library use? (DSL/Wireless/Fiber/etc.)
        i. What internet service provider does that connection come from?
    b. How much are your service costs per month?
        i. Do you think this price is fair for the service you are receiving?
            1. Compared to what?
    c. How are these services taken advantage of by others in the community besides utilizing the library?
2. What proportion of people in your community use the Internet?
    a. What are any barriers that keep this proportion as it is?
        i. Do you have any ideas on how to overcome said barriers?
    b. What options not available now would like to see implemented in the future?
        i. Why do you think these options would be beneficial?
3. How do you see the Internet use in your library and the surrounding area?
    a. Do different, distinct groups use the Internet for noticeably different things?
        i. Could you explain these groups and what they utilize your library's internet for?
    b. Do you think the library you work in currently has the service necessary to provide for all these groups?
        i. If not, what groups seem to need what improvements?
    c. Do you see groups requesting better connectivity or complaining about the current connections?
4. How confident do you feel using the Internet?
    a. What do you use the Internet for and where do you usually access it?
        i. Do you see barriers to efficient internet use as you use it yourself?

b. How often do you use the Internet?
    i. All the time, daily, weekly, etc.?
5. How significant the need for more widespread broadband in your area?
    a. 1-10 Scale
    b. How do you think the library could benefit from more broadband in the community?

3.2.2 Student Survey

We designed a survey to get a better idea of how the students at the Santa Fe Indian School use the Internet. Designing a survey requires careful planning to ensure that participant's respect, good participation, and useful responses. In this section, we describe concepts that underlie good survey design, and then discuss how we implemented the student survey.

Survey Methodology Concepts

Design, privacy, sample size, distribution, and incentive are the major methodological components used when creating a survey. *Electronic Survey Methodology: A Case Study in Reaching Hard-to-Involve Internet Users* journal by Andrews, Nonnecke, and Preece (2003) and *SME Survey Methodology: Response Rate, Data Quality, and Cost Effectiveness* by Newby, Watson, and Woodliff (2003) both study aspects of questionnaires that affect the response rate of participants. We incorporated both documents into the design process of the surveys. Outside of the survey itself, a pilot test for the survey helps review and makes the questionnaire more effective for the target audience. These methodological components can affect the response rate, completeness, and quality of the answers of the survey (Andrews et. al. 2003, 186-193).

An effective survey design will "create the 'pull' effect to bring people to the survey," (Andrews et. al. 2003, 187). Each component in the survey can either help or hurt this effort, depending on the way they are designed. Traits such as too many open-ended response (O.E.R) questions and inconsistent formatting can result in increased dropout rates and less information gathered. The design, appearance, and types of questions should keep the participants' attention in order to result in a completed response. In previous case studies, an incentive (i.e. monetary) or an incentive for others (i.e. charity) can increase the response rate, increase the length of open-ended responses, and decrease omitted answers, (Newby et. al. 2003, Andrews et. al. 2003). Although survey design may affect participants' attention, an incentive affects their attitude while completing the survey, possibly overcoming some elements of the survey that discourages participation.

Shorter and faster surveys have little effect on the survey responses. The following aspects help people feel more willing to complete the survey: inspection of entire survey before starting, personal data first (as opposed to last), and giving estimated time to complete surveys and periodic reminders. The participant's privacy and confidentiality in the survey is also important to keep in mind. This builds trust between participants and researchers and increases credibility of the survey by providing a professional attitude. Total anonymity increases response rate of surveys but does not change quality of the responses. An informed consent statement at the beginning of the survey that outlines the motivation and gives confidentiality, skipping, and quitting information is an effective way of addressing these issues.

Surveys can employ a number of question types depending on what kind of information is wanted. Some of these question types include:

- Dichotomous Questions: only two responses possible
- Level-of-Measurement Questions: utilizes a response scale such as a 1-10 choice or a list of answers for the participant to choose from
- Filter Questions: can follow up other question types to increase clarity, gain more detailed information, or to see if the participant has enough experience to answer the question accurately. (Trochim 2006)

Each question type allows for different types of information to be gathered, and thus they must be used in conjunction in order for the survey to collect the most accurate as well as most complete datasets from the participatory group. For example, using a dichotomous question followed by a filter question utilizing a 1-10 scale can be a quick way of determining not only the familiarity with a topic, but also the level of familiarity or confidence in that statement.

Proper sampling is another critical consideration when designing a survey. Participants must accurately represent the survey's intended audience. If this is not the case, the survey may draw incorrect conclusions for the intended and misrepresented group. It is imperative that those chosen to participate represent the results fairly. Choosing participants that are familiar with the survey's delivery method (in this case online) increases the number of answers and response quality as noted in *Electronics Survey Methodology*: "Those who participate in electronic surveys may be more experienced, more intense internet users and have stronger internet skills than those who do not participate" (Andrews et. al. 2003, 190). Increased participation results in an overall increased response rate for the survey and will allow the survey to collect more usable data.

Finally, participants must be interested in and devoted to the topic of the survey to provide quality responses. ""Today's online populations are less cohesive and less interested in participating in surveys not salient to their interests (Cho & LaRose, 1999; Sheehan, 2001),"" (Andrews et. al., 191). There should not be any systematic judgment or bias with the survey topic and questions. Response rates change based on the participant's' ability to answer questions and their motivation to complete the survey. Making it relevant, engaging, and fair are priorities in the design process.

In order to get feedback on a survey and make sure it is as effective as it can be, a survey pilot is usually used. ""Survey piloting is the process of conceptualizing and reconceptualizing the key aims of the study and making preparations for the fieldwork and analysis so that not too much will go wrong and nothing will have been left out' (Oppenheim, 1992, p. 64)." (Andrews et. al., 193). There are four stages to consider while piloting a survey:

1. "Review by Knowledge": where we will make sure questions are complete, appropriate, thoughtful, and efficient.
2. "Think-Aloud": observing and following-up with participants to hear their thoughts and feelings.
3. A small preliminary study to 'test-drive' the survey once it has been informed by the first two steps.
4. One last check by the design team to make sure there aren't any typos, glitches, formatting problems, or other minor errors.

This 4-step pilot process can test the survey with a small group of the participants to see how well it retrieves the desired data and if the group understands the questions. It allows the survey designers to notice and fix errors such as question bias, skewed frequency scales, leading questions, and question placement in the context of actual participants taking the survey.

Survey Implementation

In the end, we only piloted our survey with our sponsors and advisors to make sure it conformed to their standards. We organized the survey into four sections: basic information about students, Santa Fe Indian School internet connection, pueblo internet connections, and students' internet habits, totaling to thirty questions. We made many edits to get the survey just right, adding a disclaimer at the beginning about the purpose of the survey and how it was optional, to respect students' rights. Eventually, we greenlit the survey by requesting permission to send it out from the high school principal, Felisa Gulibert. She had teachers distribute it to students during classes, while

we remained on standby to provide assistance. The survey was a success, because many students responded and gave us useful information.

Questions:

Basic Information

1. What tribe are you from?
    a. Dropdown options: Acoma, Cochiti, Isleta, Jemez, Laguna, Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Felipe, San Ildefonso, Sandia, Santa Ana, Santa Clara, Santo Domingo (Kewa), Taos, Tesuque, Zia, Zuni, Navajo Nation, Jicarilla Apache Nation, Mescalero Apache Tribe, or Other
2. Where do you live
    a. Multiple Choice options: in the Pueblo, Rural, Suburban, or In a city
3. What is your gender?
    a. Multiple Choice options: Boy, Girl, or Other
4. What is your age? (Put number only)
    a. Write in age number
5. What grade are you in?
    a. Dropdown options: 6, 7, 8, 9, 10, 11, or 12
6. What kind of student are you?
    a. Multiple Choice options: Dorm or Day

SFIS Internet Connections

7. What type of internet connection are you using while at SFIS?
    a. Multiple choice options (pick all those that apply): Wired (Desktop computers), Wireless (Wi-Fi/Non-mobile), Wireless (Mobile/3G/4G), I don't know, or other (fill in the blank)
8. Do you connect to the SFIS wireless network?
    a. Multiple Choice options: Yes or No
9. On a scale of 1-5, how reliable is the SFIS wireless connection?
    a. Scale: 1 - not reliable to 5 - very reliable
10. How often does the SFIS wireless block you from going to a website?
    a. Scale: 1 - never to 5 - always
11. Does this discourage you from using the SFIS Wireless?
    a. Multiple Choice option: All the time, Somewhat, Not often, Never, or N/A
12. What improvements would you make to the Internet at SFIS?
    a. Short open response

Home Internet Connections

13. Do you have internet access at home?
    a. Multiple choice options (pick all those that apply): Yes Mobile data/3G/4G, Yes Mobile hotspot, Yes Home Internet connection, or I do not
14. Do you normally use a computer or mobile devices to connect to the Internet?
    a. Multiple Choice options: Computer (laptop, PC, Mac, etc.), Mobile devices (cell phone, tablets, smart phone, etc.), Both, Neither, or Other (fill in the blank)
15. If you use a computer, do you use wired or wireless internet to connect?
    a. Multiple Choice options: Wired, Wireless, Both, or N/A
16. If you use a mobile device, do you use wireless or cellular data?
    a. Multiple Choice options: Wireless (Wi-Fi), Cellular data, Both, or N/A

17. If you have a non-cellular (cellphone) internet at home, what kind is it?
    a. Multiple Choice options: DSL, Cable, Fiber, Satellite, Dial Up, I don't know, or Other (fill in the blank)
18. On a 1-5 scale, how reliable is your home connection?
    a. Scale: 1 - not reliable to 5 - very reliable
19. How well does your home connection work for school related functions (research, group work, etc.)?
    a. Scale: Does not work at all, Works slightly, Works fairly, Works well, or Works extremely well
20. How well does your home connection for your purposes outside of the school (entertainment, social media, etc.)?
    a. Scale: Does not work at all, Works slightly, Works fairly, Works well, or Works extremely well
21. Is there anything, positive or negative, that you can say about the Internet that you regularly use at home?
    a. Short Open Response

Internet Habits/Preferences

22. How often do you use the Internet?
    a. Scale: <1 hour per day, 1-3 hours per day, 4-6 hours per day, or >6 hours per day
23. Where do you usually interact online?
    a. Multiple choice options (pick all those that apply): School, Home, Library, Internet Cafe, or Other (fill in the blank)
24. How confident are you, your parent(s), and your grandparent(s) in using the Internet?
    a. Scale with those three options: 1 - not confident to 5 - very confident
25. How do you use the Internet for recreational purposes?
    a. Multiple choice options (pick all those that apply): Social Media (Facebook, Twitter, Instagram, etc.), Streaming TV/Movies (YouTube, Netflix, Hulu, etc.), Music (YouTube, Pandora, Spotify, etc.), Shopping, Games (Online, Stream, etc.), News (ABC, Fox, CNN, etc.), or Other (fill in the blank)
26. How many hours a day do you use the Internet for recreational purposes?
    a. Multiple Choice options: <30 minutes, 30 minutes-1.5 hours, 2-3 hours, or >3 hours
27. How do you use the Internet for educational purposes?
    a. Multiple choice options (pick all those that apply): Research, Accessing online homework assignments, Collaborative work (i.e. Google Drive)
28. How many hours a day do you need the Internet to do your homework?
    a. Multiple Choice options: <30 minutes, 30 minutes - 1 hour, 1.5-2 hours, or >2 hours
29. How important do you think the Internet is as a resource for students looking to do well in their classes?
    a. Scale: Not at all important, A little important, Fairly important, Very important, or Extremely important
30. Why or why not do you think the Internet is important for you to do well in classes?
    a. Short Open Response

3.3 Infographics

Infographics visually displays information for the intended audience to easily understand. We created infographics to inform the pueblo communities on different aspects of broadband internet and how they can utilized it. We worked with our sponsor, our advisors, and all of the stakeholders in Santa Fe to learn about the access to, inclinations towards, and knowledge of internet in the pueblo communities. We gathered this information through the aforementioned processes of speed testing, interviewing, and investigating current connections. We worked with our stakeholder groups in the Santa Fe Indian School and the pueblo communities to learn about their current knowledge and interests regarding broadband internet. We visually displayed in infographics collaboration information, guidance from our sponsor and our own background research on broadband internet in the native communities. We strived to provide the pueblo community members with information about broadband internet that helps forward specific community goals.

The Oxford Dictionary defines an infographic as "a visual image such as a chart or diagram used to represent information or data". While this defines what an infographic accomplishes, it should not just present data; the infographic should tell a story that draws the reader in and keeps their attention until the end (10 Tips for Creating Effective Infographics). The infographic needs to be planned out methodically while taking many things into account: the target audience, infographic style, end goals, and presentation to the target audience (website, poster, etc).

Two common statements that explain the effectiveness of quality infographics are 'a picture is worth 1000 words' and 'less is more'. Both statements embody simple picture-based storytelling to put forth a message that is immediate and informative. Specific manifestations of these perspectives in terms of infographic elements include:

- Bold headlines to capture the reader's attention
- Relatable images to make the meaning of data clearer and to tell more of a story
- Data in the form of graphs, charts, and other representations to back up arguments
- Small text chunks to make sure the reader does not get bored or tired

These design choices allow the infographics to present a story that is appealing and delivers an impact to the intended audience.

Within these design choices, there is variation on infographic styles and functions. Choices, such as color, layout, style, etc., must be conducive to the infographic's goal. For example, it would not be appropriate for a graphic detailing military casualties to have playful icons and bright colors, nor would it be effective for a children's poster about the benefits of reading to be drab and terse in

its delivery (Creating Great Infographics). Each element of the infographic must acknowledge the purpose, mood, and goal of the piece as a whole through its design. Drafting and redrafting the infographic is key (Creating Great Infographics), as it allows for the story and storytelling method to be honed until prime effectiveness.

Along with design choices used to capture and retain the audience, a logical framework persuades the intended audience and makes the story compelling. A common framework uses the themes *Logos, Ethos, and Pathos*, which transfers well to the creation of infographics (Hart 2013):

- Logos entails an appeal to reason: using data and common sense to make the audience acknowledge your argument.
- Ethos appeals to the reader's ethics: using their sense of morality to prove the topic's worth.
- Pathos involves appealing to the reader's emotions: evoking feelings to validate your point.

An infographic that effectively transmits an argument to the reader on multiple levels often uses a combination of these three principles to reach viewers.

All of these design and persuasive choices are effective only if they appeal to the specific audience the infographic is trying to target. Knowledge of one's audience influences color choice, tone of writing, data representation, and other facets of the design process. The design must be continually refined to create the most effective end product. These choices are known as the 'visual vocabulary' (Hart 2013). We gained information on how to best design the infographic through research and interacting with the intended audience multiple times during the design process to further hone the design choices toward the final product.

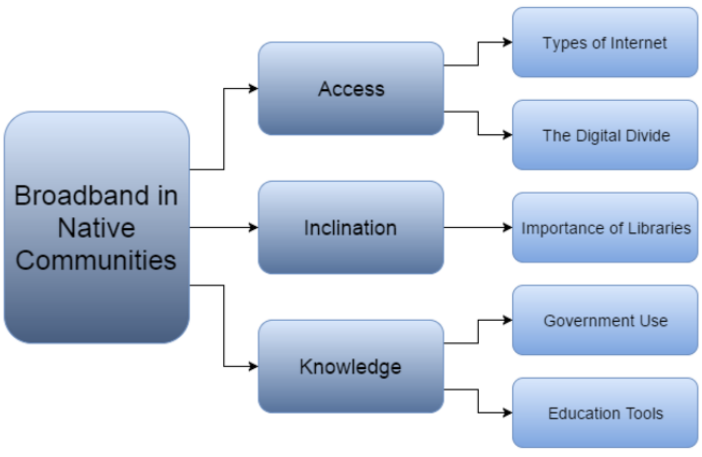

Figure 5: Rationale for choosing what topics to make infographics about.

We made a total of five infographics, each with a story about the importance of internet within the pueblo communities. The five infographics reflect three facets of the digital divide: access, inclination, and knowledge, shown in Figure 5. Access highlights the types of internet connections available and the difference between urban and rural broadband. We showed inclination with an infographic about what tribal libraries offer to their communities. We represented knowledge with the opportunities reliable broadband can bring to tribal governments and students.

Infographics are more than informative text when using visually appealing images. Different animals correlated to different types of internet speeds: snails represent slower speeds and cheetahs show faster speeds. A computer screen in the distance learning infographic explains the different internet resources students use. Urban vs. Rural infographic compares and contrasts internet using city skyscrapers and pueblo buildings to represent the two locations. The tribal library infographic highlights important resources libraries offer. The tribal governments infographic uses symbol that shows the advantages of the Internet for different government service. We used pictures to highlight the information, make the infographics more attractive, and to capture the pueblo communities' attention.

CHAPTER 4: RESULTS AND FINDINGS

By the time we left Santa Fe, our group's data collection and analysis yielded several concrete results: the speed tests provided a baseline for current performance of library internet connections in Pueblos, our student survey provided many interesting observations and useful datasets regarding student internet usage, and the student focus groups and librarian interviews demonstrated several recurring themes that inform the state of the Internet in the Pueblos. In addition to our main deliverables, our analysis of this data will hopefully prove useful to future groups studying internet connectivity in similar communities. The analysis is structured around the main findings that we garnered from our research methods:

1. Internet Access in Tribal Communities
    a. Information on Library Internet Connections
    b. Student Access at Home and in the Communities
    c. Interpreting Access: Internet Speed Evaluation is Difficult
    d. Are Tribal Libraries Receiving the Services They Pay for?
2. Access at Bureau of Indian Education Schools
    a. BIE Data Analysis
    b. Student Access at SFIS: A Case Study
3. Tribal Libraries as Critical Infrastructure
4. On Inclination and Knowledge: Attitudes Towards Internet Among the Pueblos
5. Overcoming Difficulties in Improving Internet Access for the Pueblos
    a. Challenges to and Opportunities for Improving Internet Access in the Pueblos
    b. How this Project Provided Resources to Overcome Access Challenges

4.1 Internet Access in Tribal Communities

Some of the most significant findings of our project came from our analysis of internet access in tribal communities. Our library speed tests provided a great deal of information on the current status of the library internet connections. In addition, our interactions with the Santa Fe Indian School students told us much about the state of the internet in their home pueblos. However, we also ran into many difficulties while collecting our data, so it may be necessary for future groups to conduct further research on this topic in the future. In this section, we cover different t

1. Variations in tribal library speeds
2. Views on internet connections from the students at SFIS
3. Difficulties in evaluating internet speeds from tribal library speed tests
4. Trying to determine if tribal libraries are receiving the internet services they are paying for

4.1.1 Tribal Library Speeds Vary Greatly

We collected internet connection speed data for both wired and wireless-connected computers from both pueblo libraries and Apache tribal libraries (Figures 6, 7, 8, 9). These tests show that about half of the tribal libraries have a high (>25 Mbps) download speed, as well as good upload speeds. Some Pueblo's connections are still less than 10 mbps download speed, which may not be adequate for some internet tasks, especially with multiple patrons using the Internet. The libraries with low speeds are often the ones positioned far away from the infrastructure of faster options like fiber-optic cable. Given this, there is in fact a 'digital divide' in internet connections amongst the Pueblos themselves. Ohkay Owingeh, Santa Ana, Tesuque, Isleta, and Pojoaque pueblos stood out from the others because of their fast connections (Figures 6,7). They serve as examples of how the libraries as a whole could be benefiting from internet upgrades and the potential high speeds that poorly serviced tribal libraries could have if they adopt programs like E-Rate's fiber connection plan.

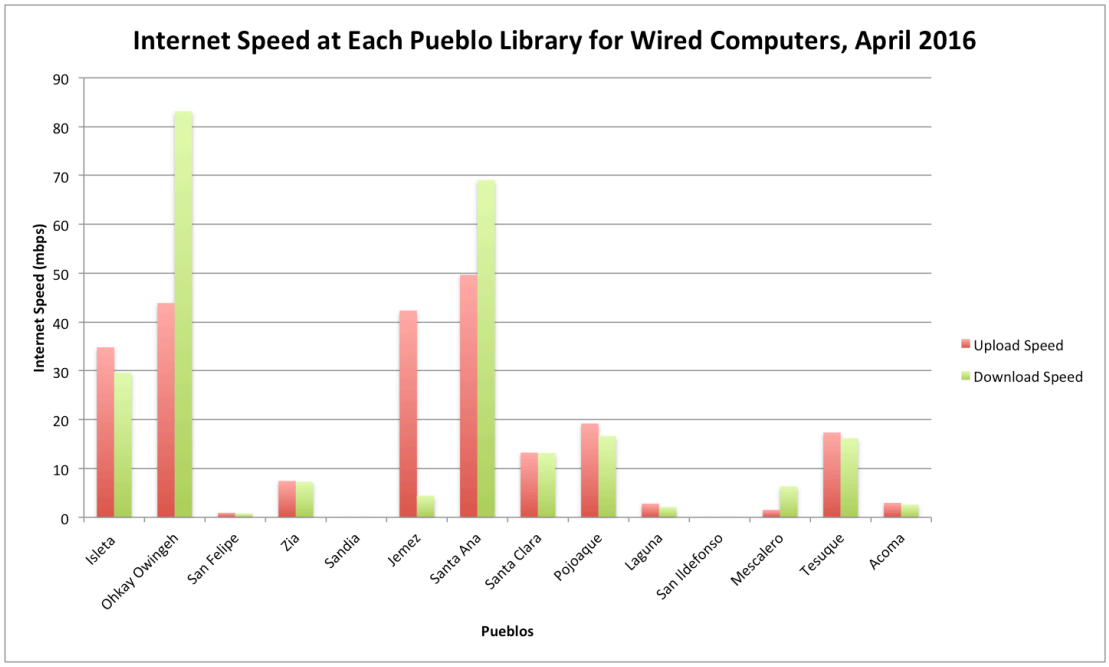

Figure 6: Library speed test results for wired computers.

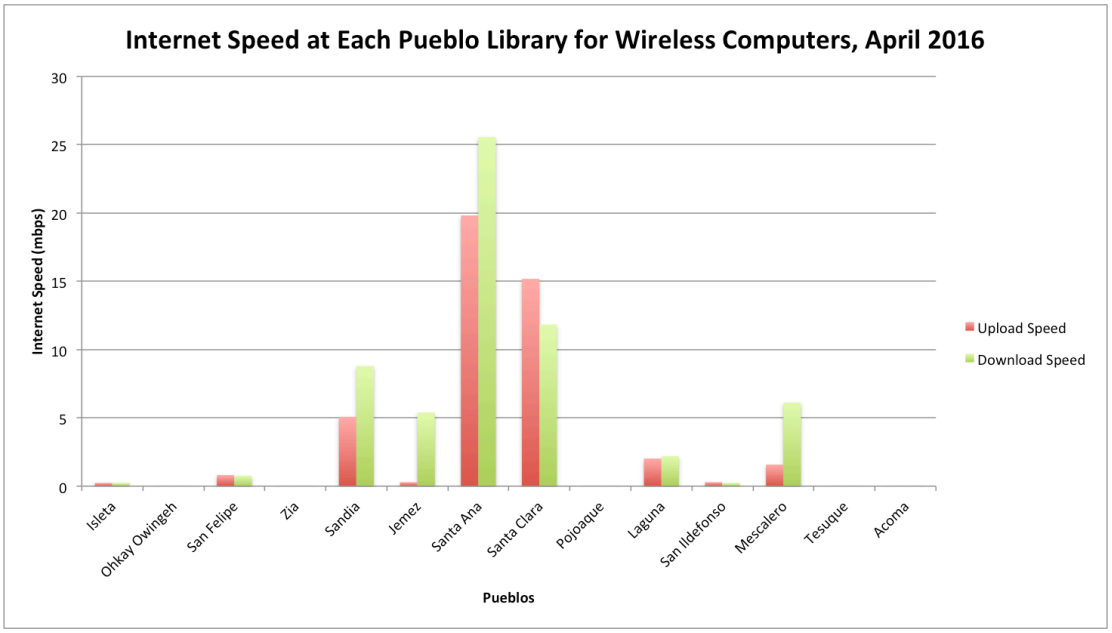

Figure 7: Library speed test results for wireless computers.

Other pueblos, however, appeared not to be getting adequate speeds. The Jemez, San Felipe, Laguna, Acoma, and San Ildefonso libraries all had lower download speeds in 2016 than reported in 2015, and they as well as several other libraries still have slower (1-5 Mbps) connections that pale in comparison to the 50+ mbps connections that the better connected libraries have, despite being promised more. For instance, the libraries at Jemez, San Felipe, and San Ildefonso all yielded speeds that were 50% or less of their advertised speeds, which seems too extreme to be explained away by error. Therefore, it seems that some pueblos are getting slower speeds than what they are paying for while others are doing fine, which highlights the difference between the ones utilizing upgrades and those who haven't.

As a concrete example of how the quality of internet connections affects their use, the ping (response time) for some of these sub-par libraries shows results inadequate to utilize services like video conferencing (Fig. 8, 9). Thus, even libraries, which are usually the best connected public places in the Pueblos, can have spotty connections in practice, which causes problems for people who rely on them for certain kinds of internet access. That again highlights the significance of the better connected libraries mentioned above; the speed tests prove that the sub-par connections in the slower libraries are an escapable fate, if they choose to utilize the upgrades available through

grant programs or federal funding. All the results from the tribal library speed tests can also be found in Appendix B.2 and the document sent out to the libraries can be found in Appendix B.1.

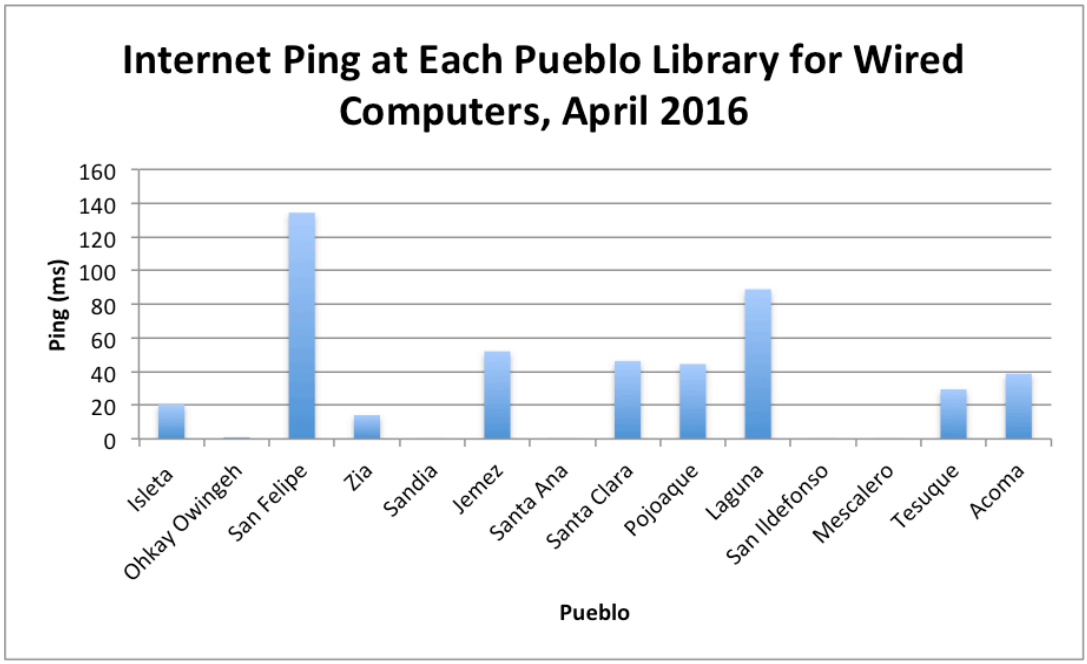

Figure 8: Library ping results for wired computers.

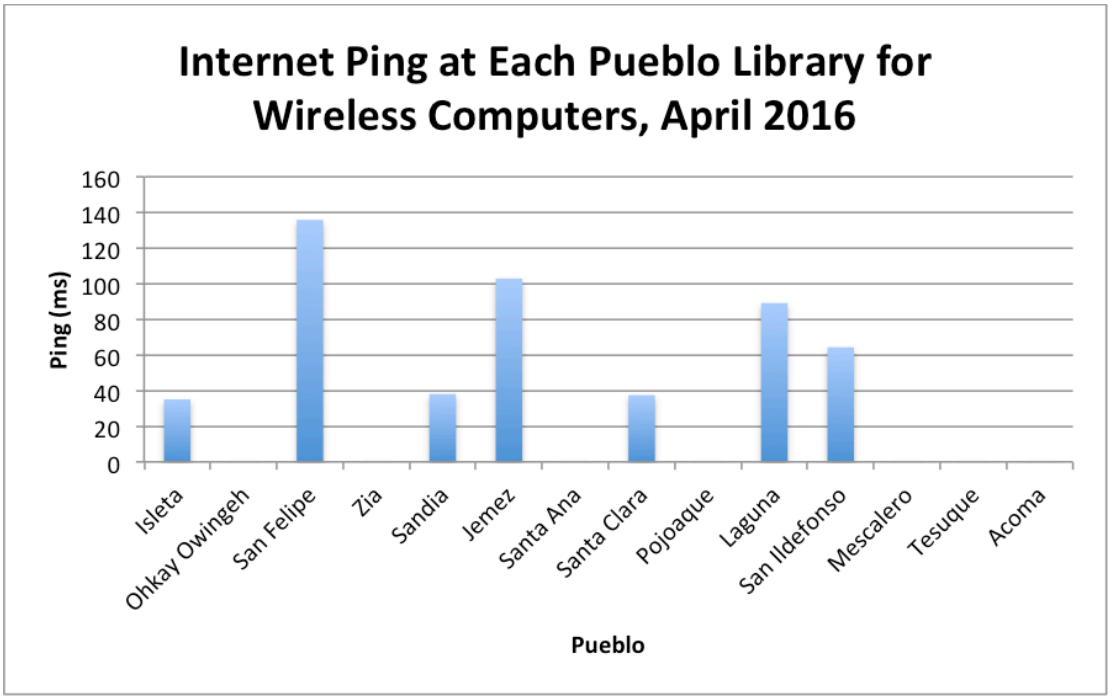

Figure 9: Library results for wireless computers.

4.1.2 Student Views on Internet Access in the Pueblos

In addition to our library speed tests, we also learned a lot from our SFIS student survey and focus group about how students access the internet in their home pueblos. During the focus group, many students mentioned that they don't have adequate internet connections at home to fulfill all their needs. The broadband situation among the Pueblos varies from having reasonably good connections through fiber, cable, or DSL sources; to being limited to weaker sources like satellite; to using only expensive and sometimes spotty cellular phone service. Due to this disparity, many students struggle to get their online homework done when they return home, such as during the Easter break. Teachers sometimes have to make allowances for students with poorer connections who cannot complete their assignments (Santa Fe Indian School 2016). Some students access the Internet through the tribal libraries, but some libraries have poorer connections that are not feasible for many patrons and students to use at the same time. In some cases, students use other measures like connecting in the school parking lot or using a personal hotspot. The general lack of technological access in the Pueblos frustrates students when they leave the school's reliable internet connection. Last year the school installed the fiber connection in the student dormitories, leading to a huge burst in productivity. Previously, the students in one dorm were fighting over just four computers for the internet access necessary to do their work (Santa Fe Indian School 2016). This upgrade increased connection options for the students outside of limited computer stations.

The survey we distributed to the Santa Fe Indian School students, the complete results that are cataloged in Appendix C.1, revealed several interesting trends. Over 70% of the students live in the Pueblos, while only a few live in cities, suburbs, or other rural areas (Figure 10), meaning most students depend on the pueblos' internet connections while outside of school. That means that the majority of the students are dependent on the pueblos' internet connections while outside of school. Less than half of the students have a working internet connection at home. Of the ones that do not, some have internet hotspots and some use cellular data on their phones, but almost 25% of all students have no internet at home whatsoever (Figure 11). When asked how reliable their home connections are, the average rating the students gave was 3.55 out of 5 (Figure 12). The students gave mixed responses about their home connections, with some saying that their connections were very good, even better than the school's, while others complained about either having very slow connections or having no connection at all or just a mobile connection. Some students had recurring complaints about their connections, such as the connection breaking up under bad weather, which suggests some type of wireless, or when too many people use it. Some also complained about lack of

coverage, such as not having a cell tower nearby or having a good connection that isn't accessible to the rest of the community. Students with both good and bad connections mentioned the necessity of doing homework outside of school, as well as things they like to use the Internet for on their free time like video games and social media. Therefore, it seems that while some students do have good connections at home, there are still some who need a new or better connection so they can do well in school and enjoy other benefits of the Internet, especially since students with good connections may have an advantage over those without.

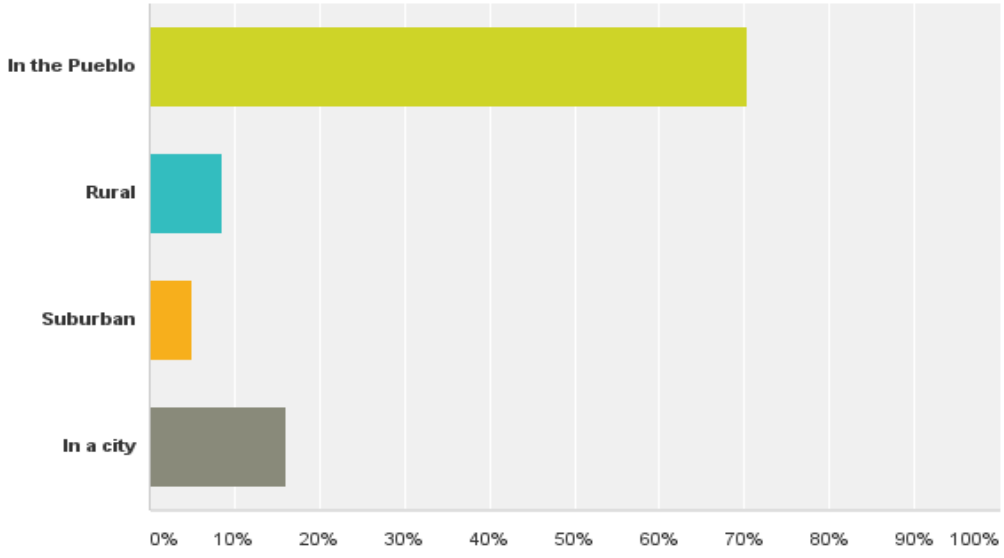

Figure 10: Student survey results for where students live outside of SFIS.

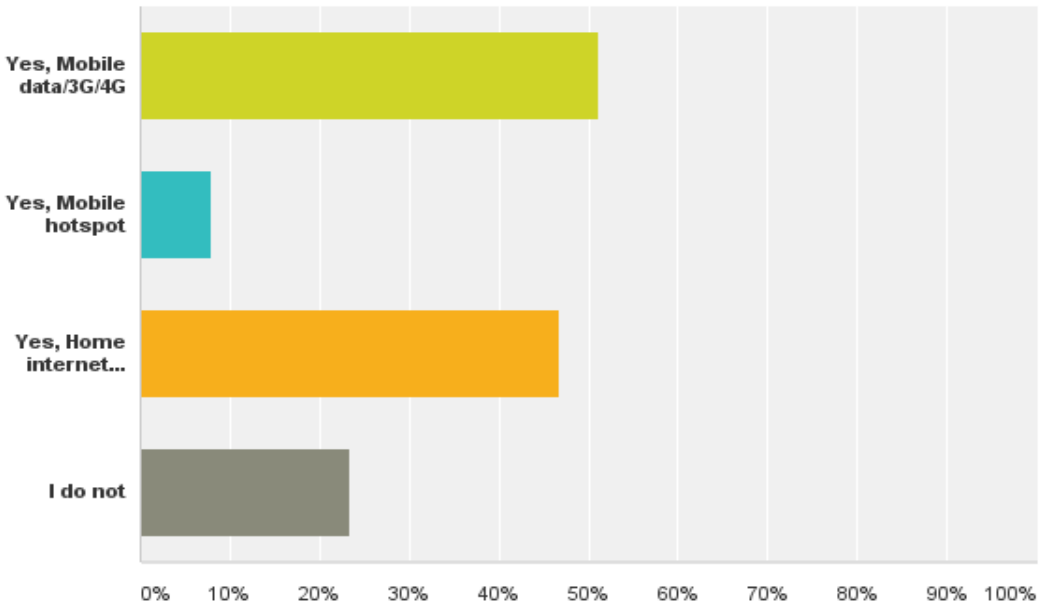

Figure 11: Student survey results for what connections students have at home (multiple choice answer, many students chose two options).

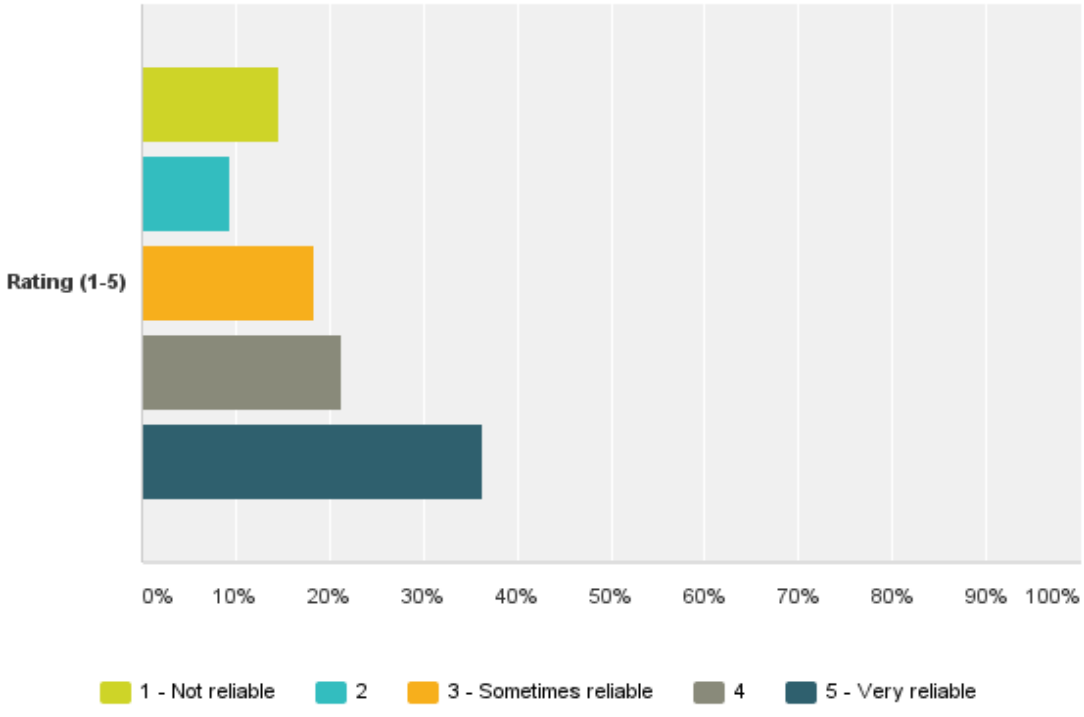

Figure 12: Student survey results for how reliable their home connections are.

We also asked students about how they connect to the Internet and learned that more connect using mobile devices than using computers. While over half of students use both, only about 5% only connect using computers, while almost 40% have to rely on mobile devices for connection (Figure 11). That suggests that many students do not have proper connections at home and have to rely on their mobile devices to use the Internet. Of the students who do use mobile devices, about half use both wireless networks and cellular data, while about 30% use only wireless and 20% rely on cellular data plans (Figure 12). Based on this information, it appears that a significant amount of students can only use their phone's data plan to connect to the Internet outside of school. However, many do have an alternative wireless connection such as the tribal library or another building with free Wi-Fi. That is further supported by the fact that only 73% of students use the Internet at home, while about 25% use it at the library and 11% use it at internet cafes (Figure 13). Lastly, it appears that internet usage is still fairly high among most of the students, since over half use it more than three hours per day and only 5% use it less than one hour per day as shown in Figure 14. Although some of this time probably comes from using the school connection, it appears that most students are still finding ways to connect to the Internet outside of school, although some of them still have to go out of their way to find a connection.

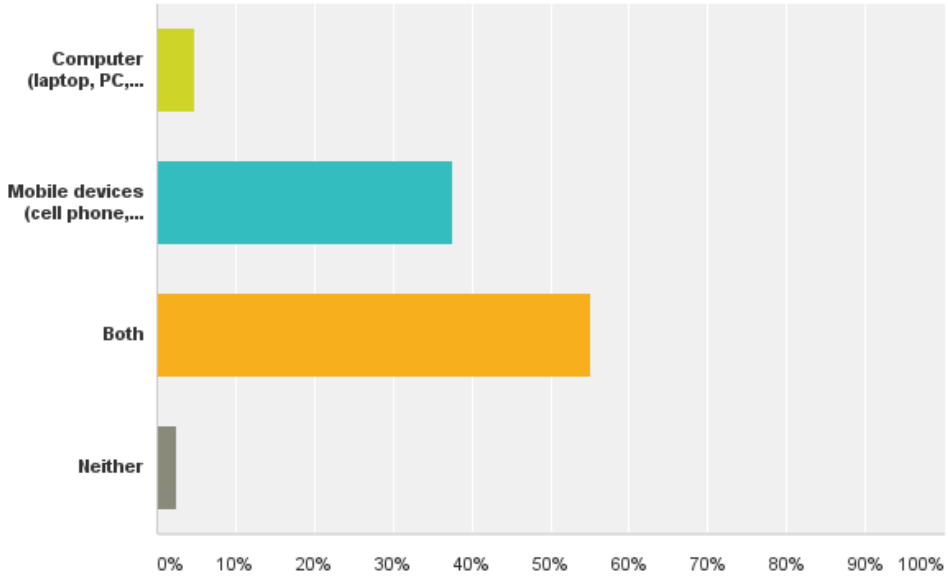

Figure 13: Student survey results for which device students connect to the internet with.

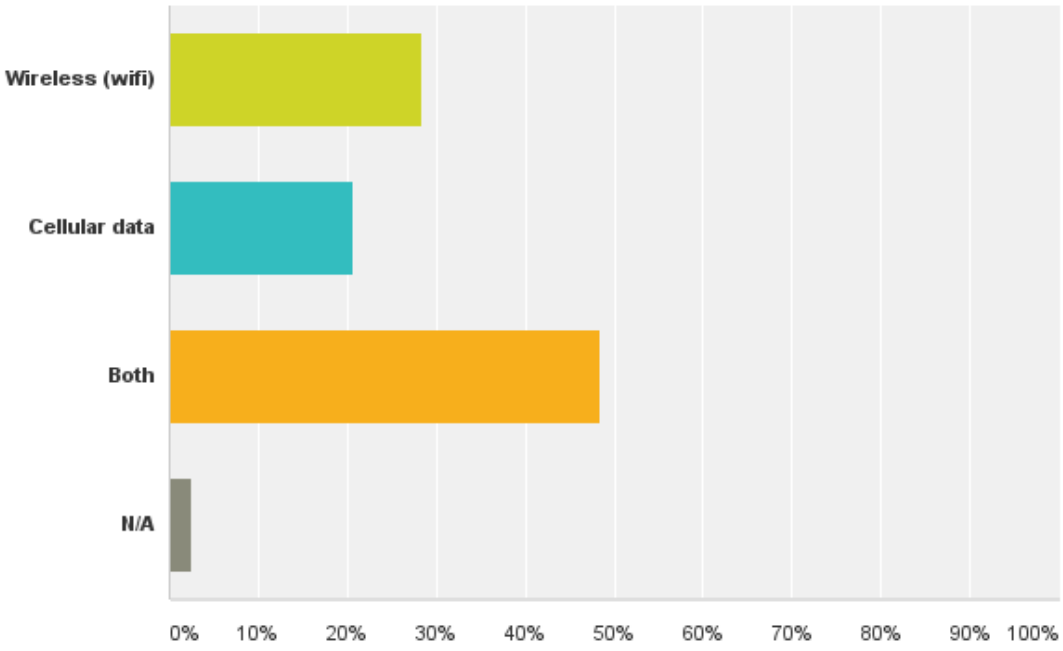

Figure 14: Student survey results for wireless vs. cellular data if they use a mobile device.

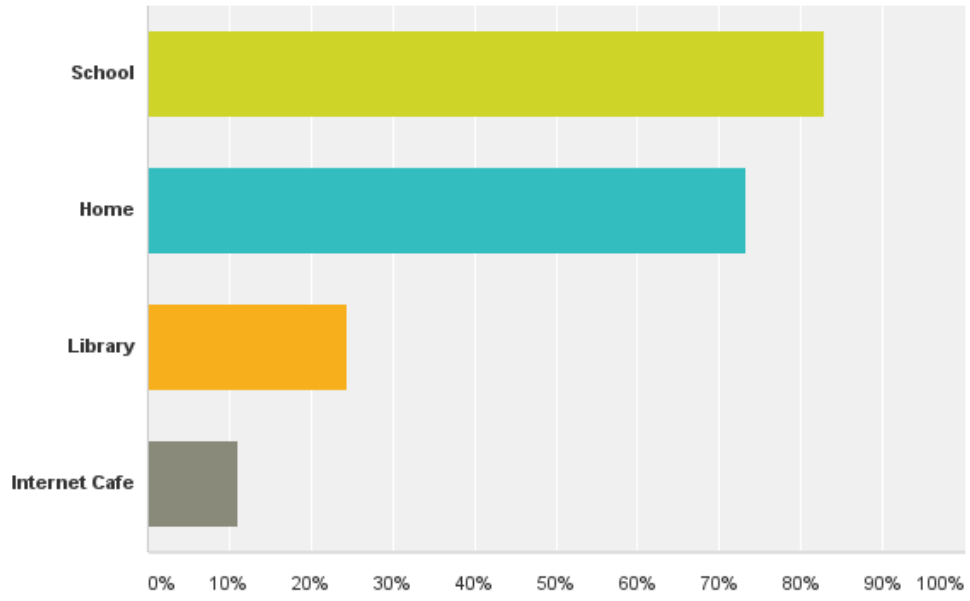

Figure 15: Student survey results for where they use the internet.

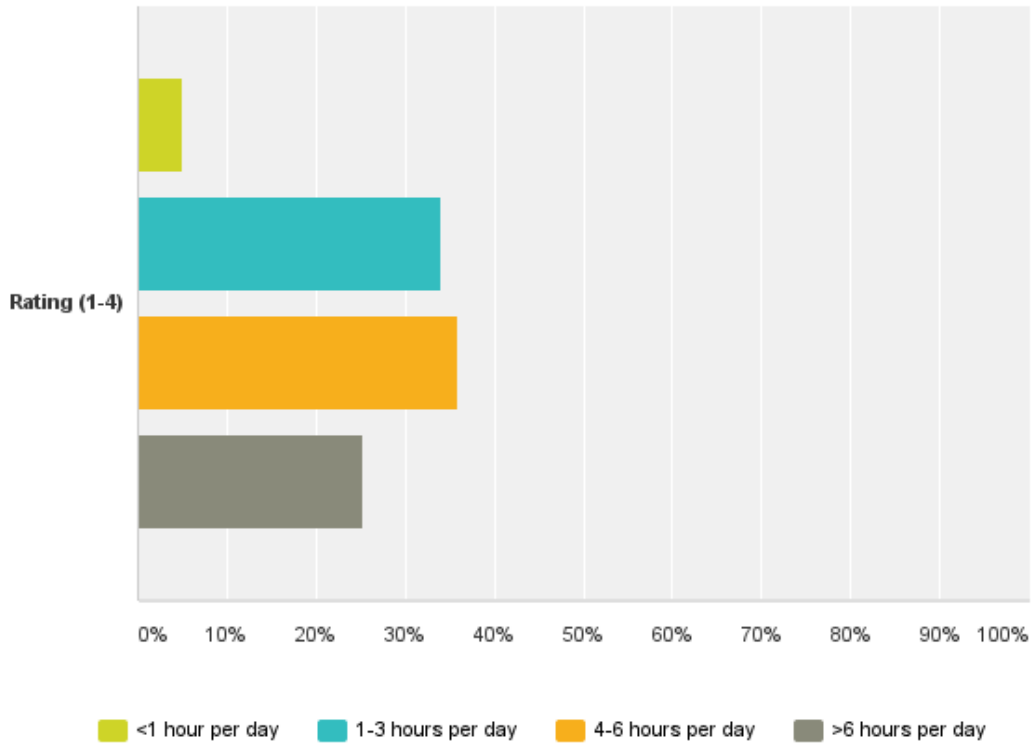

Figure 16: Student survey results for how often they use the internet on a scale of how many hours per day.

4.1.3 Interpreting Access: Evaluating Internet Speeds is Difficult

While working with tribal librarians to conduct internet speed tests, several problems emerged that made determining the accuracy of the tests difficult. For example, four libraries share their connections with others, whether with others in their one building, or with other tribal offices, or even with the whole community. The data from these libraries (Figure 17) looks quite different from those with their own connections (Figure 18), because the Internet Service Providers' (ISP) advertised speed is much higher than that measured at the library presumably because the bandwidth is being taken up by other users. Ohkay Owingeh's and Isleta's libraries took advantage of a majority of the bandwidth, which made them leaders in terms of pueblo broadband, while Santa Ana did not, making them seem like they were getting much less than warranted. While we were still able to make inferences on the quality of their connections based on how much of the 'community' connection they are able to utilize and their speeds in relation to the other pueblos, the fact that we cannot know what the libraries 'should' be getting makes determining the quality of their connection difficult.

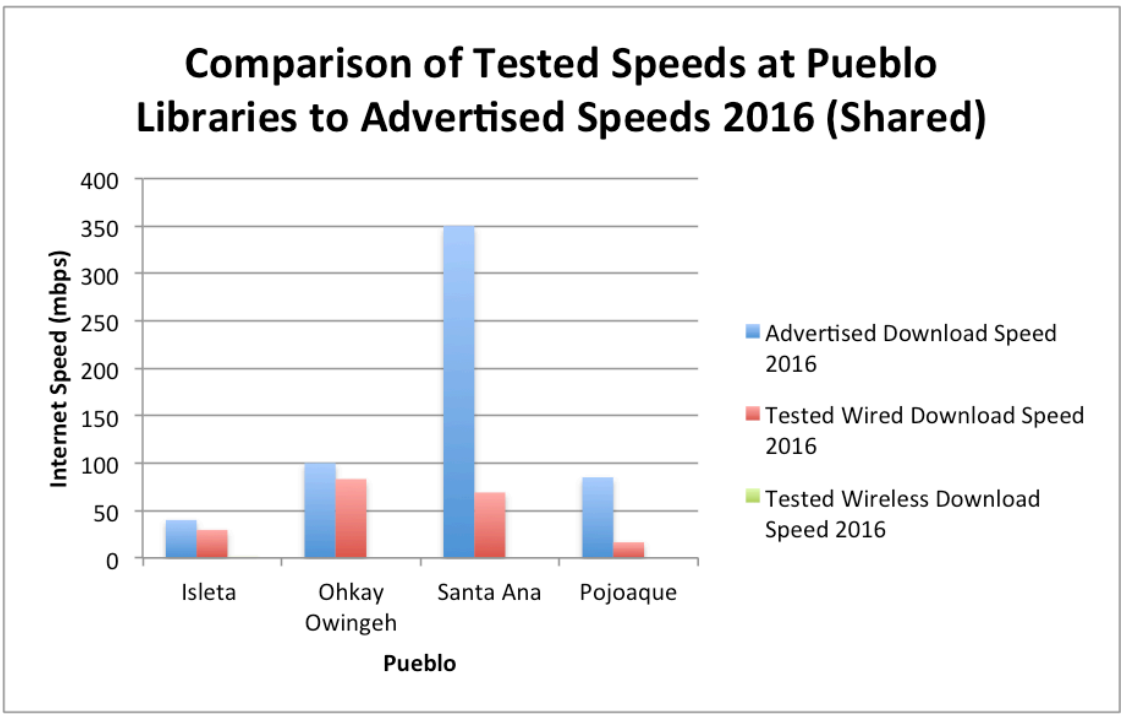

Figure 17: Chart comparing advertised 2016 speeds to tested 2016 speeds for libraries with shared connections.

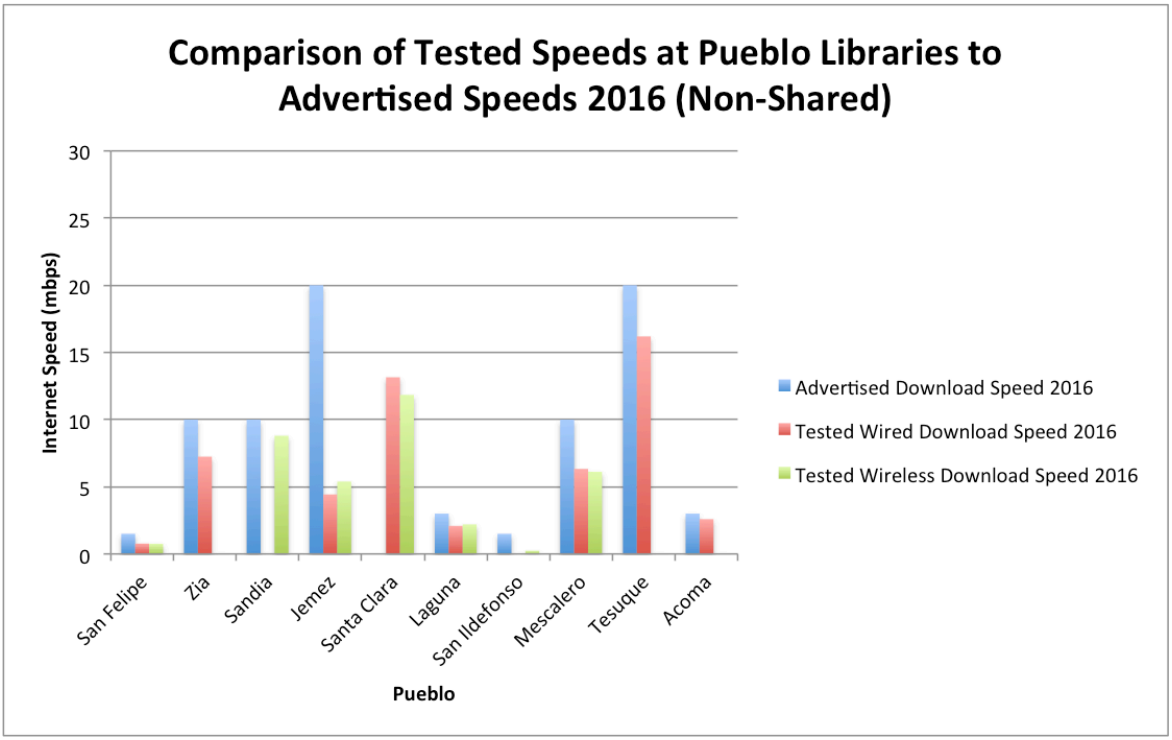

Figure 18: Chart comparing ISP-advertised 2016 speeds to tested 2016 speeds for libraries with non-shared connections.

Based on last year's annual internet speed report (New Mexico State Library 2015), it appears that many of the tribal libraries have seen improvements in their internet connections already. According to the report and our own speed tests, all but three of the Pueblos had higher download speeds in April 2016 than they did in June 2015 (Figure 19). Many of these increases are probably due to connection upgrades through the Redi Net or E-Rate programs. For example, the libraries at Ohkay Owingeh, Isleta, and Tesuque all installed fiber connections recently and had much higher download speeds in 2016 than in 2015. Many of these upgrades happen whenever it is convenient for the tribe and the ISP, and while we support these efforts, data on when upgrades occur and what improvements are to be realized is often lacking, making it difficult to analyze whether pueblos are getting the service they have contracted for. We found out after our speed tests that some of the libraries had just upgraded, were in the process of upgrading, or were scheduled for an upgrade soon, which made finding the advertised rate for the libraries difficult.

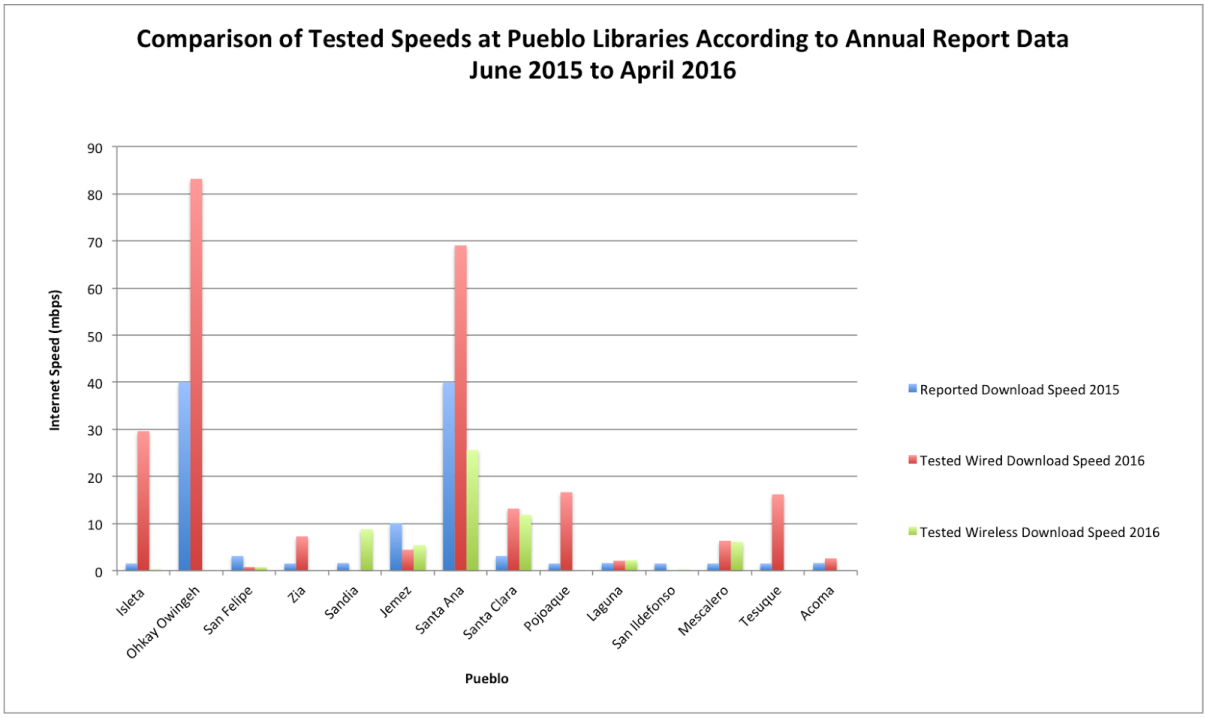

Figure 19: Chart comparing reported 2015 speeds to tested 2016 speeds.

In addition to the 'accountable' sources of speed test confusion, some issues were encountered with security, library events, and misunderstanding of how to conduct the speed tests that could have skewed the data. Despite this, most libraries were able to get at least one of our tests to work, except Santo Domingo, whose satellite connection was so poor the test would not work,

and Cochiti, Zuni, and Jicarilla, who did not participate in the effort. In addition, some data is skewed by missed tests, errors affecting the speed test software, lack of IT support, lack of available information from ISPs, and other factors. As an example, for the most part the download speeds were higher than the upload speeds, but sometimes the opposite was true, which is odd and suggests skewed upload data. In addition, some of the libraries, such as Jemez and San Ildefonso, were unable to get their internet working at all on some days, which dragged their average speeds down. All of these complications show that further tests will be necessary to get a more thorough and reliable dataset. All the data sets can be found in Appendix B.3 and B.4.

4.1.4. Are Tribal Libraries Receiving the Service They Pay For?

Despite our attempts to make the data as accurate as possible, it appears that further study is required to determine whether tribal libraries are receiving the correct internet speeds. Early anecdotal evidence suggested that libraries were getting lower speeds compared to the advertised rates from their providers. That was actually not the case: based on actual speed testing, it appears that many of the libraries do have connection speeds that compare to those advertised by ISPs. In particular, the ones with fiber connections generally yielded at least 75% of their download speeds (Appendix A.2). Since there are many factors that can affect internet speed, like connection interference, multiple users, and IT problems, it is expected that the tested speeds will be at least somewhat lower than the advertised speeds.

However, we encountered a serious lack of information in the pueblo library system dealing with both reported speeds and pricing information. In many cases, and especially in the case of shared connections, the librarians or IT coordinators did not have data on what speeds they should be getting or how much they are paying for internet service. While we eventually did learn what speed their ISP through contacting a number of people promised many libraries, it was clear that this information was not readily known or cataloged in a meaningful way. The pricing information was even harder to find, and in the time we had to conduct the speed tests we could only get one quote, which was from Acoma Pueblo, who reported paying just under $1600 for their 3 Mbps of service. While this is just anecdotal evidence, $500/Mbps is appalling compared to the average rates of urban areas in New Mexico which normally range between $4-$25/Mbps (Viorica 2016). This example shows why it is important that this data be more available and cataloged, so the tribes can know when they are being given sub-par service or being overcharged.

What the data did show was the complexity of the situation surrounding the pueblo library connections, which we believe to be a valuable finding in itself. The insights garnered from our data collection highlight that while the library connections are mostly on par with what they should be getting, a majority of them are well below what they could be at this time when compared to the impressive fiber connections in the best-connected pueblos. Furthermore, there are many interesting factors affecting the connections and the testing thereof, including IT problems, the type of software, and the presence of other internet users. Nevertheless, it is clear that further study is needed in order to determine whether tribal libraries are receiving the services they pay for.

4.2 Access at Bureau of Indian Education Schools

In addition to the data we collected on tribal communities, we found significant data relating to Indian schools. Some data came from the Bureau of Indian Education (BIE) Schools, a government organization that oversees tribal schools. We also collected data through our student survey and focus group at the Santa Fe Indian School, all of which provided different windows on the question of tribal students' internet usage and school internet connections.

4.2.1 Bureau of Indian Education Schools and Internet Connections

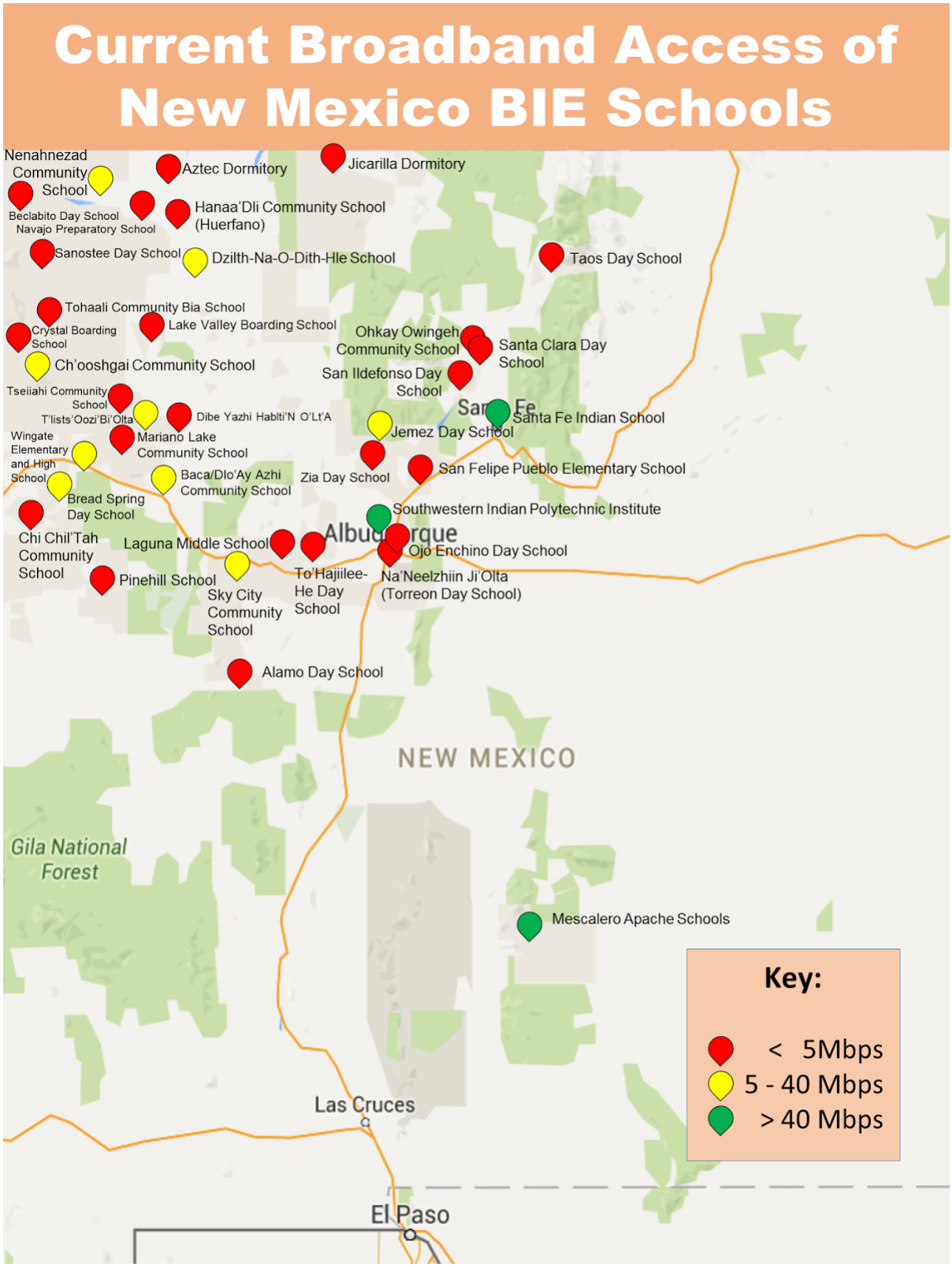

Figure 20: Map of New Mexico BIE school's internet speeds.

The BIE data indicated that more than two-thirds of the BIE schools do not have adequate access for their students. The Map in Figure 20 shows the location of the schools and a color-coded chart of internet speeds they receive. Only three schools have internet speeds higher than 40 Mbps: Santa Fe Indian School, Mescalero Apache Schools, and the Southwestern Indian Polytechnic Institute. Eight schools fall in the range of 5 to 40 Mbps. The remaining 25 schools are getting less than 5 Mbps. Most only have 1xT1 connection, resulting in a speed of 1.5 Mbps. Today, education resources, distance learning, online tools, classes, and assignments increasingly rely on the Internet, and students might not be able to fully utilize these resources without proper internet connections.

Using the Santa Fe Indian School, Mescalero Apache Schools, and the Southwestern Indian Polytechnic Institute as examples, it is certain that schools can get faster, more reliable internet in a similar situation to the libraries. For the education of the students, the BIE schools should be getting better internet access than a typical speed of 1.5 Mbps. A comprehensive program like Ms. Sekaquaptewa's E-Rate project can help ensure that schools, libraries, and other important tribal services get an adequate connection. More information on internet speeds for BIE schools, including the Santa Fe Indian School, is available in Appendix B.5.

4.2.2. Student Views on Access at SFIS

We detected several major points about school internet usage from our focus group with the freshman leadership team at the Santa Fe Indian School. One is that students have a fairly large amount of online work to do at school. Certain assignments, like group portfolios, require access to Google Drive so that all students in a group can work on them. Many students also have large research projects, like the senior project and the leadership team projects, which require a great deal of internet data. The Santa Fe Indian School has a good fiber connection and most students connect to school Wi-Fi using their phones or computers (some rented from the library). Students use the Internet for both academic purposes like research and recreational purposes like streaming videos on Netflix or playing video games (Santa Fe Indian School 2016).

We also collected quantitative data regarding the SFIS internet connection from our student survey. According to the students, they use a variety of connections at the school, including wired computers (35%), wireless computers (70%), and mobile devices (60%) as shown in Figure 21. Therefore, it seems that the school's internet connection is very effective and sufficient for multiple students to complete their work at the same time. It also appears that the school provides a wide range of technology for the students to use, some of which they may not have access to at home.

When asked about how reliable the SFIS connection is, the students gave an average rating of 3.58 out of 5 (Figure 22). Therefore, it appears that some students think the SFIS connection is very effective while others think it is a little slow, perhaps because some have faster connections at home. That statement is supported by the open-ended responses the students gave about the school connection, in which sometimes complained that the connection is slower than what they are used to. Many students complained about how the school blocks a lot of sites online, suggesting that some blocked sites are needed for schoolwork, such as research sites and college information pages, as well as recreational sites like online games or movies that students would appreciate, especially as SFIS is a residential school. Others complained about not being able to download apps on their mobile devices, including those recommended for classes, as well as not being able to use music streaming sites such as Spotify. The most common complaint that students made was not being able to use the Internet after 10:00 PM, not just because of recreational activities, but because they sometimes need to work late into the night on online assignments. Based on our information, it seems that the school has a pretty good connection, worse than some of the pueblo connections but better than many others. However, it also seems that the curfew and other restrictions on the connection are preventing students from reaching their full academic potential, so perhaps the school should consider lessening some of its restrictions in certain cases.

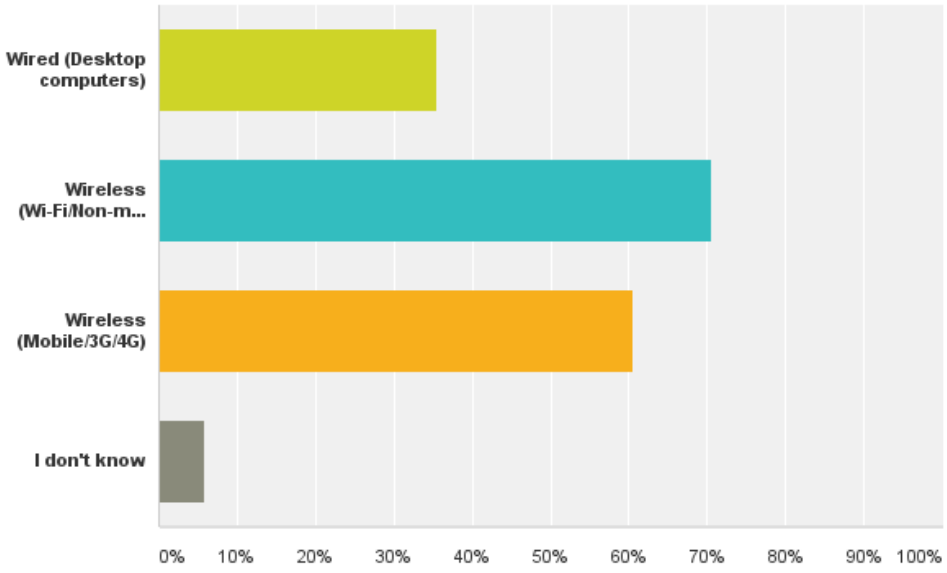

Figure 21: Student survey results for type of connection students use at school.

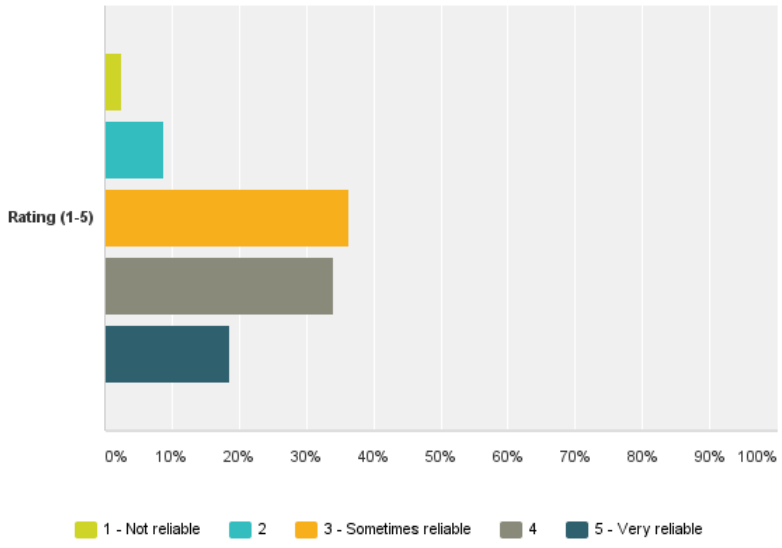

Figure 22: Student survey results for how reliable the school connection is on a scale from 1-5.

4.3 Tribal Libraries: Critical Infrastructure Supporting Community Well-being, IT Access, and Knowledge

During our research on internet connections of the Pueblos, we learned a surprising amount about the significance of their libraries. We found several shared themes that came up in our interviews with librarians at the four Pueblos we visited. One is that the libraries are important cultural and technological hubs for many of the pueblos, in ways that we didn't know about before. The libraries often provide the best internet connection available in each Pueblo, enabling patrons to do online activities they wouldn't be able to do at home. The libraries are visited by patrons of all ages, both adults and kids, for purposes such as job applications, reading, homework help, and other activities. Tribal libraries are important computing and community hubs in the Pueblos. However, our conversations with the librarians suggest that many of the libraries are not getting enough support from tribal governments, since many of them are lacking in space, programs, and funds. As the community's principal supplier of internet connections, cultural programs, and other services, we believe that the libraries need to be recognized by local and state government as a critical infrastructure on par with schools and government agencies, and they do not appear to be adequately recognized and supported right now.

The libraries are an internet hub for many of the Pueblos since their connections are generally better than the rest of the community due to programs such as E-Rate and Redi-Net. Some

people even come to the parking lots after hours to use the libraries' Wi-Fi connections. This desperation demonstrates the need for better internet connection among the Pueblos, which makes it especially important for the libraries' connections to be improved, especially while many homes are still unconnected.

Libraries also provide technological resources other than internet. For example, the Santa Clara library has a 3D printer (Naranjo 2016), the Tesuque library has a video conferencing system (Tapia 2016), and the San Felipe library rents out fishing poles and other outdoor gear (Townsend 2016). Most of the libraries have several computers available for internet usage and provide Wi-Fi connections for patrons to use on personal devices. The tribal librarians have sufficient internet experience to help patrons use it, and some libraries even offer internet or computer training programs. Adults use computers for reasons like job applications and finances. Students rely on them for doing their homework after school. In fact, many of the libraries have a few hours designated for homework before the kids are allowed to play games. Libraries like Santa Clara even have computers set up with educational gaming software (Naranjo 2016). Some of the libraries also offer a few online features, such as E-Books and audiobooks at Pojoaque. Many have their own websites for creating a strong presence online. Libraries give the option of renting internet-connected devices such as laptops, tablets, and personal hotspots (Conner 2016).

The libraries also have several major cultural programs for the community, including native language programs and arts and crafts time for kids. For example, the San Felipe library held a crafts program making Easter bunnies out of towels for kids (Townsend 2016), the Pojoaque library held a scavenger hunt for books (Conner 2016), the Tesuque library has a Teen Night (Tapia 2016), and the Santa Clara library has embroidery and pottery classes (Naranjo 2016). Many libraries also hold major community events, such as high school receptions, book clubs, and movie nights, which draw the community closer together. Tribal libraries play an important role in these communities and thus need to be recognized as a "critical infrastructure." Once classified as critical infrastructure, libraries can get additional funding to continue providing necessary services for the community.

In addition, we learned that the quality of internet connections and other services around the libraries is somewhat mixed. Some of the libraries have more advanced connections like fiber, making their connections more stable under multiple users. Others rely on weaker connection types like DSL that are insufficient for the library's volume of traffic, resulting in complaints about slow internet. Part of the problem is that libraries are often a low priority for the Pueblos' IT departments and therefore cannot fix their internet and computer issues for long periods. For example, the

Tesuque library is still having trouble getting security installed on their computers (Tapia 2016) and the Pojoaque library has been encountering repeated problems issues with their newer computers for the last few years (Conner 2016), which means fewer patrons are coming in.

Other issues that libraries come across are staffing and facilities. There are not enough staff members to serve the large number of patrons at the library. All four of the libraries we visited had fairly small facilities, and therefore have difficulty holding larger programs for the community without the proper space. Yet, they cannot physically expand because most of the money they get from their governments is meant for programs and services rather than facilities. Some libraries have had their programs decreased in recent years due to budget and staff cuts, such as the children's programs at Pojoaque. In order for the libraries to provide the best internet connectivity and other services, the tribal governments as well as state and federal agencies need to recognize their critical contributions to the wellbeing of the community.

4.4 On Inclination and Knowledge: Attitudes Towards the Internet Among the Pueblos

After conducting multiple interviews among the pueblo community, it appears that there are mixed feelings about the Internet among the Pueblos. While students generally strongly desire fast, reliable, plentiful internet access, others do not want or cannot figure out how to use the Internet, many are concerned about the cultural implications of connecting to the Internet. Many tribal leaders are concerned that young people choose technology over culture. Pueblo culture relies on stories and ceremonies, such as the Easter festivities, and many elders, especially, feel that it is important that people pay attention to cultural celebrations instead of the Internet. Others are worried about common internet problems such as cyber bullying and online theft. Parents are worried about maintaining connections with their kids if they are focused on their devices. These are fears that the community members could address while the new internet connection is being installed.

Many students, teachers, and librarians are more optimistic about the benefits that the Internet can offer. In our student survey results, students are excited about the advantages that a better internet connection could bring to their studies and recreational activities. Internet helps students with online assignments and getting ahead in classes via distance learning. They are also interested in the possibility of live streaming events from the school to the pueblos, such as sports games (Santa Fe Indian School 2016). Librarians observe residents using the internet often to carry

out necessary tasks and believe that the benefits of the Internet outweigh the risks. One solution the two groups have proposed is to have the tribal government turn off the internet connection during important ceremonies and certain other times. The Santa Fe Indian School has a 10:00 PM curfew for the Internet, a strategy that seems to works, even if some students do not like it. Currently, most pueblos will confiscate cellphones if they are used during sacred ceremonies. The curfew would be a stricter strategy to implement. This is something each Pueblos will need to decide for themselves.

The survey also suggests most students have a good understanding of how to use the Internet, with a vast majority being at least somewhat confident in their abilities. However, many students were less confident in their older relatives' internet capabilities, since many students said their parents were somewhat confident at best, and even more said their grandparents were even less (Figure 23). That suggests that there is still an age gap among pueblo internet users that needs to be filled in order to make best use of the new connection. Therefore, it may be a good idea to have more internet training programs and ask kids to help their parents adjust to the Internet. Most of the students use the Internet for recreational activities, including social media, music and video streaming, shopping, news, and video games shown in Figure 24. Therefore, it appears that there is strong interest in using the Internet at home for non-school or business related reasons. Meanwhile, increasingly need internet access for schoolwork. Figure 25 shows the vast majority of students use the Internet for research, accessing online homework, email, group collaboration and homework help. The student need for internet connection regarding educational uses is echoed by the survey response shown in Figure 26, which was overwhelmingly positive with a 4.38 out of 5 rating in favor. Many students mentioned the need to use the Internet for research, since it tends to have more up to date information than books. More teachers are posting lectures, assignments, and grades online (ex. Google Classroom), making the Internet essential for keeping up in class. There are several portfolios and major projects, like the senior project, that require group collaboration through sites like Google Drive. Even exams, like the AP tests, the PARCC test, the MAP test, and the ACTs and SATS, often require the Internet to access grades, practice tests, review sessions, and even the exams themselves. Many students are interested in the possibility of online classes, like native language classes, in order to broaden their interests and get ahead in school. The Internet also lessens the environmental concern of depleting trees for paper. It is clear that students are able and eager to use the Internet to fulfill their needs as it is quickly becoming necessary for them to do so.

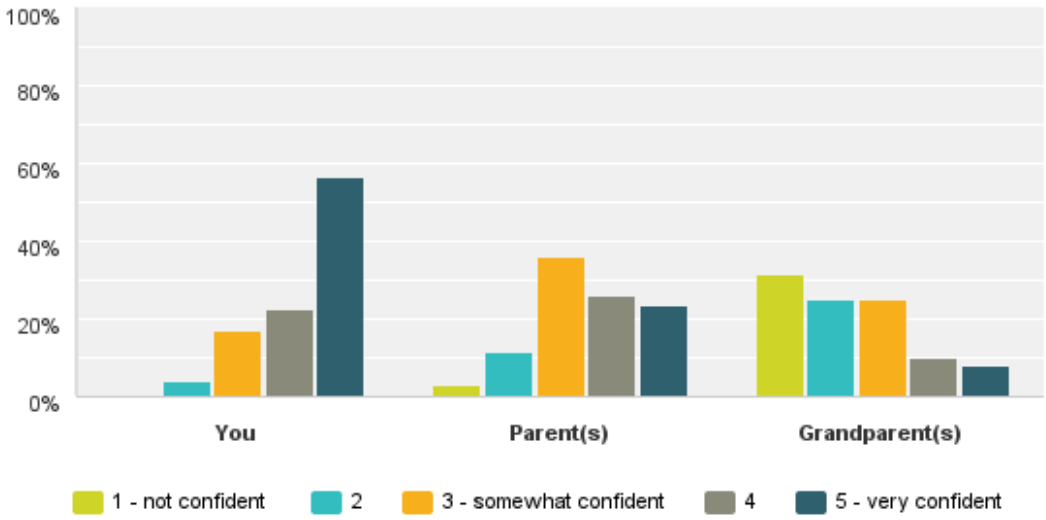

Figure 23: Student survey results for internet skills of students and their relatives.

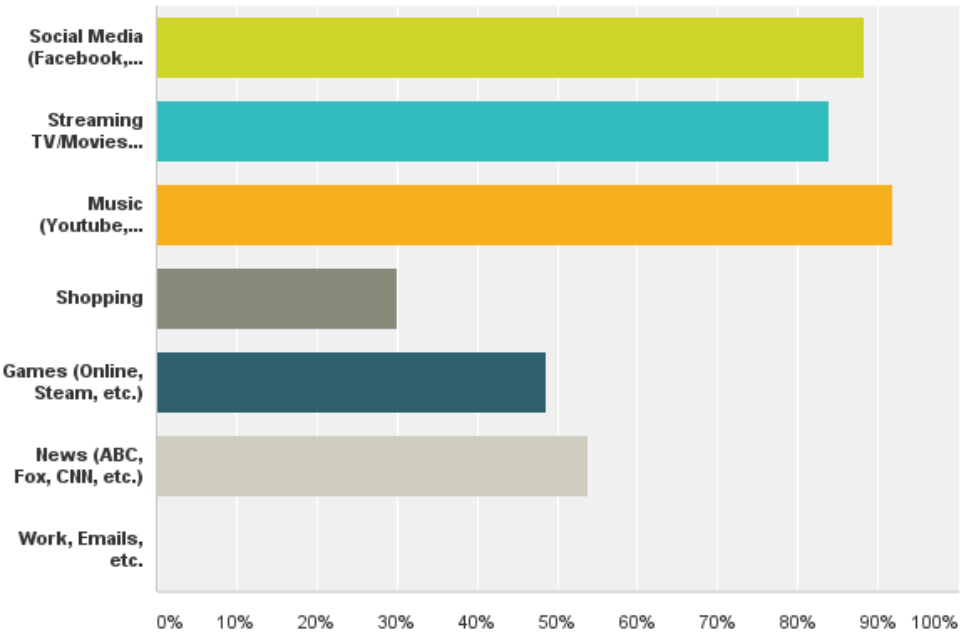

Figure 24: Student survey results for how students use the Internet recreationally.

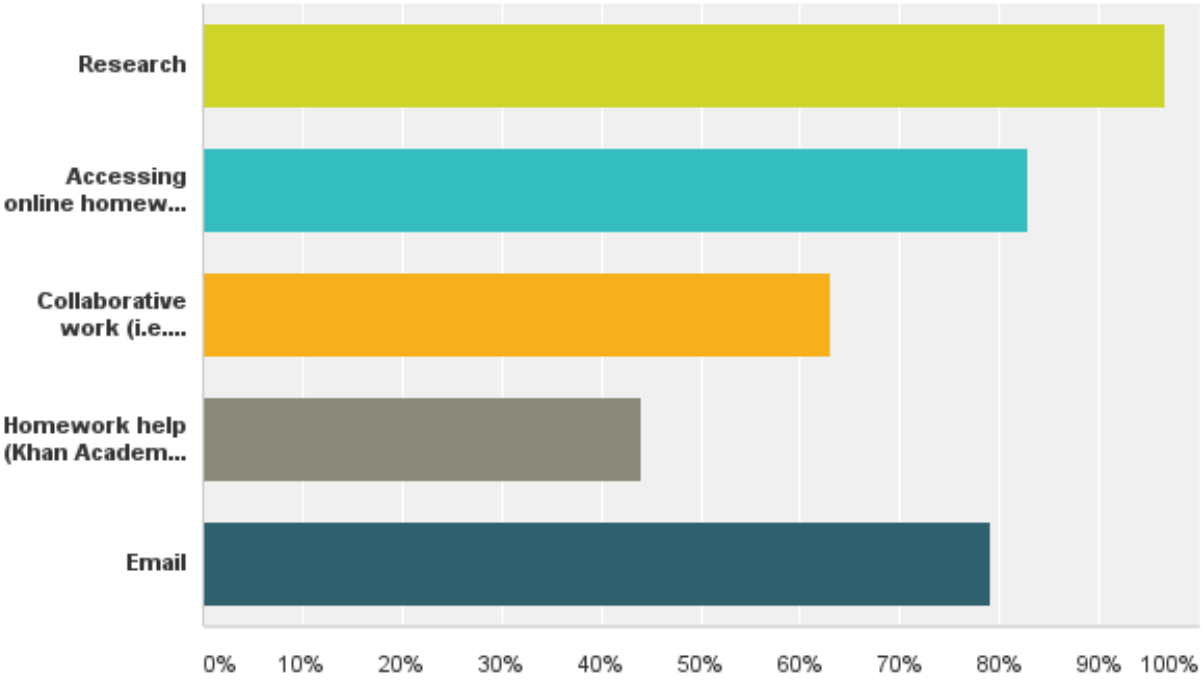

Figure 25: Student survey results for how students use the Internet academically.

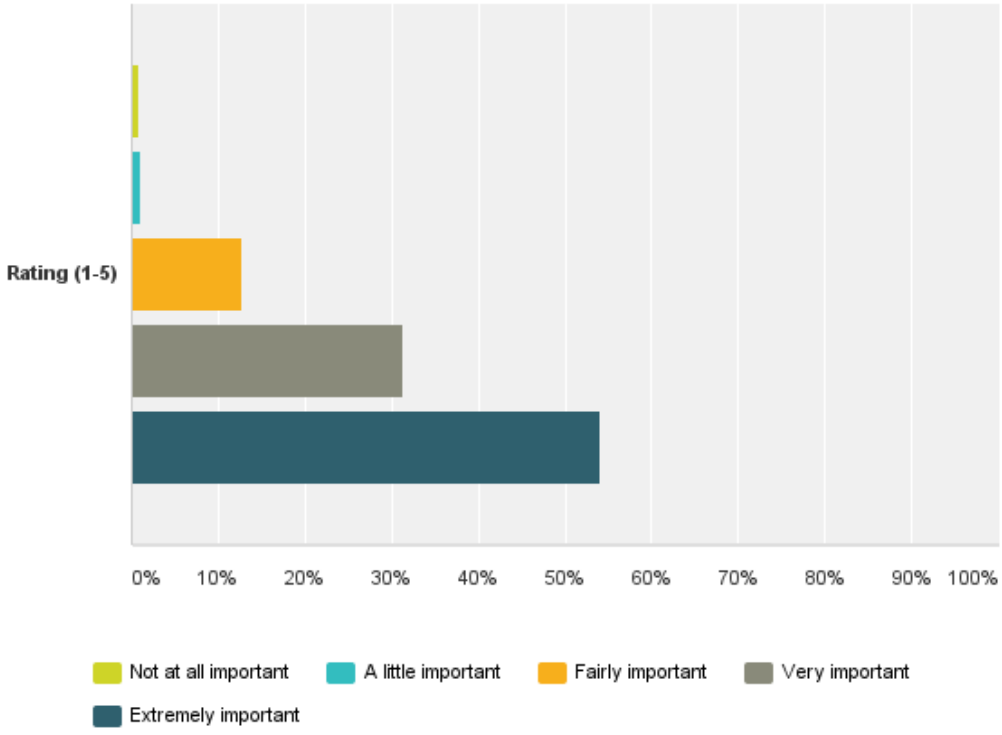

Figure 26: Student survey results for the importance of the Internet for their academics on a 1-5 scale.

4.5 Overcoming Difficulties in Improving Internet Access for the Pueblos: Pursing a Coordinated Effort

4.5.1 Native American Communities are still Behind in Both Broadband Access and Utilization

We determined from our research that the pueblos are still lacking in internet access and opportunities, despite an increase in both among most other populations. Our research at the schools and libraries shows that although many of the pueblos do have some faster connections, there are many that still have either poor connections or no connections at all. Some students at the Santa Fe Indian School are still unable to complete basic homework assignments outside of school because they lack sufficient internet connections at their home pueblos; they are also unable to enjoy many of the benefits that students with better internet access have, such as online course taking, live event streaming, and various recreational activities. In addition, although many libraries have gotten better connections through government funding, there are still some whose connections are too slow for patrons to utilize to the best of their ability. While many of the libraries do provide better internet connections to the community, the fact that so many people rely on them, to the point where they come to the parking lot after hours to use the Wi-Fi only highlights the lack of connection in the rest of the community. Lastly, the lack of attention to IT problems at the libraries suggests that there are not enough individuals with technological training to assure full and reliable internet access, and that the libraries are not a sufficiently high priority for existing IT staff. The tribes have made some improvements to their internet in recent years, such as getting the fiber connections for some schools and libraries through Redi Net, but our project shows that there is still much room for improvement.

4.5.2 Challenges to and Opportunities for Improving Internet Access in the Pueblos

Our background research indicated that rural areas have more problems than urban areas in getting internet connections, and this applies especially to Native American communities, since they tend to also have financial and cultural concerns about the Internet. This corresponds with a lower interest in using the Internet among Native American communities, which can make it difficult to get them to subscribe to new connections. Since ISPs generally prefer to service areas with high subscriber rates in order to get maximum profits, lack of interest makes the Pueblos a less attractive business opportunity for them. Thus, the few ISPs that do service the Pueblos tend to charge higher prices for slower internet connections, leaving communities little choice but to accept or forego

service. High poverty rates in many of the pueblos also make it difficult for their residents to pay for expensive internet connections. Lack of money and good terrain for building quality infrastructure means that the tribes have to rely a lot on wireless connections, which tend to be slower, since ISPs are unwilling to build infrastructure Pueblos are increasingly determined, however, to get ownership of their connection so that they can manage it themselves and charge prices that the community can afford. The recent success of schools and libraries in getting new connections via government funds has fueled optimism.

Some of the communities identified broadband efforts, such as E-Rate and Redi Net, to be the best option for upgrading their connections. Our sponsor, Ms. Kimball, is helping lead these efforts and we hope our project will inform and support these efforts. The datasets gathered through this project can act as a baseline to show the improvements in access, inclination, and knowledge around the pueblos as they adopt these initiatives. We produced a number of resources to present our information to the pueblos. Our infographics address the findings we encountered and present them effectively to the wide native audience.

CHAPTER 5: INFOGRAPHICS AND DELIVERABLES

Utilizing the results and analysis from our internet speed tests, focus group, and student survey, we produced a number of deliverables that we hope can be used to further spread this information and provide resources for future efforts on this topic. The main deliverable was a set of 5 infographics designed to present the information we gathered in an appealing and easy to understand way. We also produced an annotated bibliography of the market research compiled by our sponsor and us as well as a website where anyone can access our report and all the files pertaining to our project.

5.1 Infographics

We produced a set of five infographics for our project as our main deliverable. As stated before in the methodology and shown in Figure 5, we organized the concepts of the graphics to highlight the three key concepts of the project: access, inclination, and knowledge. In this section, we present each infographic with a brief explanation of what design choices we made, who the audience is, how they could be used, and what information they present.

5.1.1 Types of Internet Connections

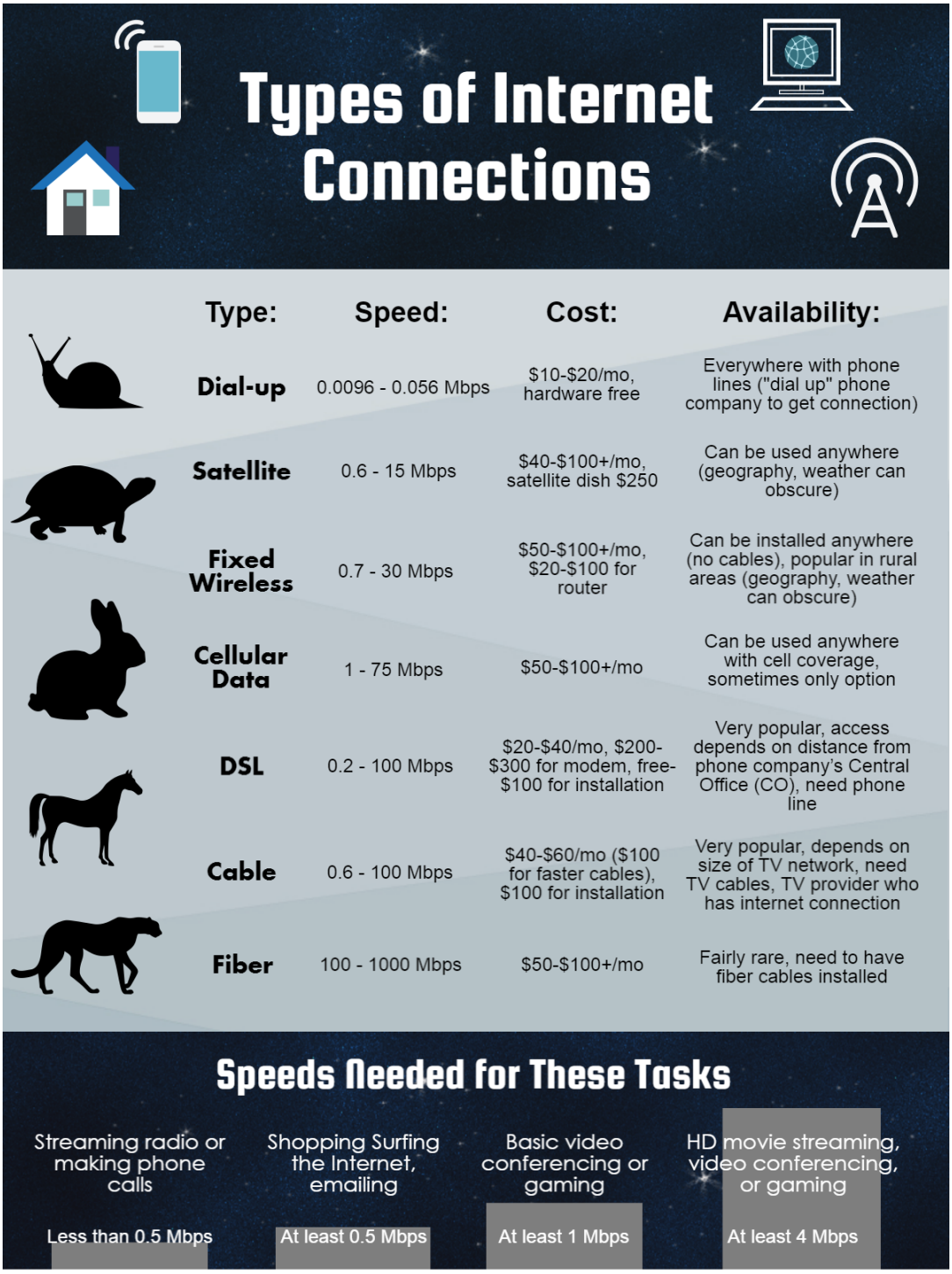

Figure 27: Types of Internet Connections Infographic.

The 'Types of Internet' infographic displays information about different kinds of internet connections and allows the viewer to compare and contrast these connections based on speed, cost and availability. The internet connection table was ordered such that the slowest internet connection was presented first and progressed downward to the fastest connection. We used different animals to represent different levels of speed. For example, a snail represented a slow connection and a cheetah represented a fast connection. The purpose of this infographic is to provide a basic understanding of the types of internet connections in order to familiarize the tribal communities with these different connections and what distinguishes each of them (speed, availability, etc.).

This infographic also supplies the pueblo community members with access to basic information about different internet speeds. It provides general facts that differentiate each internet connection to help people determine which one may be best suited for their household. The infographic also shows what internet speeds are required to perform particular tasks on the Internet, such as streaming videos, surfing the web, or checking emails. This information will help make the speeds relevant in a way many people can understand and inform the tribal communities about types of internet connections that are available and which one might be best for them.

5.1.2 Urban vs. Rural Connectivity

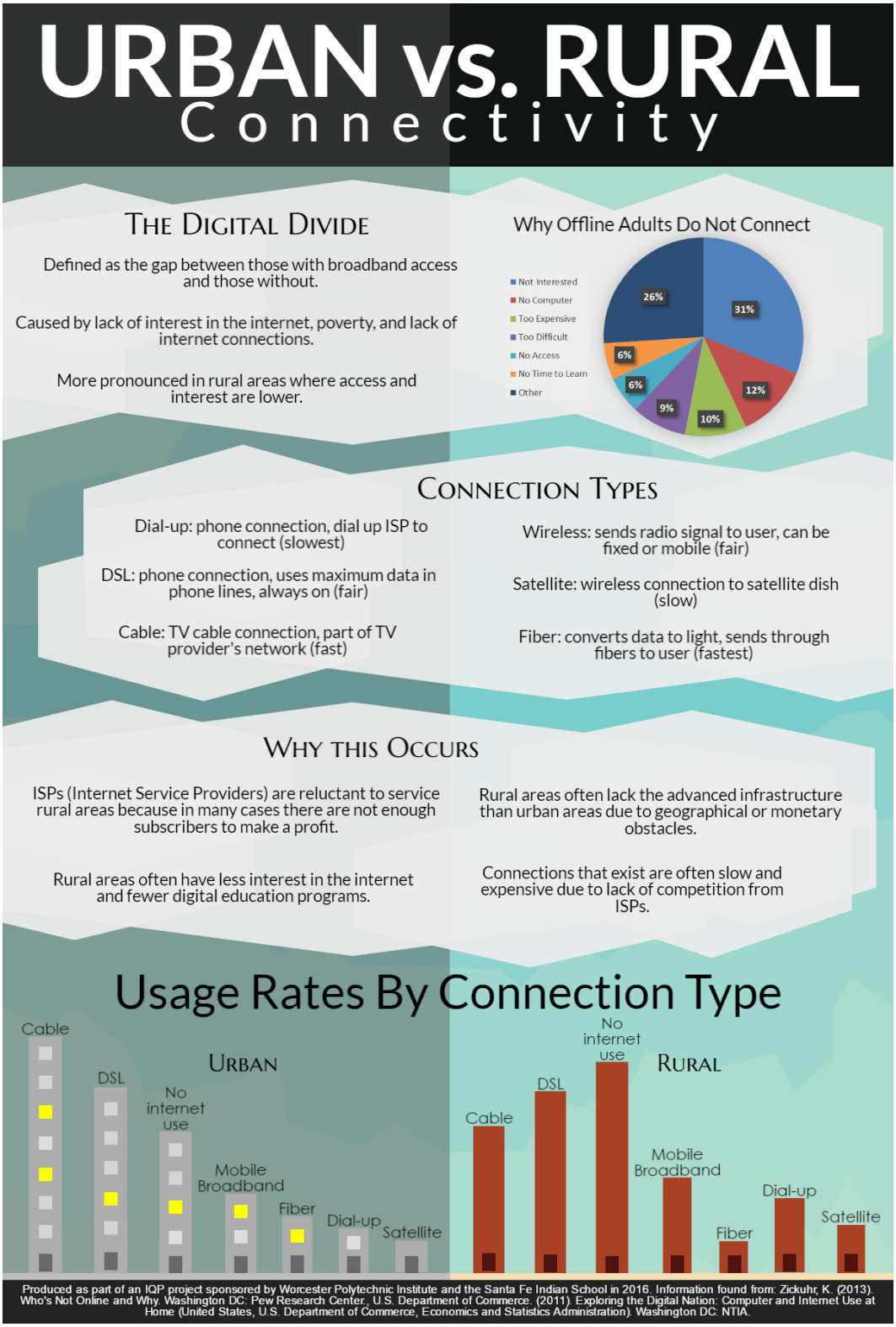

Figure 28: Urban vs. Rural Connectivity Infographic.

In the light of our sponsor's efforts to expand internet access in and among Pueblo communities, this infographic seeks to illustrate general aspects of the digital divide between rural and urban America.

The infographic is split down the middle, with an urban landscape on one side and a rural one on the other, representing the divide that is explained in text on the clouds above. The information presented on the clouds first explains what the digital divide is, and then continues by showing who it normally affects and why it occurs. These statements are supplemented by two charts: one which provides an overview of why consumers choose to not connect to the Internet (to show the digital divide in action) and one that shows what connection types are popular in both urban and rural settings. The latter graph is preceded by a short overview on the different connection types to make sure the audience knows which ones are more desirable and can compare them to the connection they have. The chart itself is located at the bottom of the page and is separated just as the background is into urban and rural connections. The bars for skyscrapers represent the urban section and the bars for rural are represented by pueblo-style houses to further visualize the difference in the data. The columns are arranged such that the viewer can easily see the differences in the types of connections, with faster types being more utilized in urban areas and slower connections (or no connection) being more prominent in rural areas.

5.1.3 Libraries: Community Digital Computing Hubs

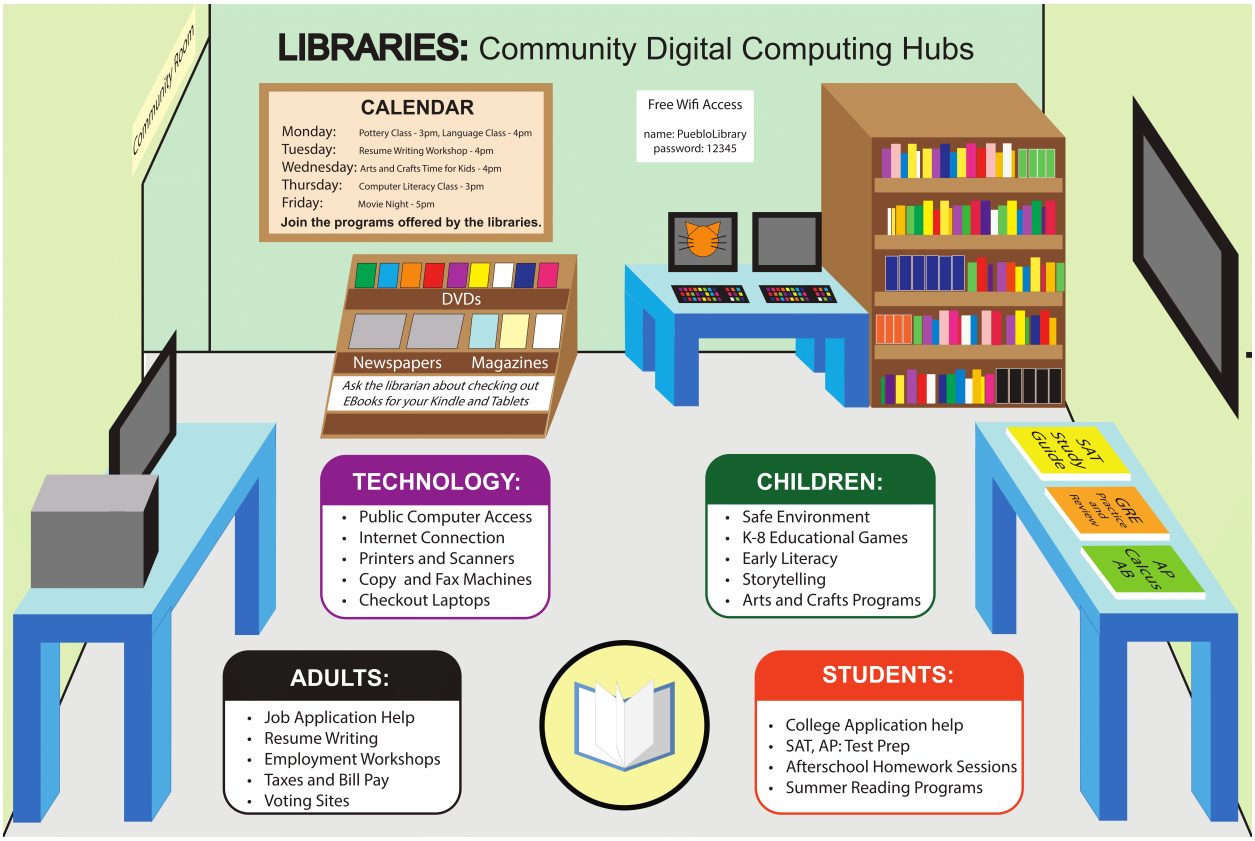

Figure 29: Libraries as Community Digital Computing Hubs Infographic.

The 'Libraries as Critical Infrastructure' infographic portrays a layout of a community library, to represent a familiar atmosphere in the pueblos. By showing a warm, familiar image, we ensure that the tribes will be able to relate more and be more inclined to view the infographic. All the different aspects of the infographic represent all the services that the library can provide. These include a bookshelf, magazine rack, e-books, computers, display screens, free Wi-Fi, textbooks, and a calendar of the current events in the library.

The information is divided by the audience that the library targets into services available for children, students, and adults. There is also a separate box that notes the technological resources the library provides. We based "Community Digital Computing Hubs" on our visits to the libraries and the interviews with the librarians. By listing and displaying the different services the library has to offer, the poster informs the viewers how many opportunities the library provides for the community already.

The audience of this infographic will be the tribal communities and tribal leaders. For the community members, the infographic provides information about what their libraries can do for them. Members can utilize all the services the libraries provide for the Pueblos. By displaying the libraries as important community hubs for technological and educational purposes, the infographic can show the libraries to tribal leaders as critical infrastructures. Tribal libraries play an important role in the pueblo communities, and this infographic can spread the word of their importance and strengthen their leadership position.

5.1.4 Broadband as a Tool for Government

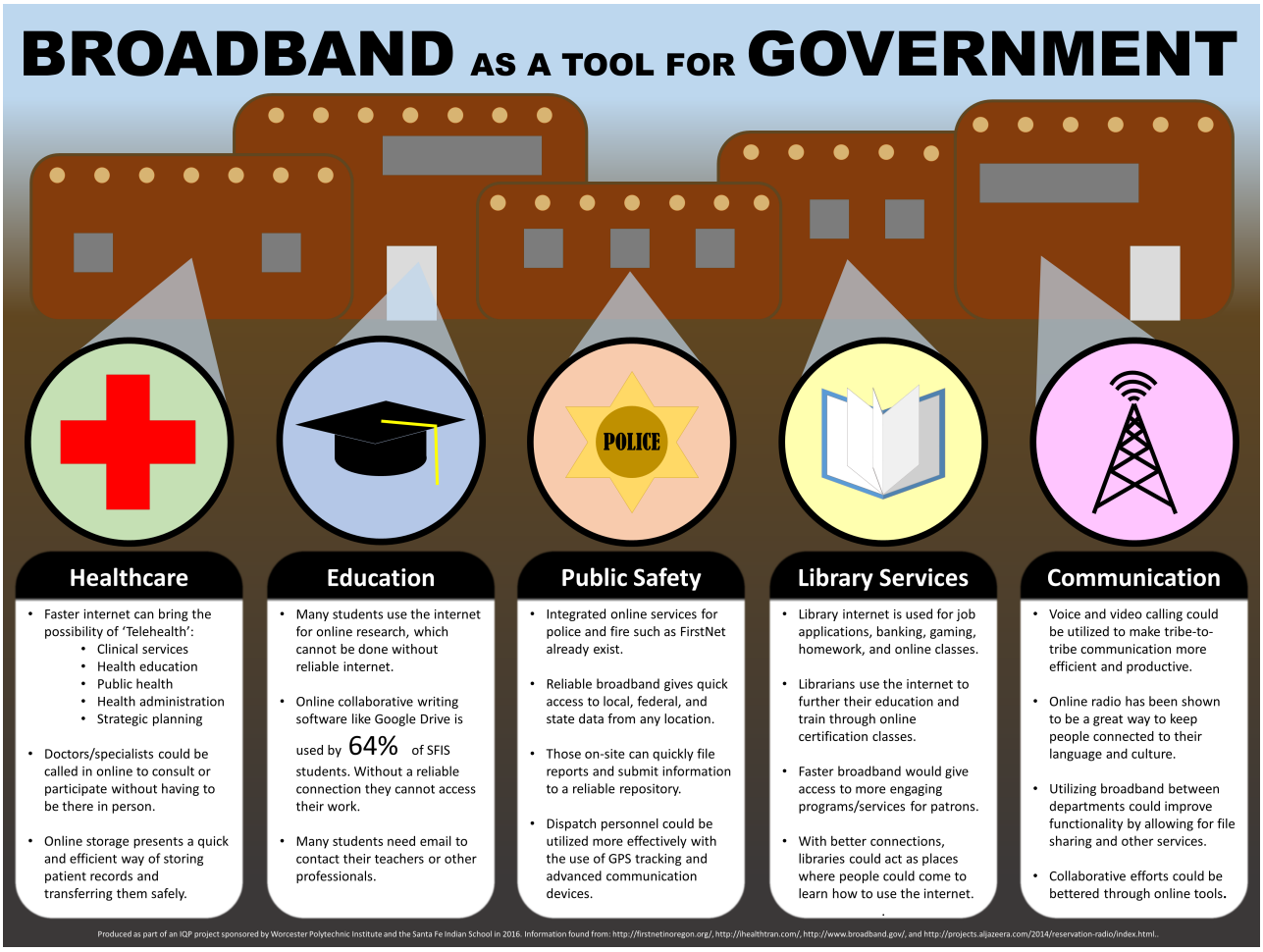

Figure 30: Broadband as a Tool for the Government Infographic.

This infographic presents a number of different ways that tribal governments could utilize improve broadband connections to improve their services to the communities they oversee. The

layout of the graphic creates the illusion that the audience is looking into each office in a larger pueblo government complex and seeing the benefits that are brought to the fields of healthcare, education, public safety, library service, and communication. Each sector is represented by a large and vibrant logo and the facts are bulleted below.

In the healthcare section, 'telehealth' is highlighted as the main service broadband can bring to the government. Telehealth is a term that encompasses online healthcare, which has services that include: having patient records available instantly online, being able to video call in specialists so those with a critical need for treatment do not have to wait for consultations, and more efficient cross-talk between departments and employees within the healthcare system. The education section presents many of the insights we gained through the student focus group and survey, such as that many students use online tools to do homework and projects. The public safety section provides information about broadband as a communicative and reference tool for law enforcement and fire services that could be used to reference national data or submit new reports. The library services section presents much of the same information as the library infographic, but focuses on the technological benefits of broadband and how they could be utilized by the community. Lastly, the communication section promotes broadband as a powerful tool for inter-tribal discussions and communication. Similar online tools that are already utilized in the education system such as video calling or online workspaces could make overall government work more effective and collaborative. This infographic contains a lot of examples of how broadband can improve functionality without much information dealing with 'how' or 'why', and thus we believe this graphic would be most effective as part of a presentation to government officials on why they should prioritize broadband upgrades for their community.

5.1.5 Online Learning: Education at a Distance

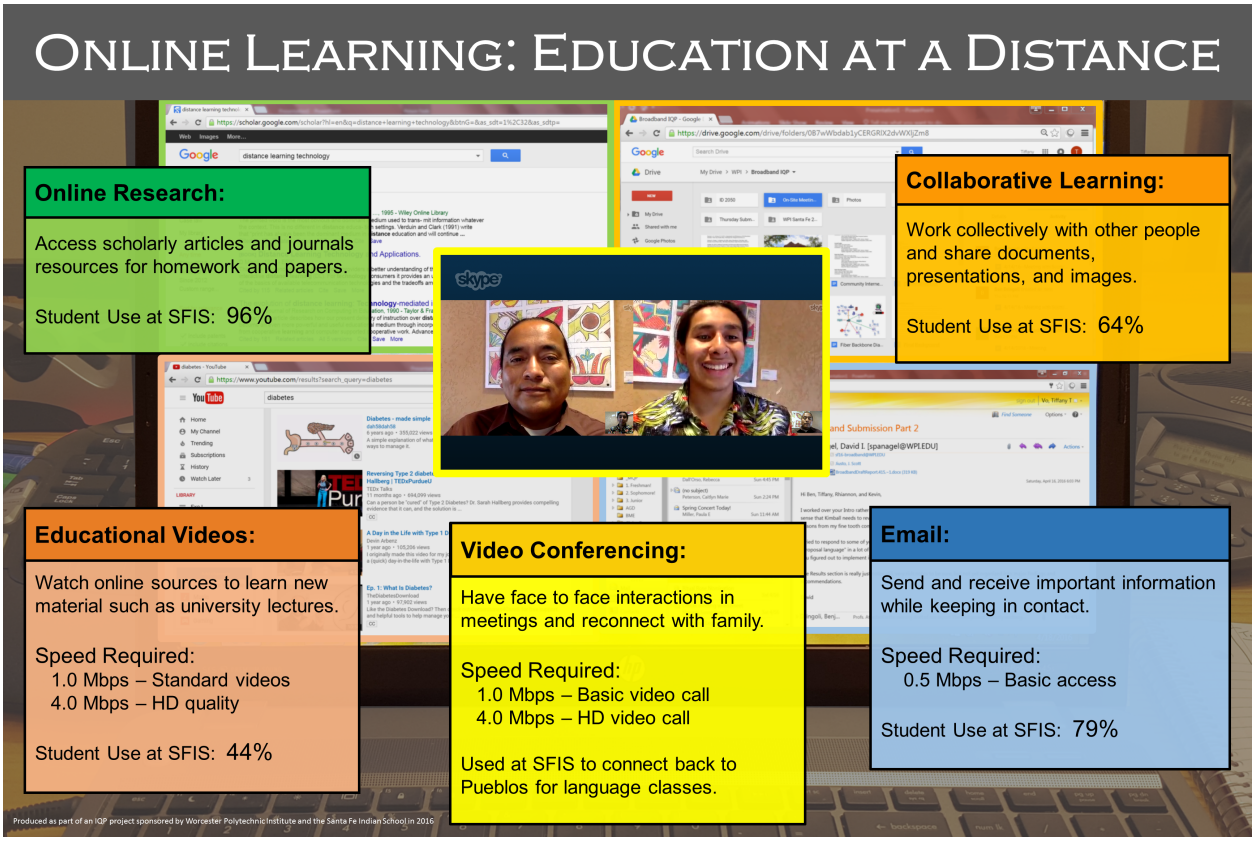

Figure 31: Online Learning - Education at a Distance Infographic.

The background of the 'Online Education' infographic shows a laptop screen with windows showing different resources involving distance learning. Students use this learning tool in many ways including online research, collaborative learning, watching educational videos, video conferencing, and email communication. A post-it note box accompanies each window with a short description of how students use that resource and what percentage of students at the Santa Fe Indian School use it. Percentage of student use data came from the SFIS survey data. The post it notes also includes the minimum speed required (if applicable) for the given distance-learning tool: educational videos, video conferencing, and email. For the video conferencing post it note, an example is provided of the SFIS using the video conferencing to connect teachers in the Pueblos to the students in the classroom for language classes. This information shows the important aspects of online education and learning from afar.

Distance learning utilizes technology to take education to another level where the physical presence of teachers is not required. Seeing the number of students using these tools as well as their

comments in the survey, it is clear that the Internet is important to these students during their school career. When they go home after school or for the weekend with homework, many cannot complete the assignments due to lack of a good internet connection. Parents, tribal leaders, and community decision makers are the audience for this infographic. Pueblo adults care about their students and their education, so if these adults can see the importance of the Internet to students, they will realize that the Internet is useful in the pueblos for student use so they can complete assignments and continue to learn outside of the school building. This infographic stands as a case for bringing internet to the pueblos, for the sake of the students.

5.2 Annotated Bibliography

Using market data supplied by our sponsor, we compiled a list of sources about the demographics of broadband internet. We used these sources to back up data we currently had and to incorporate into our infographics. These sources can also be used for future research regarding broadband internet. The bibliography can be found in Appendix D and consists of a list of sources with comments about each source.

5.3 Website

Lastly, we created a website that compiled all of our documents that we used during our project. Our home page contains an overview of our project and has a link to the deliverables of our project. The next page is the executive summary, which is a more in depth summary of our project containing general background information, methods, results, findings, and recommends. The following page contains our entire report document for our project and the tab after that contains our final presentation about our report. The last two pages contain our deliverables and our team photos. The deliverables are our five infographics, which are "Types of Internet Connections," "Urban vs. Rural Connectivity," Libraries: Community Digital Computing Hubs," "Broadband as a tool for Government," and "Online Learning: Education at a Distance." Our deliverables also include our annotated bibliography a list of compiled market data and demographics about broadband internet. The last page is a team photo and information about our team. The link to the website can be found below.

https://sites.google.com/site/sf16dsfis/

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

Over the 14 weeks our group has worked on this report, we have learned more about people, culture, and lifestyles than we ever expected from a project regarding broadband internet use and adoption. Despite the technical focus of our project, connecting with our sponsor, those who helped us along the way such as Alana McGrattan and Gar Clarke, and all the students and librarians we worked with over the 7 weeks we spent in Santa Fe was a valuable experience in itself. These human interactions helped us keep the scope and purpose of our project grounded and allowed us to look forward and see the potential impacts our work can have, even after we leave the southwest. In addition to this, seeing the work that Ms. Kimball is doing with E-Rate to connect the tribes in person really gave us a sense of what this project was working towards and what the findings we produce will be used for in the future, which was very motivational throughout the length of our stay in Santa Fe.

While the main goal of the project revolves around the implementation of better broadband options in the pueblos, it narrowed down to getting information to tribal communities that they did not have before in a way that would start a conversation about the Internet. This sculpted both the way we took our data and the way we presented it. Our speed tests were performed by members of the community and supplemented by various types of qualitative data from interviews, focus groups, and speed tests. Also, infographics were chosen as the best medium to bring this technical information to a largely non-tech-savvy audience because of their simple pictorial storytelling. This allowed for our deliverables to have a meaningful and lasting impact on the unique communities we worked with. This community-oriented sentiment also continued into how our work can be utilized moving forward.

While participating in the ongoing efforts of getting the pueblos connected and completing our project, we were able to produce a few recommendations based on our experiences. These mainly concern how to best utilize our work as a baseline and continue the research we have done to better understand the situation these communities face and create meaningful results from the effort that has been put in thus far.

1. Establish libraries as 'critical infrastructure' in these communities, resulting in more adequate funding for broadband connections. E-Rate is a program Ms. Kimball works with that is meant to connect libraries and schools to the Internet via fiber, and once they are connected the rest of the community can branch off from these institutions. Once the tribes install the

library fiber, it will be much easier for other important community offices and eventually the community at large to tap into the faster connection.

2. Utilize more focus groups and surveys to help foster a widespread community discussion about broadband adoption. We only collected information from a few stakeholder groups; by engaging more people in these communities, more information can be collected regarding opinions on broadband and these people can be informed about what better internet could mean for them. Also, by engaging more groups within the pueblo communities, we hope that the average person will become more familiar with the topic of broadband upgrades and that the discussion becomes one that the communities could rally behind. This could lead to the Pueblo people pushing for upgrades on their own behalf and being more proactive about getting the service they deserve in this day and age.
3. Make speed-testing part of a more complete community effort to create more of this valuable data and show the effects of broadband upgrades in the future. By taking more speed tests over a longer time scale and by having more groups participate, the tribes can show the potential of future upgrades. If the tribes adopt a community wide speed testing effort, it could work in a similar way to the surveys and focus groups by allowing people to see how their service actually affects them and fostering a community discussion about broadband upgrades.

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APPENDIX A: INTERNET INFORMATION TABLES

A.1 Types of Internet Access

Type of Connection	Basic Information	ISP	Speed	Cost	Availability
Dial-up	Slow, not always on, have to call phone company to turn on, uses phone lines, modem converts analog phone data to digital internet data	Phone company	9.6 kbps-56 kbps	$10-$20 per month, hardware free	Can be installed anywhere, need phone line (interference makes performance worse)
ISDN	Faster than DSL (uses more of phone line, no digital conversion), always on, still slower than broadband	Phone company	64 kbps-128 kbps	$10-$50 per month, $250-$500 for terminal, $65-$200 for installation (some computers already have)	More common in urban areas (more expensive in rural areas), need phone line
DSL	Earliest form of broadband (uses maximum phone line data), includes ADSL (faster download), SDSL (same upload/download), HDSL (more stable SDSL), others	Phone company	0.2 mbps-100 mbps	$20-$40 per month, $200-$300 for modem, free-$100 for installation	Very popular, access depends on distance from phone company's Central Office (CO), need phone line
Cable	Broadband, uses cable modem to connect through TV cables, part of network with all other devices connected to neighborhood cables	TV provider	0.6 mbps-100 mbps	$40-$60 per month ($100 for faster cables), $100 for installation	Very popular, depends on size of TV network, need TV cables, TV provider who has internet connection
Leased Line	Phone line rented directly from ISP for	Phone company	1.5 mbps-	$100s-$1000s per month	Mainly used by businesses, too

	personal use (not broadband), includes T1/T3 lines		43 mbps		expensive for homeowners (can rent specific channels)
Fixed Wireless	Broadband, uses ISP's radio signal from tower to set up connection with antenna, no cables, also used for extending connection (last mile, Wi-Fi, etc.)	Radio signal provider	0.7 mbps-30 mbps	$50-$100+ per month, $20-$100 for router	Can be installed anywhere (no cables), popular in rural areas (geography, weather can obscure)
Mobile Wireless	Broadband, uses cell modem to get data from cell tower's radio signal, connection on cell phone	Cell phone company	1 mbps-75 mbps	$50-$100+ per month	Can be used anywhere with cell coverage, often only option (geography, weather can obscure)
Satellite	Wireless broadband, sends radio signal to satellite dish, transmits data to computer	Satellite TV provider	0.6 mbps-15 mbps	$40-$100+ per month, satellite dish $250	Can be used anywhere (geography, weather can obscure)
Fiber	Broadband, converts data to light/runs through fiber to user, FTTP runs directly to building, FTTN runs to node/uses copper for rest of connection	Phone company or other fiber provider	100 mbps-1 gbps	$50-$100+ per month	Fairly rare, need to have fiber cables installed

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A.2 List of Each Pubelo's Internet Connections

Pueblo	Library	Library's Internet Connection	Pueblo's Internet Connections
Acoma	Acoma Learning Center	**DSL** (CenturyLink)	**DSL** (CenturyLink) **Fixed Wireless** (Agave Broadband) **Mobile Wireless** (Sprint, AT&T, Verizon) **Satellite** (HughesNet, Exede, Dish)
Cochiti	Pueblo de Cochiti Library	**DSL** (CenturyLink)	**DSL** (CenturyLink) **Fixed Wireless** (CityLink Wireless) **Mobile Wireless** (Sprint, T-Mobile, AT&T, Verizon, Cricket) **Satellite** (HughesNet, Exede, Dish)
Isleta	Pueblo of Isleta Library	**Fiber** (CenturyLink)	**DSL** (CenturyLink) **Cable** (Comcast) **Fixed Wireless** (CityLink Wireless) **Mobile Wireless** (Sprint, T-Mobile, AT&T, Verizon, Cricket) **Satellite** (HughesNet, ViaSat, Starband, Skycasters, Exede)
Jemez	Jemez Pueblo Community Library	**DSL** (Windstream Communications)	**DSL** (Windstream Communications) **Fixed Wireless** (CityLink Wireless) **Mobile Wireless** (T-Mobile, AT&T, Verizon) **Satellite** (HughesNet, Exede, Dish)
Laguna	Laguna Public Library	**DSL** (CenturyLink) **Fixed Wireless** (Kawaika Hanu)	**DSL** (CenturyLink) **Leased Line** (MegaPath Corporation) **Fixed Wireless** (CityLink Wireless, Agave Broadband, Kawaika Hanu) **Mobile Wireless** (Sprint, AT&T, Verizon) **Satellite** (HughesNet, Exede, Dish) **Fiber** (Sacred Wind Communications)
Nambe	None	None	**DSL** (CenturyLink) **Cable** (Comcast) **Fixed Wireless** (Agave Broadband, CNSP Internet) **Mobile Wireless** (Sprint, T-Mobile, AT&T, Verizon, Cricket) **Satellite** (HughesNet, Exede, Dish)

Ohkay Owingeh	P'oe Tsawa Community Library	**Fiber** (Redi Net)	**DSL** (Windstream Communications) **Fixed Wireless** (CNSP Internet) **Mobile Wireless** (Sprint, T-Mobile, AT&T, Verizon, Cricket) **Satellite** (HughesNet, Exede, Dish)
Picuris	None	None	**DSL** (CenturyLink) **Fixed Wireless** (Kit Carson Telecom) **Mobile Wireless** (T-Mobile, AT&T, Verizon) **Satellite** (HughesNet, Exede, Dish)
Pojoaque	Pueblo of Pojoaque Public Library	**DSL** (CenturyLink)	**DSL** (CenturyLink, Cyber Mesa) **Cable** (Comcast) **Leased Line** (Cyber Mesa) **Fixed Wireless** (CNSP Internet) **Mobile Wireless** (Sprint, T-Mobile, AT&T, Verizon, Cricket) **Satellite** (HughesNet, Exede, Dish)
San Felipe	Pueblo of San Felipe Community Library	**Leased Line** (CenturyLink)	**DSL** (CenturyLink) **Leased Line** (Cyber Mesa, TW Telecom of New Mexico) **Fixed Wireless** (CityLink Wireless) **Mobile Wireless** (Sprint, T-Mobile, AT&T, Verizon, Cricket) **Satellite** (HughesNet, Exede, Dish)
San Ildefonso	Pueblo de San Ildefonso Library	**Leased Line** (CenturyLink)	**DSL** (CenturyLink) **Cable** (Comcast) **Fixed Wireless** (Agave Broadband, CNSP Internet) **Mobile Wireless** (Sprint, T-Mobile, AT&T, Verizon, Cricket) **Satellite** (HughesNet, Exede, Dish)
Sandia	Sandia Pueblo Learning Resource Center	**Fixed Wireless** (CenturyLink)	**DSL** (CenturyLink) **Cable** (Comcast) **Leased Line** (MegaPath Corporation) **Fixed Wireless** (CityLink Wireless) **Mobile Wireless** (Sprint, T-Mobile, AT&T, Verizon, Cricket) **Satellite** (HughesNet, Exede)
Santa Ana	Santa Ana Pueblo Community Library	**Fiber** (TW Telecom of New Mexico)	**DSL** (CenturyLink) **Cable** (Comcast) **Leased Line** (TW Telecom of New Mexico)

			Fixed Wireless (CityLink Wireless) **Mobile Wireless** (Sprint, T-Mobile, AT&T, Verizon, Cricket) **Satellite** (HughesNet, Exede) **Fiber** (TW Telecom of New Mexico)
Santa Clara	Santa Clara Pueblo Community Library	**Fiber** (Windstream)	**DSL** (Windstream Connections) **Leased Line** (Cyber Mesa Computer Systems) **Fixed Wireless** (CNSP Internet) **Mobile Wireless** (Sprint, T-Mobile, AT&T, Verizon, Cricket) **Satellite** (HughesNet, Exede, Dish)
Santo Domingo	Santo Domingo Pueblo Library	**Satellite** (HughesNet)	**DSL** (CenturyLink) **Fixed Wireless** (CityLink Wireless) **Mobile Wireless** (Sprint, T-Mobile, AT&T, Verizon, Cricket) **Satellite** (HughesNet, Exede, Dish)
Taos	Taos Public Library	**Fiber** (Kit Carson Telecom)	**DSL** (CenturyLink) **Cable** (Comcast) **Leased Line** (Cyber Mesa) **Fixed Wireless** (Kit Carson Telecom) **Mobile Wireless** (T-Mobile, AT&T, Verizon) **Satellite** (HughesNet, Exede, Dish)
Tesuque	Taytsugeh Oweengeh Library	**Fiber** (Redi Net)	**DSL** (CenturyLink) **Cable** (Comcast) **Leased Line** (MegaPath Corporation) **Fixed Wireless** (Agave Broadband, CNSP Internet) **Mobile Wireless** (Sprint, T-Mobile, AT&T, Verizon) **Satellite** (HughesNet, Exede)
Zia	Zia Enrichment Library	**Fixed Wireless** (UNM)	**DSL** (CenturyLink) **Fixed Wireless** (CityLink Wireless) **Mobile Wireless** (Sprint, T-Mobile, AT&T, Verizon, Cricket) **Satellite** (HughesNet, Exede, Dish)
Zuni	Zuni Public Library	**Fixed Wireless** (Cellular One)	**DSL** (CenturyLink, Sacred Wind Communications) **Mobile Wireless** (Verizon) **Satellite** (HughesNet, Exede, Dish)

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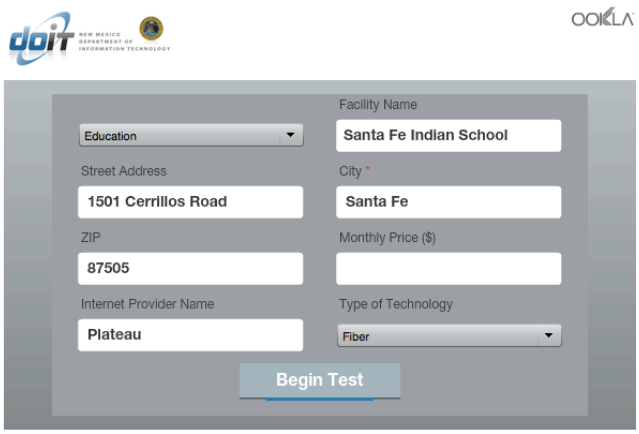
APPENDIX B: INTERNET SPEED DATA

B.1 Tribal Library Speed Test

Tribal Library Speed Test
WPI Broadband Project Group 2016

1. Go to http://nmbbmapping.org/speedtest/

   This website requires the most updated Flash
2. Fill out the boxes shown in the picture below with the library information (after the first day only the facility name and city need to be filled in)



3. Run the speed tests for patron wired and wireless computers at each of the time intervals shown in the chart below.
4. Check off the box once the speed test is completed
5. Use the same computer(s) to complete the speed tests
6. If the NM broadband speed test does not work, use one of the speed tests listed below and record the results in the table below.
   - http://www.speedtest.net/
     - This website also require the most updated version of Flash (but may work, if the NM broadband speed test does not work)
     - Once the website loads, click “begin test” and record the ping, upload speed, and download speed in the table below
   - http://beta.speedtest.net/
     - Once the website loads, click “begin test” and record the ping, upload speed, and download speed in the table below

Library:							
Person Conducting Speed Test:							
Speed Test Used:							
		April 11		**April 12**		**April 13**	
Times:	**Speed Results:**	Wired	Wireless	Wired	Wireless	Wired	Wireless
Morning before opening (8am-9am)	Ping (ms)						
	Upload Speed (mbps)						
	Download Speed (mbps)						
Mid-morning (10am-11am)	Ping (ms)						
	Upload Speed (mbps)						
	Download Speed (mbps)						
After school (3:30 or high use)	Ping (ms)						
	Upload Speed (mbps)						
	Download Speed (mbps)						

		April 14		**April 15**	
Times:	**Speed Results:**	Wired	Wireless	Wired	Wireless
Morning before opening (8am-9am)	Ping (ms)				
	Upload Speed (mbps)				
	Download Speed (mbps)				
Mid-morning (10am-11am)	Ping (ms)				
	Upload Speed (mbps)				
	Download Speed (mbps)				
After school (3:30 or high use)	Ping (ms)				
	Upload Speed (mbps)				
	Download Speed (mbps)				

B.2 Tribal Library Speed Test Results

Pueblo of Isleta Public Library						
Conducting test: library staff		Speed test: speedtest.net				
	Ping (ms)		**Upload Speed (mbps)**		**Download Speed (mbps)**	
	Wired	Wireless	Wired	Wireless	Wired	Wireless
Morning	15	33	38.15	0.26	35.77	0.24
	33	29	37.72	0.25	32.17	0.24
	1	128	37.05	0.25	33.12	0.18
	15	32	38.39	0.24	34.69	0.25
	51	15	27.75	0.24	8.87	0.24
Mid-morning	15	30	38.06	0.24	34.6	0.22
	19	30	37.01	0.25	37.02	0.24
	20	30	38.08	0.24	37.11	0.24
	25	31	20.39	0.24	6.55	0.24
	19	28	27.75	0.24	37.01	0.47
After school	20	31	34.6	0.22	30.57	0.24
	19	32	37.02	0.24	27.55	0.25
	15	29	37.11	0.24	29.79	0.24
	27	34	36.17	0.25	24.8	0.25
	15	15	36.83	0.24	34.44	0.24
Total Average	20.6	35.13333333	34.80533333	0.242666667	29.604	0.252

P'oe Tsawa Community Library (Ohkay Owingeh)						
Conducting test: Christy VanBuren		Speed test: N.M. Broadband Program Speed Test				
	Ping (ms)		**Upload Speed (mbps)**		**Download Speed (mbps)**	
	Wired	Wireless	Wired	Wireless	Wired	Wireless
Morning	1	X	26.2	X	93.4	X
	1	X	22.91	X	92.1	X
	1	X	83.17	X	57.14	X
	1	X	61.99	X	84.35	X
	0	X	69.48	X	93.84	X
Mid-morning	1	X	38.62	X	89.88	X
	1	X	27.72	X	87.5	X
	0	X	49.95	X	82.66	X
	1	X	66.81	X	90.1	X
	2	X	39.33	X	85.91	X
After school	1	X	22.83	X	76.61	X
	1	X	28.13	X	77.8	X

	1	X	51.43	X	69.87	X
	1	X	26.14	X	76.52	X
	2	X	43.4	X	89.8	X
Total Average	1	X	43.874	X	83.16533333	X

San Felipe Pueblo Community Library						
Conducting test: Shannon Townsend		Speed test: beta.speedtest.net				
	Ping (ms)		**Upload Speed (mbps)**		**Download Speed (mbps)**	
	Wired	Wireless	Wired	Wireless	Wired	Wireless
Morning	74	125	1.42	1.06	1.65	1.4
	212	214	0.5	0.55	0.16	0.67
	160	142	0.65	0.34	0.78	0.46
	41	56	1.56	2.17	1.41	2.02
	182	156	0.66	0.85	0.72	0.62
Mid-morning	121	86	1.05	0.76	1.26	0.46
	141	154	0.85	0.66	1.2	0.56
	136	175	0.51	0.69	0.17	0.27
	58	60	0.87	1.16	1	0.69
	120	141	0.7	0.75	0.47	1.21
After school	173	182	1.24	0.38	0.51	0.12
	130	132	0.99	0.62	0.38	1.07
	198	142	1.07	0.49	0.34	0.31
	X	X	X	X	X	X
	X	X	X	X	X	X
Total Average	134.3076923	135.7692308	0.928461538	0.806153846	0.773076923	0.758461538

Zia Pueblo						
Conducting test: IT Administrator		Speed Test: NM Broadband Mapping				
	Ping (ms)		**Upload Speed (mbps)**		**Download Speed (mbps)**	
	Wired	Wireless	Wired	Wireless	Wired	Wireless
Morning	3	X	7.265	X	8.228	X
	4	X	7.359	X	9.217	X
	34	X	6.135	X	4.247	X
	5	X	6.443	X	5.451	X
	4	X	8.413	X	8.339	X
Mid-morning	5	X	6.251	X	7.583	X
	6	X	8.12	X	8.68	X

	32	X	7.87	X	6.63	X
	3	X	8.244	X	6.75	X
	35	X	8.507	X	8.626	X
After school	4	X	6.992	X	6.078	X
	30	X	6.857	X	5.73	X
	4	X	7.898	X	7.057	X
	8	X	6.831	X	7.934	X
	35	X	8.53	X	8.096	X
Total Average	14.13333333	X	7.447666667	X	7.243066667	X

Sandia Learning Resource Center						
Conducting test: Dominic Montoya		Speed test: NM Broadband Mapping				
	Ping (ms)		**Upload Speed (mbps)**		**Download Speed (mbps)**	
	Wired	Wireless	Wired	Wireless	Wired	Wireless
Morning	X	34	X	5.83	X	8.89
	X	35	X	5.48	X	9.38
	X	47	X	5.32	X	8.17
	X	35	X	5.47	X	9.3
	X	33	X	4.77	X	9.32
Mid-morning	X	34	X	4.06	X	6.62
	X	34	X	4.95	X	8.89
	X	34	X	5.77	X	9.31
	X	47	X	4	X	9.31
	X	48	X	4.98	X	9.37
After school	X	36	X	4.4	X	7.87
	X	34	X	4.82	X	8.37
	X	36	X	5.36	X	9.28
	X	49	X	6.73	X	9.37
	X	36	X	4.29	X	8.48
Total Average	X	38.13333333	X	5.082	X	8.795333333

Jemez Pueblo Community Library						
Conducting test: Arlan Sando, Maureen Wacondo, and Wilson Barrow						
	Ping (ms)		**Upload Speed (mbps)**		**Download Speed (mbps)**	
	Wired	Wireless	Wired	Wireless	Wired	Wireless
Morning	59	59	0.48	0.66	11.74	11.52
	79	89	0.56	0.62	4.98	11.6

	69	60	0.65	0.65	10.89	11.66
	X	X	0	0	0	0
	X	X	0	0	0	0
Mid-morning	59	47	0.64	0.54	9.55	8.1
	82	95	0.23	0.15	2.58	4.56
	59	59	0.39	0.65	7.87	11.7
	X	X	0	0	0	0
	X	X	0	0	0	0
After school	1	121	437.25	0.16	6.52	4.67
	59	60	0.3	0.59	6.88	10.85
	X	X	0	0	0	0
	1	336	194.75	0.26	5.47	5.41
	X	X	0	0	0	0
Total Average	52	102.8888889	42.35	0.285333333	4.432	5.338

Santa Ana Pueblo Community Library						
Conducting test: Melverna Lujan		Speed test: NM Broadband Mapping				
	Ping (ms)		**Upload Speed (mbps)**		**Download Speed (mbps)**	
	Wired	Wireless	Wired	Wireless	Wired	Wireless
Morning	X	X	50.57	16.54	87.99	27.48
	X	X	50.37	15.99	88.87	10.06
	X	X	48.45	19.14	72.38	55.3
	X	X	50.28	19.12	91.4	39.48
	X	X	48.49	23.27	91	32.93
Mid-morning	X	X	48.18	14.32	56.91	14.32
	X	X	49.97	3.73	89.82	10.63
	X	X	50.19	18.57	62.52	5.63
	X	X	48.95	31	56.21	28.13
	X	X	49.7	25.29	88.78	50.39
After school	X	X	50.18	22.01	50.18	22.02
	X	X	49.96	17.17	49.96	17.17
	X	X	50.17	34.95	50.17	34.04
	X	X	50.23	11.88	50.23	11.88
	X	X	49.2	24.28	49.2	24.28
Total Average	X	X	49.65933333	19.81733333	69.04133333	25.58266667

Santa Clara Pueblo Community Library						
Conducting: Larissa Aguilar		Speed test: speedtest.net				
	Ping (ms)		**Upload Speed (mbps)**		**Download Speed (mbps)**	
	Wired	Wireless	Wired	Wireless	Wired	Wireless

Morning	46	26	13.9	16.28	13.2	14.26
	40	26	13.58	16.02	13.98	13.36
	40	26	14.28	13.91	17.32	10.17
	42	26	14.3	15.86	15.84	15.03
	48	26	12.22	16.11	16.04	14.64
Mid-morning	47	26	13.38	16.03	10.78	12.18
	41	42	13.82	16.06	12.79	8.6
	42	26	12.28	13.54	11.2	10.66
	40	26	15.3	16.57	13.41	13.91
	50	57	12.61	14.15	13.38	14.15
After school	41	41	13.47	13.46	15.28	11.84
	40	26	13.88	15.51	13.87	11.55
	58	73	12.17	14.89	9.22	5.59
	43	42	11.2	15.17	9.15	11.89
	76	73	12.25	14.15	11.78	9.74
Total Average	46.26666667	37.46666667	13.24266667	15.18066667	13.14933333	11.838

Pueblo of Pojoaque						
Conducting test: Jill Conner		Speed test: Beta				
	Ping (ms)		**Upload Speed (mbps)**		**Download Speed (mbps)**	
	Wired	Wireless	Wired	Wireless	Wired	Wireless
Morning	X	X	X	X	X	X
	38.9	X	X	X	4.04	X
	63	X	0.76	X	0.77	X
	23	X	26.41	X	21.99	X
	45	X	28.12	X	29.15	X
Mid-morning	29.5	X	0.59	X	3.69	X
	23	X	X	X	3.7	X
	X	X	X	X	X	X
	56	X	16.5	X	11.43	X
	45	X	25.24	X	25.28	X
After school	X	X	X	X	X	X
	X	X	X	X	X	X
	92	X	22.39	X	24.42	X
	26.47	X	24.86	X	36	X
	47	X	27.95	X	22.52	X
Total Average	44.44272727	X	19.20222222	X	16.63545455	X

Laguna Public Library					
Conducting test: Janice	Speed test: NM Broadband Mapping				

Kowemy						
	Ping (ms)		**Upload Speed (mbps)**		**Download Speed (mbps)**	
	Wired	Wireless	Wired	Wireless	Wired	Wireless
Morning	X	X	X	X	X	X
	X	X	4.12	2.26	2.58	2.76
	X	X	X	X	X	X
	X	X	X	X	X	X
	X	X	2.4	2.3	X	X
Mid-morning	99	76	3.81	1.5	2.06	3.68
	91	100	3.28	2.16	1.44	2.02
	X	X	X	X	X	X
	X	X	X	X	X	X
	94	109	2.4	2.3	2.17	0.89
After school	70	95	2.5	1.56	1.67	1.29
	89	75	1.59	2.04	3.15	2.67
	X	X	X	X	X	X
	X	X	X	X	X	X
	90	80	2.18	2.04	1.58	2.12
Total Average	88.83333333	89.16666667	2.785	2.02	2.092857143	2.204285714

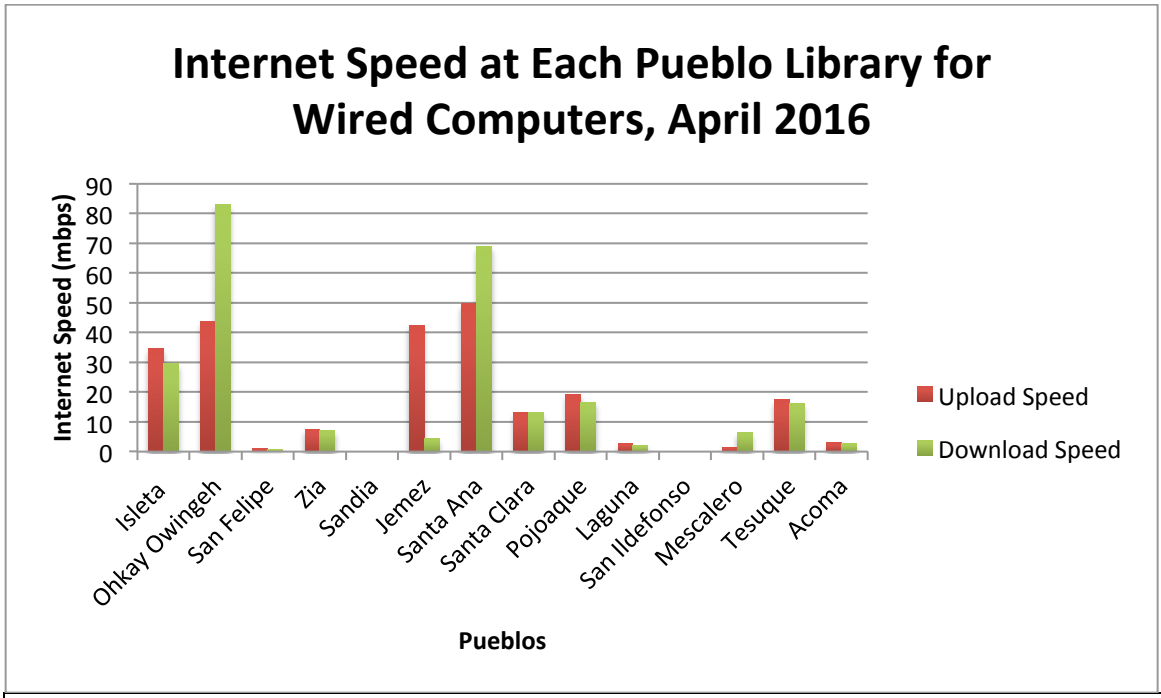
San Ildefonso Library						
Conducting test: library staff		Speed test: speedtest.net				
	Ping (ms)		**Upload Speed (mbps)**		**Download Speed (mbps)**	
	Wired	Wireless	Wired	Wireless	Wired	Wireless
Morning	X	X	X	0	X	0
	X	X	X	0	X	0
	X	X	X	0	X	0
	X	33	X	1.48	X	1.49
	X	X	X	0	X	0
Mid-morning	X	X	X	0	X	0
	X	X	X	0	X	0
	X	X	X	0	X	0
	X	40	X	1.48	X	1.5
	X	X	X	0	X	0
After school	X	X	X	0	X	0
	X	120	X	1.36	X	0.63
	X	X	X	0	X	0
	X	X	X	0	X	0
	X	X	X	0	X	0

Total Average	X	64.33333333	X	0.288	X	0.241333333
Mescalero Community Library						
Conducting test: library staff		Speed test: NM Broadband Mapping				

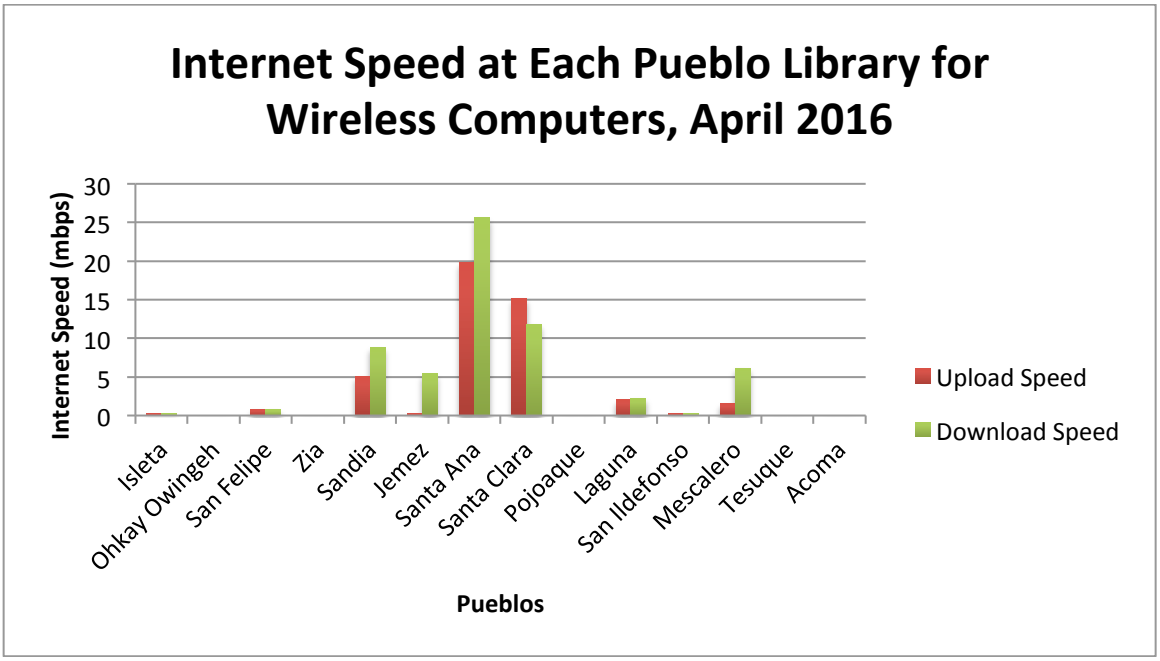
	Ping (ms)		**Upload Speed (mbps)**		**Download Speed (mbps)**	
	Wired	Wireless	Wired (Patron 0)	Wireless (Patron 3)	Wired	Wireless
Morning	X	X	1.701	1.631	10.94	6.904
	X	X	1.713	1.677	7.979	7.388
	X	X	1.637	1.606	7.07	3.119
	X	X	1.646	1.676	9.442	7.795
	X	X	1.661	1.659	2.11	8.361
Mid-morning	X	X	1.658	1.585	7.627	5.856
	X	X	1.654	1.663	8.536	7.427
	X	X	1.558	1.291	10.197	6.396
	X	X	1.668	1.624	5.861	2.848
	X	X	1.276	1.554	2.813	5.911
After school	X	X	0.902	1.669	6.357	5.849
	X	X	1.3	1.354	6.962	5.518
	X	X	1.593	1.509	7.534	7.551
	X	X	1.304	1.638	0.996	5.299
	X	X	1.691	1.544	0.55	5.535
Total Average	X	X	1.5308	1.578666667	6.3316	6.117133333

Wired

Pueblo	**Ping (ms)**	**Upload Speed**	**Download Speed**
Isleta	20.6	34.81	29.6
Ohkay Owingeh	1	43.87	83.17
San Felipe	134.31	0.93	0.77
Zia	14.13	7.45	7.24
Sandia	X	X	X
Jemez	52	42.35	4.43
Santa Ana	X	49.66	69.04
Santa Clara	46.27	13.24	13.15
Pojoaque	44.44	19.2	16.64
Laguna	88.83	2.79	2.09
San Ildefonso	X	X	X
Mescalero	X	1.53	6.33
Tesuque	29.5	17.36	16.19
Acoma	38.75	2.96	2.59

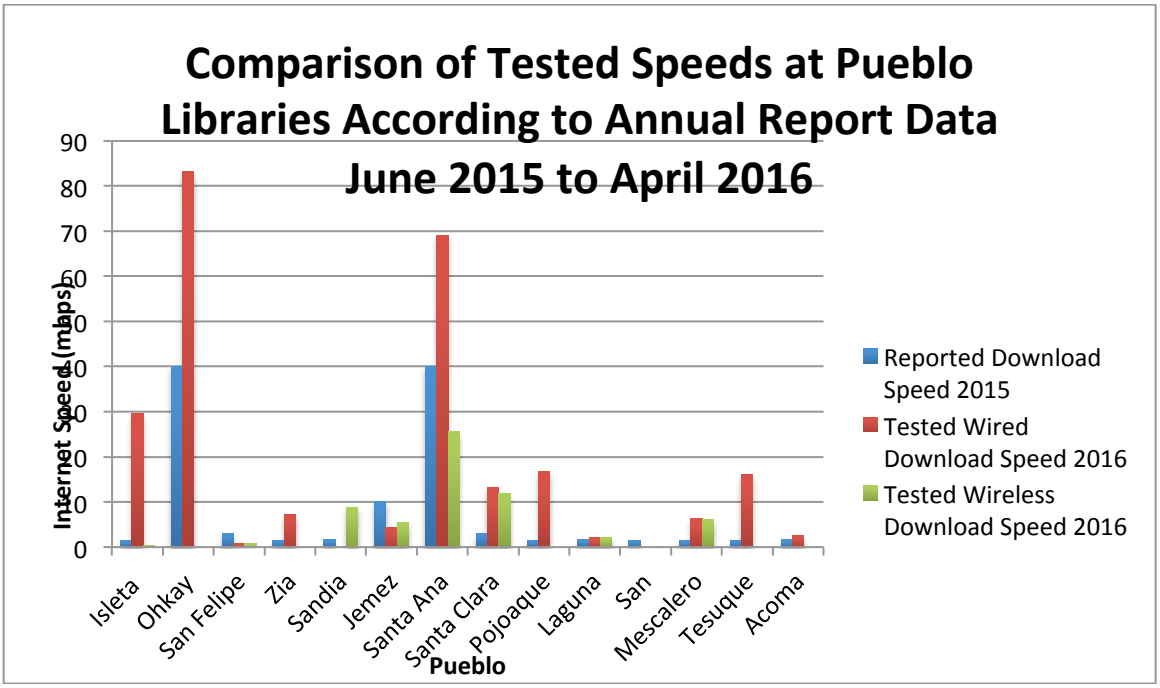


Wireless			
Pueblo	**Ping (ms)**	**Upload Speed**	**Download Speed**
Isleta	35.13	0.24	0.25
Ohkay Owingeh	X	X	X
San Felipe	135.77	0.81	0.76
Zia	X	X	X
Sandia	38.13	5.08	8.8
Jemez	102.89	0.29	5.39
Santa Ana	X	19.82	25.58
Santa Clara	37.47	15.18	11.84
Pojoaque	X	X	X
Laguna	89.17	2.02	2.2
San Ildefonso	64.33	0.29	0.24
Mescalero	X	1.58	6.12
Tesuque	X	X	X
Acoma	X	X	X



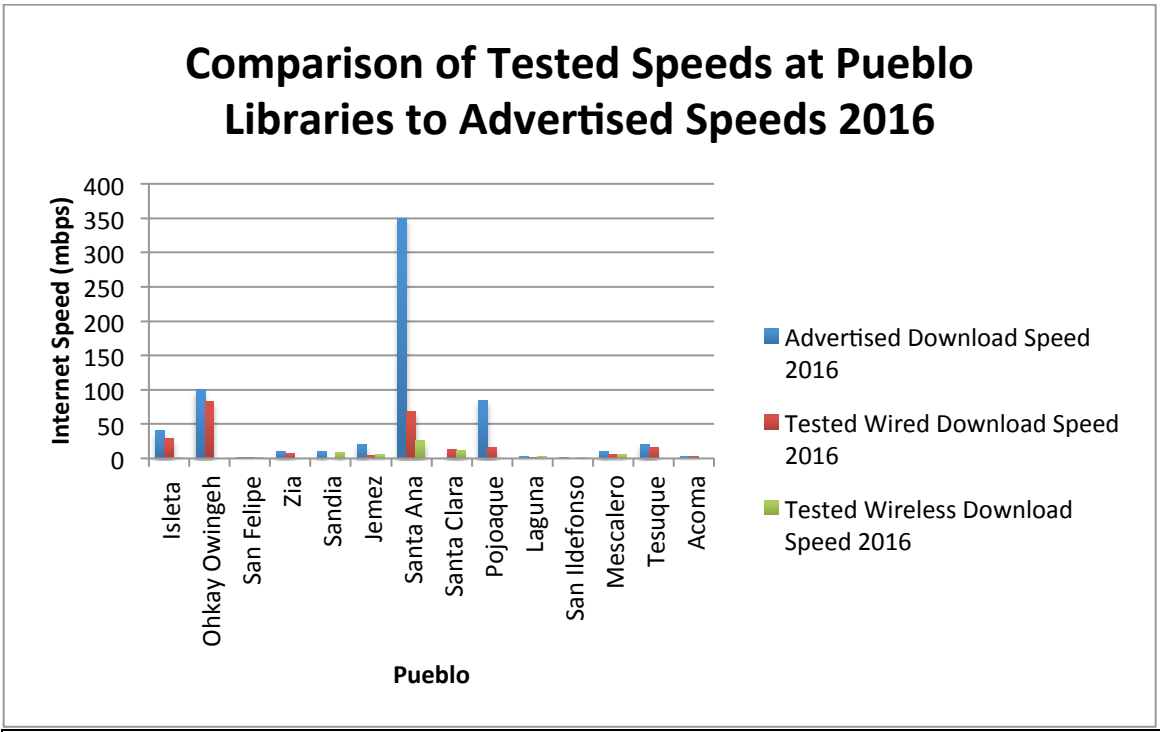
B.3 Old Speed Test Data vs. New Speed Test Data

Pueblo	Reported Download Speed 2015 (mbps)	Tested Wired Download Speed 2016 (mbps)	Tested Wireless nload Speed 2016 ps)
Isleta	1.5	29.6	0.25
Ohkay Owingeh	40	83.17	X
San Felipe	3.1	0.77	0.76
Zia	1.5	7.24	X
Sandia	1.6	X	8.8
Jemez	10.1	4.43	5.39
Santa Ana	40	69.04	25.58
Santa Clara	3.1	13.15	11.84
Pojoaque	1.5	16.64	X
Laguna	1.6	2.09	2.2
San Ildefonso	1.5	X	0.24
Mescalero	1.5	6.33	6.12
Tesuque	1.5	16.19	X
Acoma	1.6	2.59	X

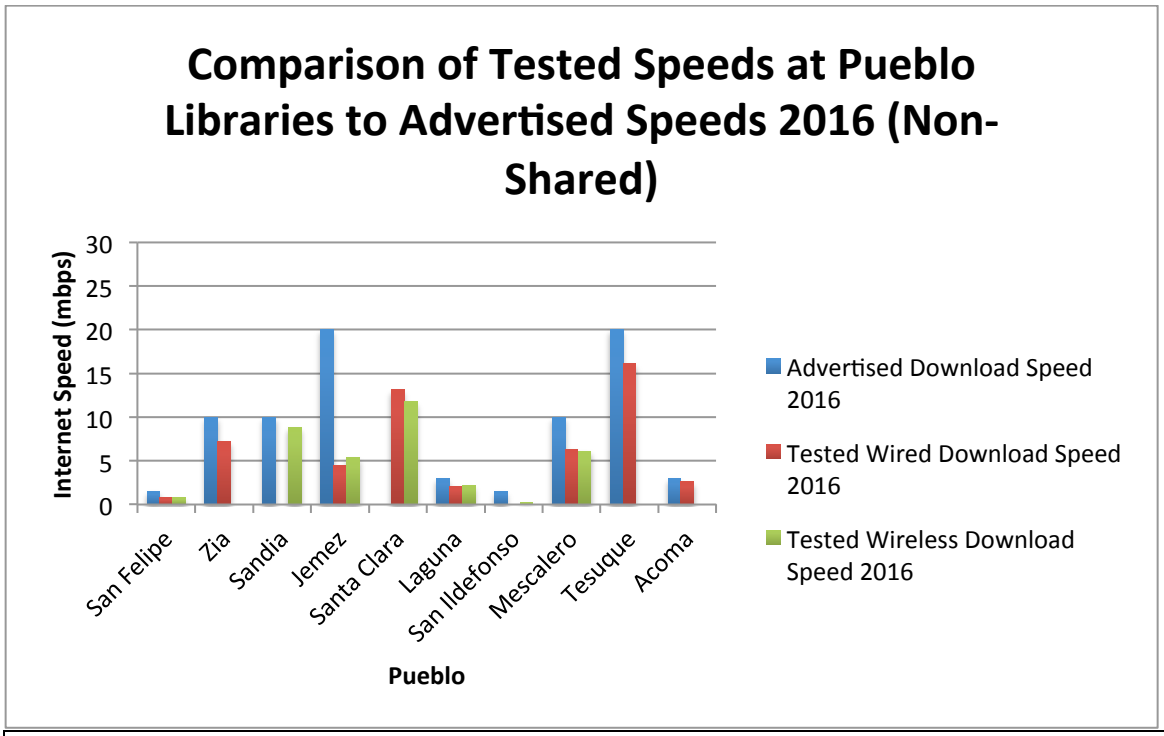


B.4 Tested Speeds vs. Advertised Speeds

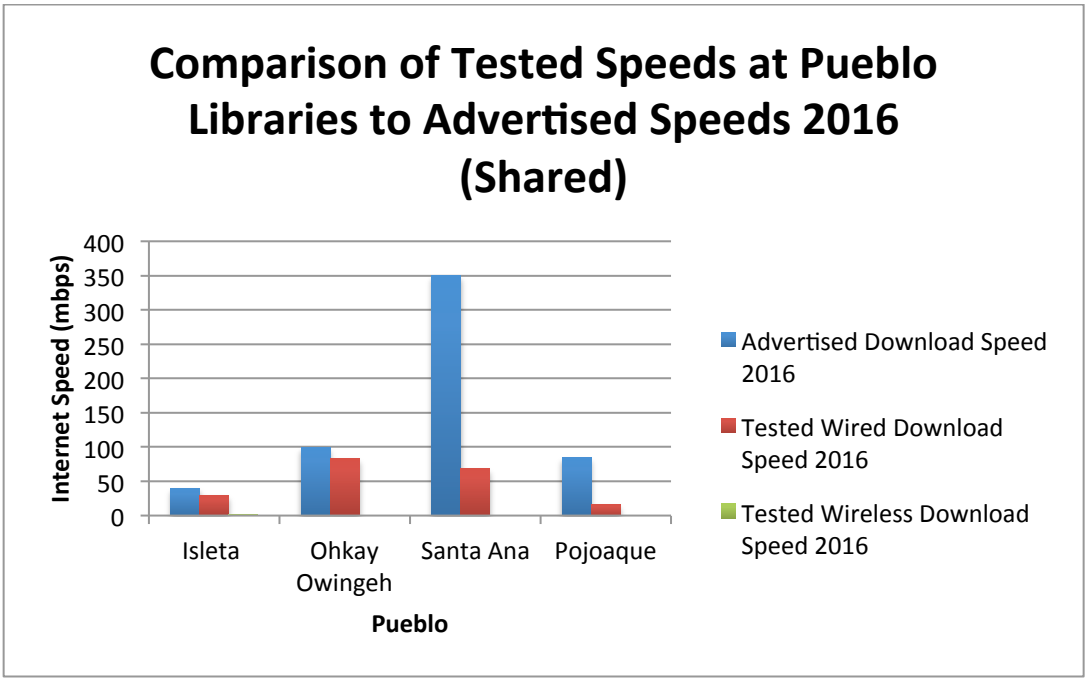
Pueblo	Advertised Download Speed 2016 (mbps)	Tested Wired Download Speed 2016 (mbps)	Tested Wireless Download Speed 2016 (mbps)
Isleta	40	29.6	0.25
Ohkay Owingeh	100	83.17	X
San Felipe	1.5	0.77	0.76
Zia	10	7.24	X
Sandia	10	X	8.8
Jemez	20	4.43	5.39
Santa Ana	350	69.04	25.58
Santa Clara		13.15	11.84
Pojoaque	85	16.64	X
Laguna	3	2.09	2.2
San Ildefonso	1.5	X	0.24
Mescalero	10	6.33	6.12
Tesuque	20	16.19	X
Acoma	3	2.59	X



Non-Shared			
Pueblo	**Advertised Download Speed 2016 (mbps)**	**Tested Wired Download Speed 2016 (mbps)**	**Tested Wireless Download Speed 2016 (mbps)**
San Felipe	1.5	0.77	0.76
Zia	10	7.24	X
Sandia	10	X	8.8
Jemez	20	4.43	5.39
Santa Clara		13.15	11.84
Laguna	3	2.09	2.2
San Ildefonso	1.5	X	0.24
Mescalero	10	6.33	6.12
Tesuque	20	16.19	X
Acoma	3	2.59	X



Shared			
Pueblo	**Advertised Download Speed 2016**	**Tested Wired Download Speed 2016**	**Tested Wireless Download Speed 2016**
Isleta	40	29.6	0.25
Ohkay Owingeh	100	83.17	X
Santa Ana	350	69.04	25.58
Pojoaque	85	16.64	X



B.5 New Mexico Circuits and Speeds

School Name	S_Type	E-rate BEN
Alamo Day School NM	Tribal - O	99448
Albuquerque Bldg 2	BIE - G	17007151
Albuquerque Gateway	BIE - G	17007151
Atsa Biya a zh Community School NM	Tribal - O	99260
Baca/Dloay Azhi Community School NM	BIE - O	98953
Ch ooshgai Community School (Chuska) NM	Tribal - O	99188
Crystal Boarding School NM	BIE - O	99199
Dibe Yazhi Habiti n O It a Inc. (Borrego Pass) NM	Tribal - O	99169
New Mexico Navajo Central Education Line Office (Eastern Navajo) NM	BIE - A	
Jemez Day School NM	BIE - O	98919
Jicarilla Dormitory NM	Tribal - O	99333
Laguna Elementary School NM	Tribal - O	16033631
Lake Valley Navajo School NM	BIE - O	99172
Mariano Lake Community School NM	BIE - O	99168
Mescalero Apache School NM	Tribal - O	99732
Na Neelzhiin Ji Olta (Torreon Day School) NM	Tribal - O	98898
Navajo Preparatory School NM	Tribal - O	99209
Nenahnezad Community School NM	BIE - O	99246
New Mexico Navajo North Education Line Office (Shiprock) NM	BIE - A	
New Mexico North Education Line Office (NPA) NM	BIE - A	
Ohkay Owingeh Communit School (San Juan Day School) NM	Tribal - O	99380
Ojo Encino Day School NM	BIE - O	98890
Pine Hill School NM	Tribal - O	99176
Pueblo Pintado Community School NM	BIE - O	98895
San Felipe Pueblo Elementary School NM	BIE - O	98872
San Ildefonso Day School NM	BIE - O	99294
Sanostee Day School NM	BIE - O	99267
Santa Clara Day School NM	BIE - O	99343
Santa Fe Indian School NM	Tribal - O	99297
Sky City Community School NM	BIE - O	98941
New Mexico Navajo South Education Line Office (Gallup) NM	BIE - A	
Taos Day School NM	BIE - O	99384
Te Tsu Geh Oweenge Day School (Tesuque) NM	Tribal - O	99293
T iists oozi Bi Olta (Crownpoint) NM	BIE - O	99166
Tohaali Community School (Toadlena) NM	BIE - O	99266
To Hajiilee-He Day School (Canoncito) NM	Tribal - O	98923
Tse ii ahi Community School (Standing Rock) NM	BIE - O	99173
Tsiya (Zia) Elementary & Middle School NM	BIE - O	98959
Wingate Elementary School NM	BIE - O	99174
Wingate High School NM	BIE - O	16040831
Bread Springs Day School NM	BIE - O	99164
Chi Chil Tah Community School (Jones Ranch) NM	BIE - O	99190
Isleta Elementary School NM	Tribal - O	98917
Hanaa dli Community School (Huerfano) NM	Tribal - O	99239
Aztec Dormitory NM	Tribal - O	99233
Beclabito Day School NM	BIE - O	99255
Southwest Indian Polytechnic Institute NM	BIE - PS	

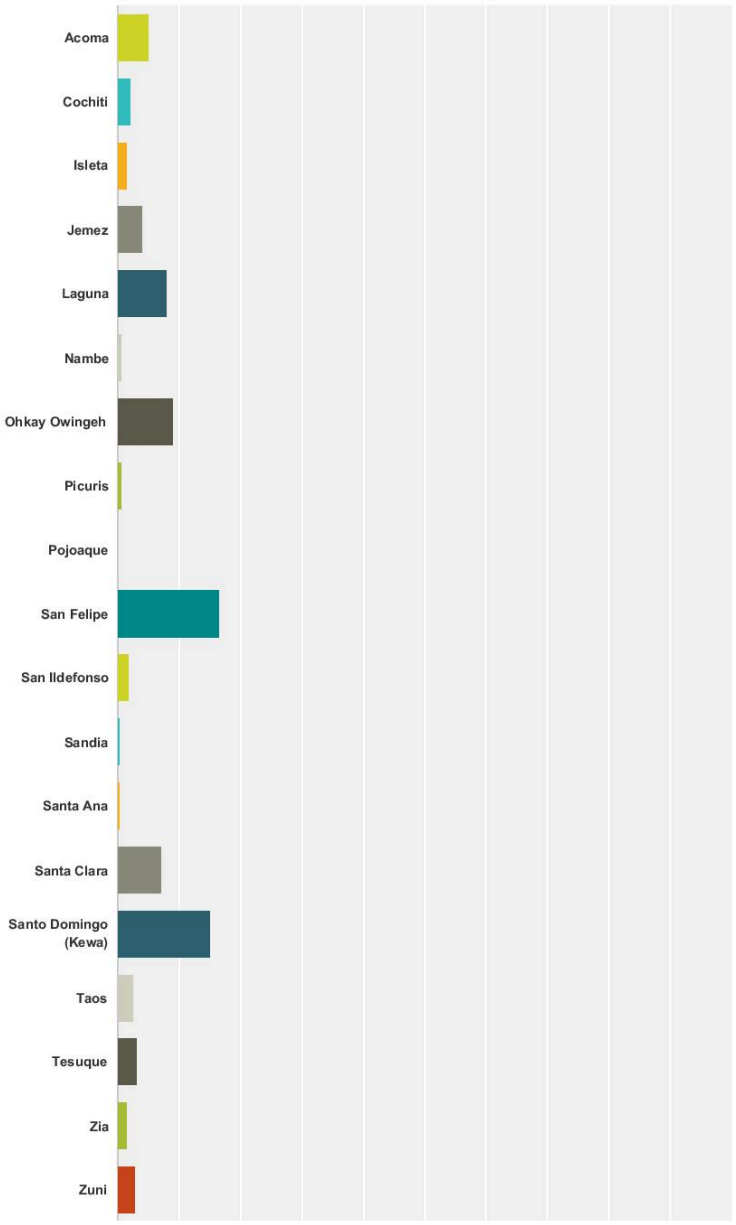
E-rate Eligible	In Consortium	Existing Bandwidth	Upgrade Bandwidth	Port Speed
Yes	Yes	T1	Ethernet - 100 Mbps	100
Yes	Yes	OC-12c	Ethernet - 1 Gbps	1,000
Yes	Yes	OC-12c	Ethernet - 1 Gbps	1,000
Yes	No	No Circuit	N/A; 100M available	100
Yes	Yes	FT3 (6xDS1)	Ethernet - 100 Mbps	100
Yes	Yes	Ethernet - 40 Mbps	Ethernet - 100 Mbps	100
Yes	Yes	Ethernet - 20 Mbps	Ethernet - 100 Mbps	100
Yes	Yes	Ethernet - 20 Mbps	Ethernet - 100 Mbps	100
No	No	T1	0	0
Yes	Yes	FT3 (6xDS1)	Ethernet - 100 Mbps	100
No	No	T1	Ethernet - 100 Mbps	100
Yes	No	No Circuit	N/A	0
Yes	Yes	T1	Ethernet - 100 Mbps	100
Yes	Yes	Ethernet - 20 Mbps	Ethernet - 100 Mbps	100
Yes	Yes	T3	Ethernet - 100 Mbps	100
Yes	No	T1	Ethernet - 100 Mbps	100
Yes	Yes	T1	Ethernet - 100 Mbps	100
Yes	Yes	Ethernet - 20 Mbps	Ethernet - 100 Mbps	100
No	No	T1	0	0
No	No	T1	0	0
Yes	No	T1	Ethernet - 100 Mbps	100
Yes	Yes	T1	Ethernet - 100 Mbps	100
Yes	Yes	T1	Ethernet - 100 Mbps	100
Yes	Yes	T1	Ethernet - 100 Mbps	100
Yes	Yes	FT3 (2xDS1)	Ethernet - 100 Mbps	100
Yes	Yes	FT3 (6xDS1)	Ethernet - 100 Mbps	100
Yes	Yes	Ethernet 10 Mbps	Ethernet - 100 Mbps	100
Yes	Yes	FT3 (6xDS1)	Ethernet - 100 Mbps	100
Yes	No	T1	Ethernet - 100 Mbps	100
Yes	Yes	FT3 (4xDS1)	Ethernet - 100 Mbps	100
No	No	T1	0	0
Yes	Yes	FT3 (6xDS1)	Ethernet - 20 Mbps	20
Yes	No	No Circuit	N/A	0
Yes	Yes	FT3 (6xDS1)	Ethernet - 100 Mbps	100
Yes	Yes	Ethernet - 20 Mbps	Ethernet - 100 Mbps	100
Yes	No	No Circuit	N/A	0
Yes	Yes	Ethernet - 20 Mbps	Ethernet - 100 Mbps	100
Yes	Yes	T1	Ethernet - 100 Mbps	100
Yes	Yes	Ethernet - 50 Mbps	Ethernet - 100 Mbps	100
Yes	Yes	Ethernet - 50 Mbps	Ethernet - 100 Mbps	100
Yes	Yes	Ethernet - 20 Mbps	Ethernet - 100 Mbps	100
Yes	Yes	Ethernet - 20 Mbps	Ethernet - 100 Mbps	100
Yes	No	1.544 Mbps	N/A;Ethernet - 100 Mbps	100
Yes	No	T1	Ethernet - 100 Mbps	100
No	No	FT3 (4xDS1)	Ethernet - 100 Mbps	100
Yes	Yes	FT3 (4xDS1)	Ethernet - 100 Mbps	100
No	No	No Circuit	0	0

APPENDIX C: STUDENT SURVEY

WPI - SFIS Student Internet Survey

Q1 Which tribe are you from?

Answered: 279 Skipped: 3



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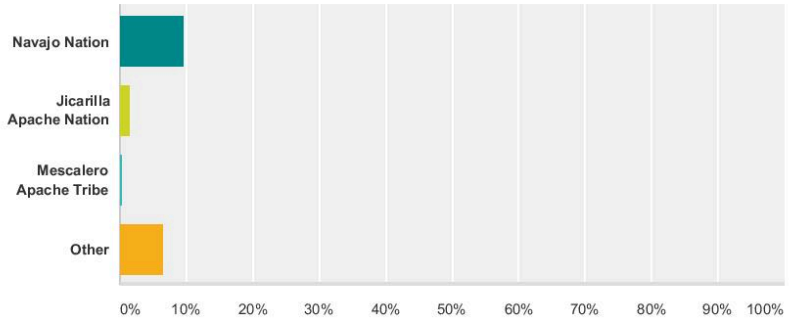
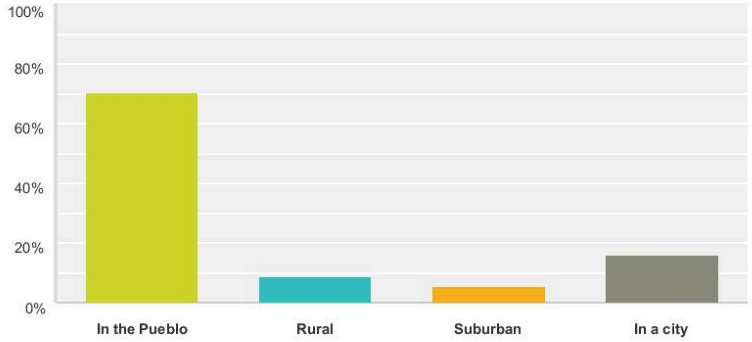


Answer Choices	Responses	
Acoma	5.02%	14
Cochiti	2.15%	6
Isleta	1.43%	4
Jemez	3.94%	11
Laguna	7.89%	22
Nambe	0.72%	2
Ohkay Owingeh	8.96%	25
Picuris	0.72%	2
Pojoaque	0.00%	0
San Felipe	16.49%	46
San Ildefonso	1.79%	5
Sandia	0.36%	1
Santa Ana	0.36%	1
Santa Clara	7.17%	20
Santo Domingo (Kewa)	15.05%	42
Taos	2.51%	7
Tesuque	3.23%	9
Zia	1.43%	4
Zuni	2.87%	8
Navajo Nation	9.68%	27
Jicarilla Apache Nation	1.43%	4
Mescalero Apache Tribe	0.36%	1
Other	6.45%	18
Total		279

Q2 Where do you live?

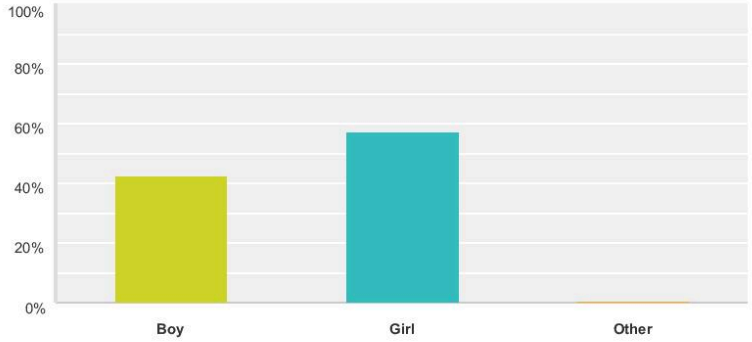
Answered: 281 Skipped: 1



Answer Choices	Responses	
In the Pueblo	**70.46%**	198
Rural	**8.54%**	24
Suburban	**4.98%**	14
In a city	**16.01%**	45
Total		**281**

Q3 What is your gender?

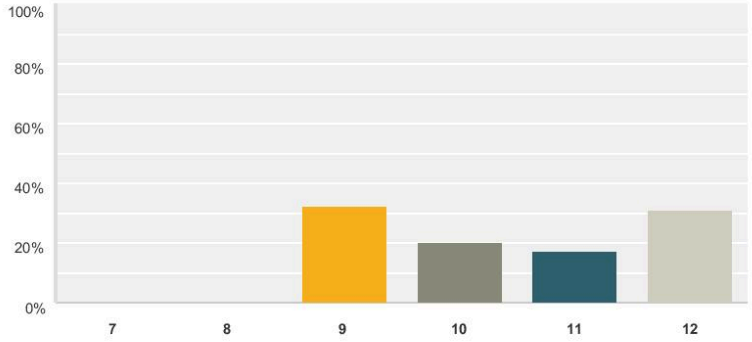
Answered: 281 Skipped: 1



Answer Choices	Responses	
Boy	42.35%	119
Girl	57.30%	161
Other	0.36%	1
Total		281

Q5 What grade are you in?

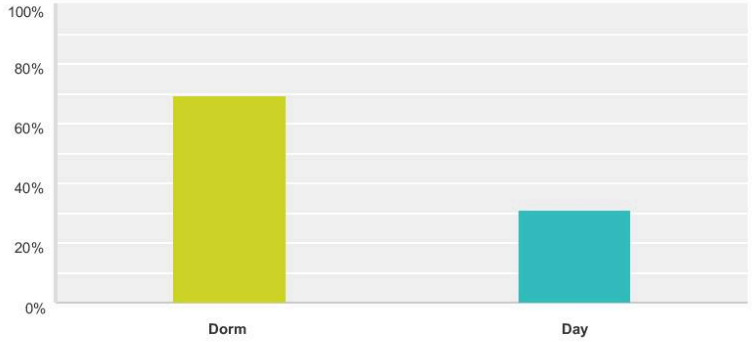
Answered: 277 Skipped: 5



Answer Choices	Responses	
7	0.00%	0
8	0.00%	0
9	32.13%	89
10	19.86%	55
11	17.33%	48
12	30.69%	85
Total		277

Q6 What kind of student are you?

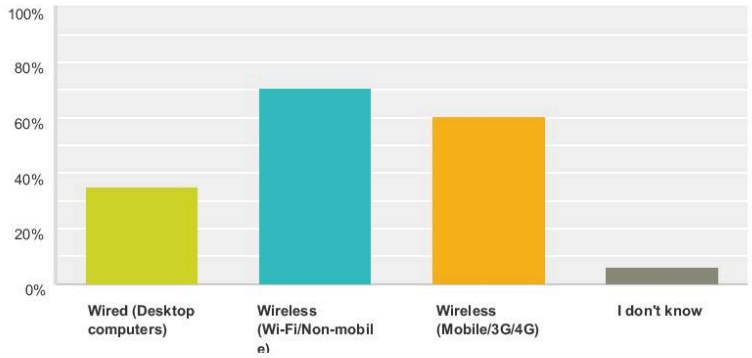
Answered: 279 Skipped: 3



Answer Choices	Responses	
Dorm	69.18%	193
Day	30.82%	86
Total		279

Q7 What type of internet connection are you using while at SFIS?

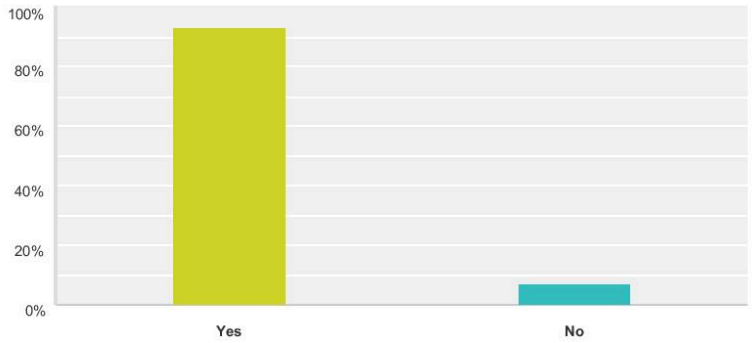
Answered: 274 Skipped: 8



Answer Choices	Responses	
Wired (Desktop computers)	35.04%	96
Wireless (Wi-Fi/Non-mobile)	70.44%	193
Wireless (Mobile/3G/4G)	60.58%	166
I don't know	5.84%	16
Total Respondents: 274		

Q8 Do you connect to the SFIS wireless network?

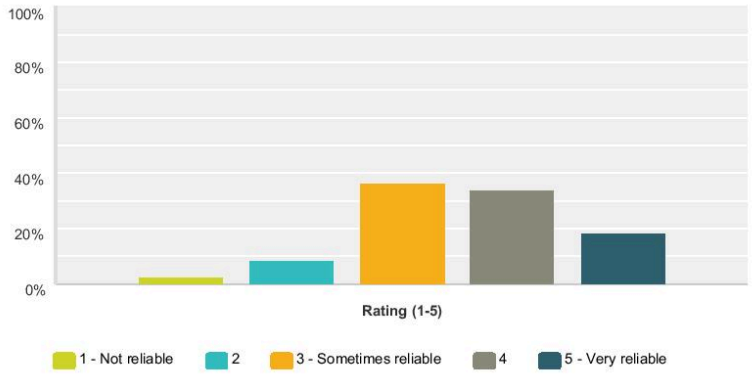
Answered: 277 Skipped: 5



Answer Choices	Responses	
Yes	93.14%	258
No	6.86%	19
Total		277

Q9 On a scale of 1-5, how reliable is the SFIS wireless connection?

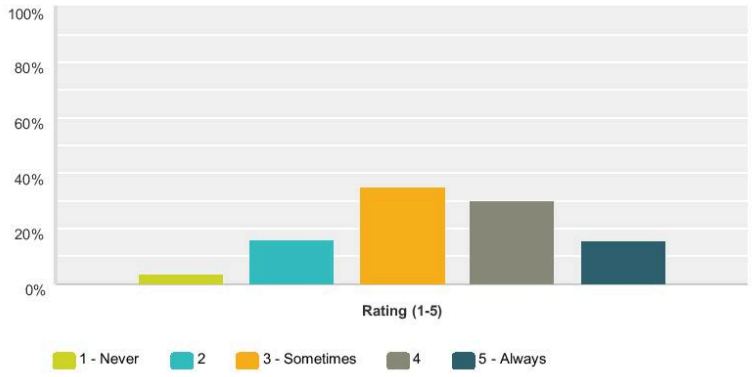
Answered: 278 Skipped: 4



	1 - Not reliable	2	3 - Sometimes reliable	4	5 - Very reliable	Total	Weighted Average
Rating (1-5)	2.52% 7	8.63% 24	36.33% 101	34.17% 95	18.35% 51	278	3.57

Q10 How often does the SFIS wireless block you from going to a website?

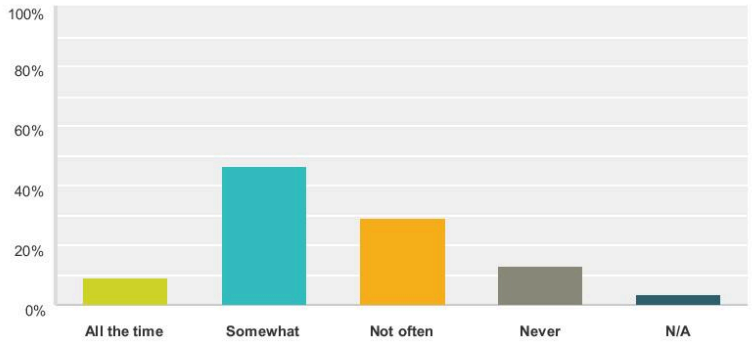
Answered: 278 Skipped: 4



	1 - Never	2	3 - Sometimes	4	5 - Always	Total	Weighted Average
Rating (1-5)	**3.60%** 10	**16.19%** 45	**34.89%** 97	**29.86%** 83	**15.47%** 43	278	3.37

Q11 Does this discourage you from using the SFIS Wireless?

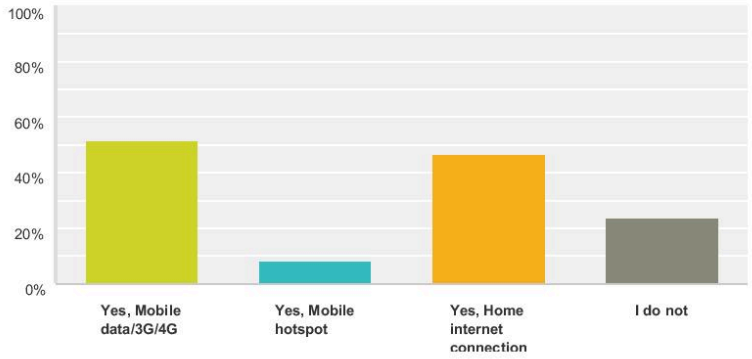
Answered: 276 Skipped: 6



Answer Choices	Responses	
All the time	8.70%	24
Somewhat	46.38%	128
Not often	28.62%	79
Never	13.04%	36
N/A	3.26%	9
Total		276

Q13 Do you have internet access at home?

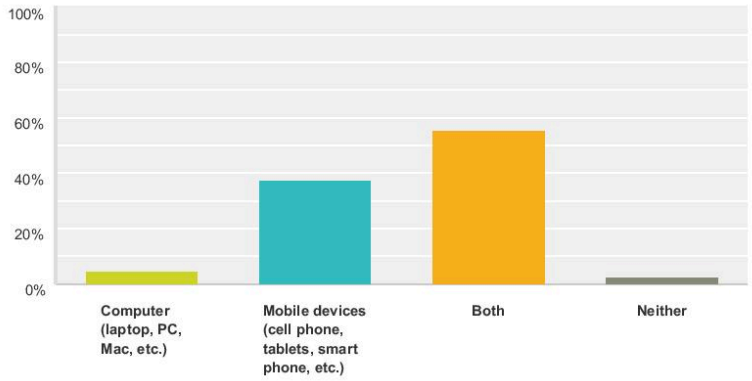
Answered: 275 Skipped: 7



Answer Choices	Responses	
Yes, Mobile data/3G/4G	51.27%	141
Yes, Mobile hotspot	8.00%	22
Yes, Home internet connection	46.55%	128
I do not	23.27%	64
Total Respondents: 275		

Q14 Do you normally use a computer or mobile devices to connect to the internet?

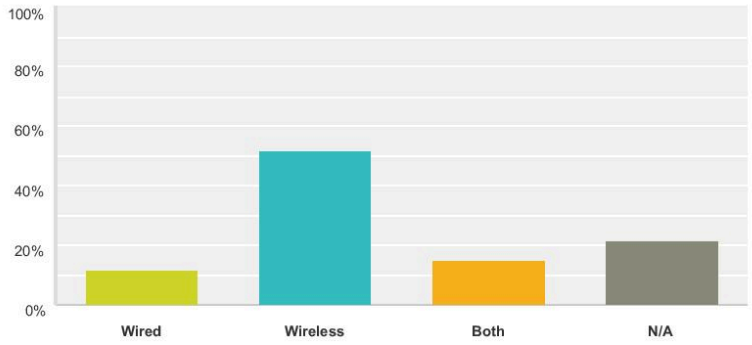
Answered: 275 Skipped: 7



Answer Choices	Responses	
Computer (laptop, PC, Mac, etc.)	4.73%	13
Mobile devices (cell phone, tablets, smart phone, etc.)	37.45%	103
Both	55.27%	152
Neither	2.55%	7
Total		275

Q15 If you use a computer, do you use wired or wireless internet connect?

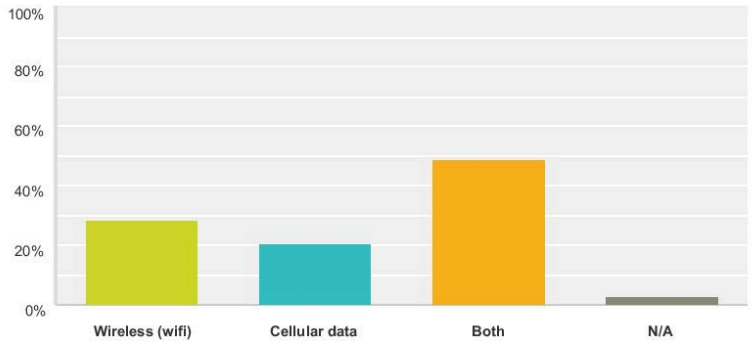
Answered: 272 Skipped: 10



Answer Choices	Responses	
Wired	11.76%	32
Wireless	51.84%	141
Both	15.07%	41
N/A	21.32%	58
Total		272

Q16 If you use a mobile device, do you use wireless or cellular data?

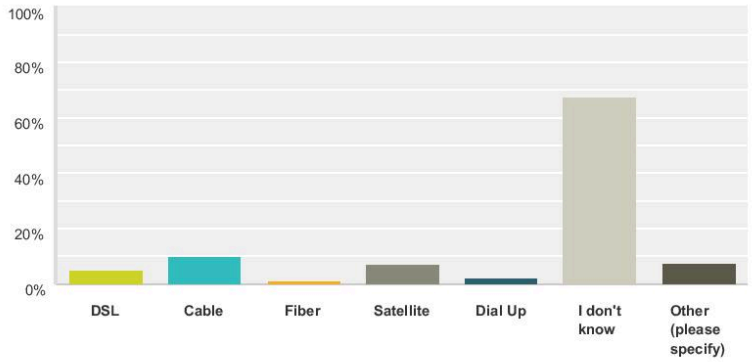
Answered: 273 Skipped: 9



Answer Choices	Responses	
Wireless (wifi)	28.21%	77
Cellular data	20.51%	56
Both	48.72%	133
N/A	2.56%	7
Total		273

Q17 If you have a non-cellular (cellphone) internet at home, what kind is it?

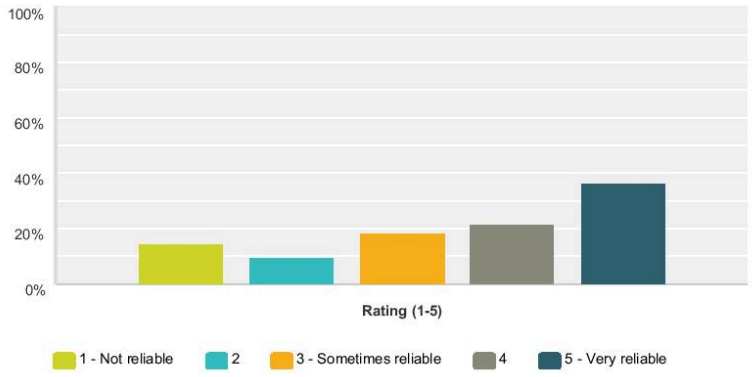
Answered: 247 Skipped: 35



Answer Choices	Responses	
DSL	4.86%	12
Cable	10.12%	25
Fiber	0.81%	2
Satellite	6.88%	17
Dial Up	2.02%	5
I don't know	67.61%	167
Other (please specify)	7.69%	19
Total		247

Q18 On a 1-5 scale, how reliable is your home connection?

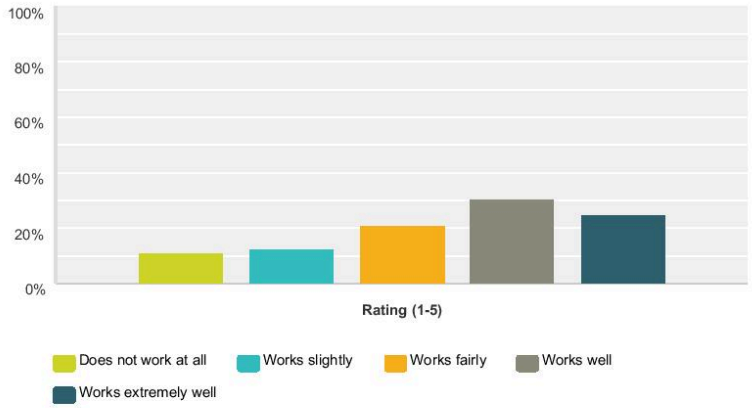
Answered: 268 Skipped: 14



	1 - Not reliable	2	3 - Sometimes reliable	4	5 - Very reliable	Total	Weighted Average
Rating (1-5)	**14.55%** 39	**9.33%** 25	**18.28%** 49	**21.27%** 57	**36.57%** 98	268	3.56

Q19 How well does your home connection work for school related functions (research, group work, etc)?

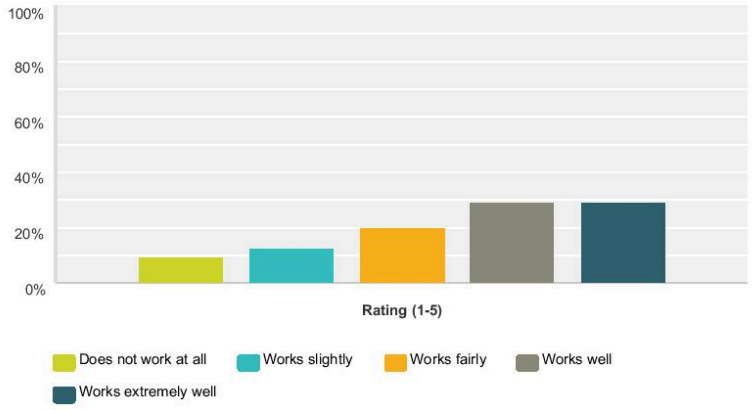
Answered: 269 Skipped: 13



	Does not work at all	Works slightly	Works fairly	Works well	Works extremely well	Total	Weighted Average
Rating (1-5)	**11.15%** 30	**12.64%** 34	**20.82%** 56	**30.48%** 82	**24.91%** 67	269	3.45

Q20 How well does your home connection work for your purposes outside of school (entertainment, social media, etc)?

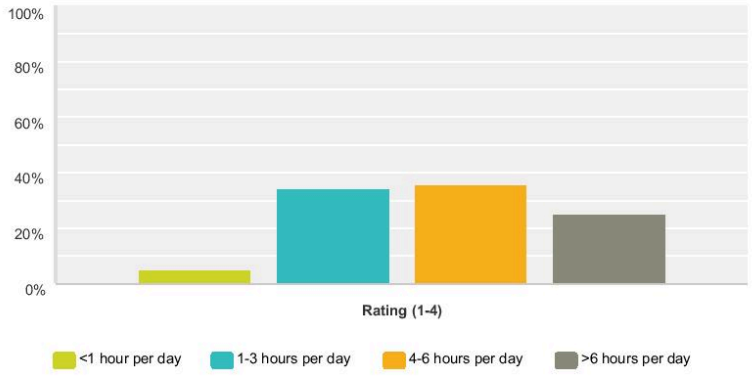
Answered: 270 Skipped: 12



	Does not work at all	Works slightly	Works fairly	Works well	Works extremely well	Total	Weighted Average
Rating (1-5)	**9.63%** 26	**12.59%** 34	**20.00%** 54	**28.89%** 78	**28.89%** 78	270	3.55

Q22 How often do you use the internet?

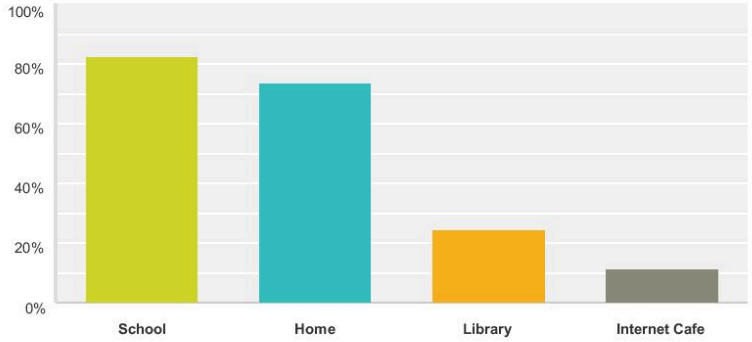
Answered: 263 Skipped: 19



	<1 hour per day	1-3 hours per day	4-6 hours per day	>6 hours per day	Total	Weighted Average
Rating (1-4)	**4.94%** 13	**34.22%** 90	**35.74%** 94	**25.10%** 66	263	2.81

Q23 Where do you usually interact online?

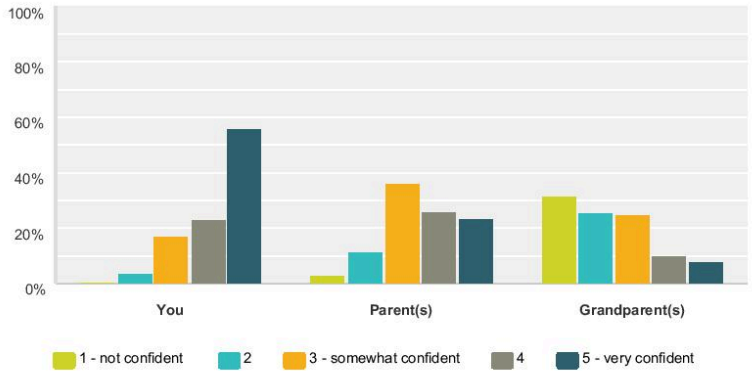
Answered: 263 Skipped: 19



Answer Choices	Responses	
School	82.51%	217
Home	73.38%	193
Library	24.33%	64
Internet Cafe	11.03%	29
Total Respondents: 263		

Q24 How confident are you, your parent(s), and your grandparent(s) in using the internet?

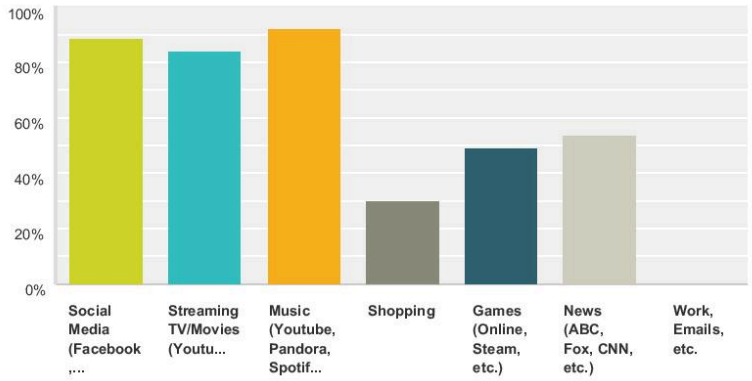
Answered: 267 Skipped: 15



	1 - not confident	2	3 - somewhat confident	4	5 - very confident	Total	Weighted Average
You	**0.37%** 1	**3.75%** 10	**16.85%** 45	**22.85%** 61	**56.18%** 150	267	4.31
Parent(s)	**3.04%** 8	**11.41%** 30	**36.12%** 95	**25.86%** 68	**23.57%** 62	263	3.56
Grandparent(s)	**31.37%** 80	**25.49%** 65	**25.10%** 64	**10.20%** 26	**7.84%** 20	255	2.38

Q25 How do you use the internet for recreational purposes?

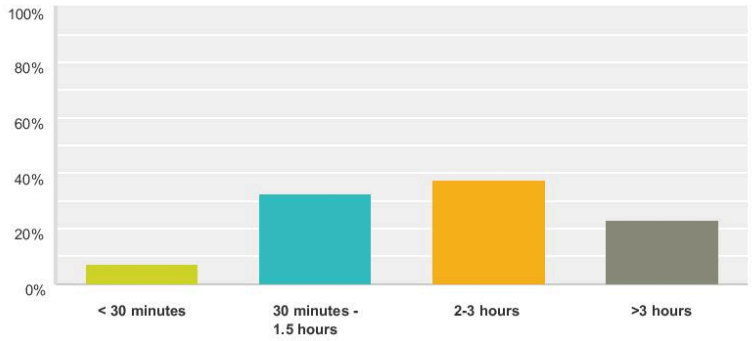
Answered: 268 Skipped: 14



Answer Choices	Responses	
Social Media (Facebook, Twitter, Instagram, etc.)	88.43%	237
Streaming TV/Movies (Youtube, Netflix, Hulu, etc.)	83.96%	225
Music (Youtube, Pandora, Spotify, etc.)	91.79%	246
Shopping	30.22%	81
Games (Online, Steam, etc.)	48.88%	131
News (ABC, Fox, CNN, etc.)	53.73%	144
Work, Emails, etc.	0.00%	0
Total Respondents: 268		

Q26 How many hours a day do you use the internet for recreational purposes?

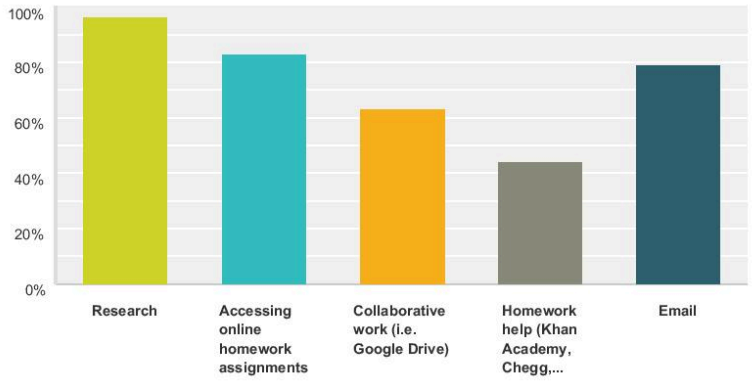
Answered: 267 Skipped: 15



Answer Choices	Responses	
< 30 minutes	7.12%	19
30 minutes - 1.5 hours	32.58%	87
2-3 hours	37.45%	100
>3 hours	22.85%	61
Total		267

Q27 How do you use the internet for educational purposes?

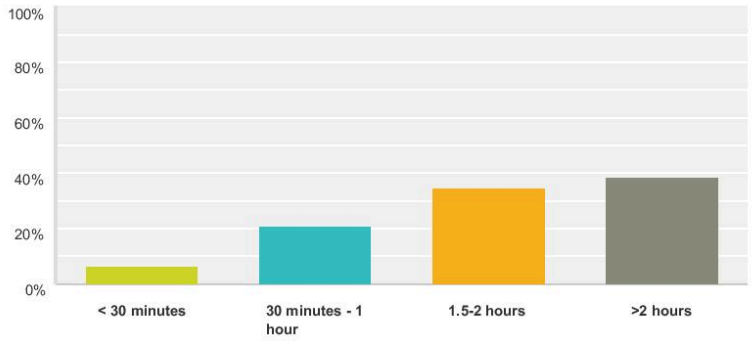
Answered: 269 Skipped: 13



Answer Choices	Responses	
Research	96.65%	260
Accessing online homework assignments	82.90%	223
Collaborative work (i.e. Google Drive)	62.83%	169
Homework help (Khan Academy, Chegg, Wolfram Alpha, etc.)	44.24%	119
Email	79.18%	213
Total Respondents: 269		

Q28 How many hours a day do you need the internet to do your homework?

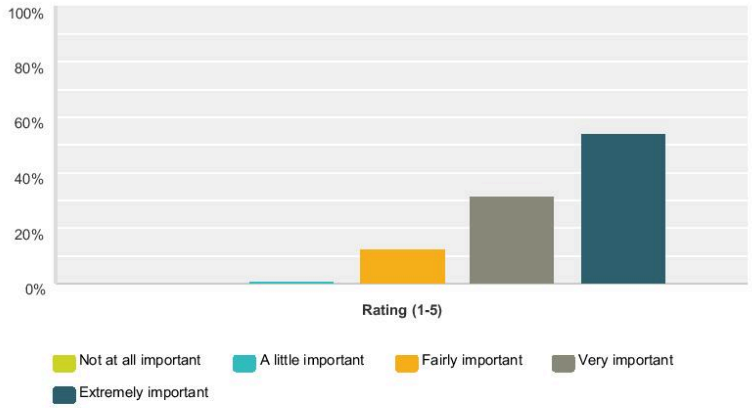
Answered: 269 Skipped: 13



Answer Choices	Responses	
< 30 minutes	6.32%	17
30 minutes - 1 hour	20.82%	56
1.5-2 hours	34.57%	93
>2 hours	38.29%	103
Total		269

Q29 How important do you think the internet is as a resource for students looking to do well in their classes?

Answered: 269 Skipped: 13



	Not at all important	A little important	Fairly important	Very important	Extremely important	Total	Weighted Average
Rating (1-5)	**0.74%** 2	**1.12%** 3	**12.64%** 34	**31.60%** 85	**53.90%** 145	269	4.37

APPENDIX D: ANNOTED BIBLIOGRAPHY

The following sources are a compilation of the research market data available. It consists of different broadband speeds available, maps, and demographics. Data exist on libraries, schools, education, and home uses. This data informed the infographics created in the *Providing Resources for the Advancement of Rural Broadband Internet in Native Communities* Interactive Qualifying Project in 2016. These resources and data can inform future projects involving Broadband in Native American communities.

Belson, D. (2015). *Akamai's State of the Internet: Q1 2015 Report* (Vol. 8, Rep. No. 1). MA: Akamai.

This report address global connection speeds and broadband adoptions while comparing it to those of the United States. It specifically reports on the connection speeds and broadband adoptions of North and South America, Asia, Europe and the Middle East, and Africa. They discuss mobile connection speeds, average load times, and internet traffic issues.

DeVoe, J. F., Darling-Churchill, K. E., & Snyder, T. D. (2008). *Status and Trends in the Education of American Indians and Alaska Natives*. Washington DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

This report examines the educational progress and challenges of American Indian and Alaskan Native children and adults. It provides demographic information of preprimary, elementary, secondary, and higher education based on race and ethnic groups.

DPI. (2014). *State School Connectivity Profiles* (pp. 1-47) (United States, Department of Public Instruction).

These profiles show the status of schools in 2013 based on states where E-Rate was implemented. There is data on the current structure state and cost of connection. New Mexico is one of the states in this report.

Eisenach, J. A., & Caves, K. W. (2011). *Evaluating the Cost-Effectiveness of RUS Broadband Subsidies: Three Case Studies* (Rep.). Washington DC: Navigant Economics LLC.

George, M., Ortega, F., & Martinez, M. (2005). *State of New Mexico Tribal State: Indian Education Summit Report* (Rep.). NM: State of New Mexico Higher Education Department.

This paper reports on Indian education overall and student achievement data. There are demographics on students, teachers, and administrators as well as higher education and adult education.

Goldstein, M. (2016). *Additional Coordination and Performance Measurement Needed for High-Speed Internet Access Programs on Tribal Lands* (United States of America, Federal Communications Commission, Government Accountability Office). Washington DC.

Horrigan, J. B. (2010). *Broadband Adoption and Use in America* (pp. 1-52, Working paper No. 1). Washington DC: Federal Communications Commission.

As broadband use grows in America, this paper studies its demographics and access points across the country. There is information on cell phone activity and public internet access as well as reasons for not adopting broadband.

Horrigan, J. B. (2009). *Home Broadband Adoption 2009*. Washington DC: Pew Research Center's Internet & American Life Project.

Horrigan complies a large variety of data involving broadband adoption in the home. This information includes trends on home internet connection types, types of broadbands services, monthly costs, broadband in the community, user demographics, and reasons why people opt out of using broadband.

Jorgensen, M., Morris, T., & Feller, S. (2014). *Digital Inclusion in Native Communities: The Role of Tribal Libraries*. Oklahoma City, OK: Association of Tribal Archives, Libraries, and Museums.

This report is rich in information on types of libraries and foundational principles. It talks about the computer and internet availability, electronic resources, internet usage, technology upgrade plans, connection speeds and types, and websites/social media for the tribal libraries. There is also discussion on digital literacy, library funding, and internet needs of patrons.

Kolko, J. (2010). *Does Broadband Boost Local Economic Development*. San Francisco, CA: Public Policy Institute of California.

This report studies the effects of broadband availability on local economic development. There are visuals on broadband speed, activity maps, and a list of broadband providers.

Lenhart, A., Madden, M., & Hitlin, P. (2005). *Teens and Technology: Youth are leading the transition to a fully wired and mobile nation*. Washington DC: Pew Research Center's Internet & American Life Project.

This paper reports on teen internet and technology uses as well as internet activities.

Morris, T. L., & Meinrath, S. D. (2009). *New Media, Technology and Internet Use in Indian Country: Quantitative and Qualitative Analyses* (Rep.). San Francisco, CA: Native Public Media.

This studies the use of multimedia, online IT, online activities, music/radio, video games, and electronic gadgets. There is information on types of internet connection, ISPs, media sharing, information alerts, and cell service.

National Telecommunications and Information Administration. *Broadband Statistics Report: Broadband Availability in Urban vs. Rural Areas*. Washington DC: National Broadband Map.

This is a series of maps and charts that compile speed availability and Urban vs. Rural data sets.

Native American Kids Count. (2012). [2012 NM Kids Count Special Edition]. Unpublished raw data.

This contains data in excel sheets on the child population of Pueblos.

New Mexico Broadband Project. (2011). *New Mexico Broadband Report* (Rep.). NM: 1st-Mile Institute.

This report talks about the New Mexico Broadband Stimulus Awards.

Purcell, K., Heaps, A., Buchanan, J., & Friedrich, L. (2013). *How Teachers are Using Technology at Home and in Their Classrooms*. Washington DC: Pew Research Center's Internet & American Life Project.

These authors talk about how internet and technology is utilized in the classroom. There are specifics on student internet access and teacher internet usage.

Smith, A. (2013). *Civic Engagement in the Digital Age* (Rep.). Washington DC: Pew Research Center's Internet & American Life Project.

Smith ties in the civic engagement and political aspects that relate to internet. He talks about online and offline United States civic engagements, actions, activities, communications, and contributions. There is information on social media's role in networking and politics as well as society's attitude towards social and political issues.

U.S. Census Bureau (2003). *Computer Uses in 2003*. Education and Social Stratification Branch of the Census Bureau.

These graphs hold data on computer and internet access based on households, age, sex and employment. The data was collected from 1984 to 2003.

U.S. Census Bureau. (2005, October 25). American Indian and Alaska Native Heritage Month.

The United States Census Bureau published an article with the demographics and statistics on tribal populations in 2005.

U.S. Congress (1995). *Telecommunications Technology and Native Americans: Opportunities and Challenges* (United States, Congress of the United States, Office of Technology Assessment). Washington DC: U.S. Government Printing Office.

The United States Congress created this report on tribal telecommunication networks. It discusses the uses of telecommunication with Native Americans and the potential opportunities they may bring, especially in the realm of socioeconomic conditions.

U.S. Department of Commerce. (2011). *Exploring the Digital Nation: Computer and Internet Use at Home* (United States, U.S. Department of Commerce, Economics and Statistics Administration). Washington DC: NTIA.

The United States Department of Commerce studied the computer type and internet type of connection in households. The Department also looked into internet connection based on rural and urban demographics.

Zickuhr, K., & Smith, A. (2012). *Digital Difference* (Rep.). Washington DC: Pew Research Center's Internet & American Life Project.

Zickuhr and Smith discuss internet, broadband, and dial-up adoption over time, user demographics, reasons to not use the internet, and reasons for lack of broadband at home. There are demographics on home broadband, online activity, and mobile and smartphone ownership.

Zickuhr, K. (2013). *Who's Not Online and Why*. Washington DC: Pew Research Center.

There are many reasons for people not to choose using the internet. This report talks about those reasons for offline adults, the assistance needed to get online, and the statistics of adult internet use. There is also discussion on home internet use, specifically going into dial-up use.