Home broadband adoption and student achievement: Scenes from an initial examination of households in rural Florida, USA

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Abstract
The United States' broadband network is old, slow, and sparse. Federal investments to extend robust networks to rural areas parallel the U.S. Department of Education's emphasis on improving rural education and technology. Many rural schools received upgraded networks with federal monies, but home broadband is essential for maintaining the home-school learning connection in the face of impending digital textbook adoptions. Despite home broadband growth nationwide, rural residents have lower rates of adoption due to a lack of perceived need. A secondary analysis of home connectivity and middle grades student achievement suggested that students without broadband were also in districts with low student achievement. A lack of home broadband, then, can be possibly detrimental for rural children and further research is imperative.

Introduction
In 2009, the United States federal government allocated $7.2 billion USD to extending broadband to the country's unserved and underserved areas. Of this, $2.5 billion USD was set aside for rural communities and administered through the U.S. Department of Agriculture's (USDA) Broadband Infrastructure Program (BIP). Another $4.7 billion USD funded the National Telecommunication and Information Administration's (NTIA) Broadband Technology Opportunities Program (BTOP) with a special focus on promoting broadband adoption in anchor institutions (i.e., public libraries, governmental agencies, health care institutions, community centers, and schools) in rural areas. Despite current studies that demonstrate broadband's vast potential to transform the daily lives of rural residents by enabling civic, entrepreneurial, personal, and educational applications far beyond what is available to these residents now, broadband adoption still lags and children's access to broadband has been cited as an emerging issue of equal access to educational opportunity.

In early 2011, the Florida Department of Education announced that it would be moving to digital textbooks and digital assessments by 2016. This move will put pressure on schools to not only provide adequate devices and digital resources, but also ensure the school bandwidth is adequate and that home access is possible. Digital textbooks have many benefits, but also pose issues for students who lack home access to computers and adequate connectivity (Mardis, Everhart, Johnston, Baker, & Newsum, 2010).

Research by Everhart and Mardis (2010) demonstrated that U.S. school librarians are responsible not only for managing broadband use in schools, but they are also tasked with making learning resources available beyond the school walls, coordinating the distribution and maintenance of mobile learning devices, and providing professional development to teachers, but that few of them play strong roles in building connections to the community. Related research by the American Association of School Libraries (AASL, 2010) has indicated that school librarians are highly involved in the selection and promotion of digital learning resources. In light of these responsibilities and disconnections, school librarians have the unrealized potential to be key players in engaging parents and community organizations in the promotion of home broadband as well as guiding schools through the transition to digital textbooks and learning materials.

The relationship between home and school technology and broadband is pronounced in rural environments due to the many roles anchor institutions must play in isolated communities. Recent economic challenges have hit rural areas in the United States especially hard, eroding agricultural and manufacturing sectors with profound implications for citizens. As a consequence, rural populations are shrinking and this decline puts pressure on schools to maintain services with diminished tax revenues, state per-pupil allocations, and shrinking enrollment. These rippling economic impacts have led many school districts, especially in Florida, to turn to resources like virtual schooling to provide credit recovery, credit forward, and diversified course offerings. Increased virtual schooling demands greater home broadband.

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Many issues remain as to how to extend transactional deployments of broadband in rural environments to transformational uses of high speed networking (Glasmeier, Benner, & Ohdedar, 2008). Namely, it is not clear that if a network is built, social and economic benefits will come. The aim of this study is to examine the extent to which non-use in Florida's rural communities reflects the state of broadband use throughout the state and attempt to define possible scenarios in which home broadband may relate to the rural students' academic achievement. These aims resulted in three main research questions:

1. What are the reasons for broadband Internet non-use in rural homes with children in Florida? How do these reasons compare to non-rural counties in Florida?
2. What are the possible impacts on rural children in terms of student achievement and technology participation?
3. What are possible implications for school libraries as well as for future research and policymaking?

To achieve these aims, the researcher characterized existing broadband infrastructure in rural areas through a review of research and policy relating to broadband in schools and homes. Then, through exploration of U.S. Census home broadband data for Florid and student achievement data in for Florida's rural schools, the researcher explored possible relationships between home broadband and student achievement. Then, literature and research results were synthesized into recommendations for policy and practice for educators and parents.

Literature Review

Numerous policy reviews have noted that the accelerating rate of children's technology use outside of school has resulted in an agenda for education in which embedded ICT skills, often referred to as 21st Century Skills, are woven into all aspects of learning (Moyle, 2010;)

Broadband in rural U.S. Schools

The digital divide exists in schools in multiple dimensions: access, skill, policy, and motivation (Mardis, Hoffman, & Marshall, 2008). In many schools, bandwidth capacity dictates how teachers integrate the Internet into their classrooms. While 99% of public schools in the United States report having Internet access, classroom connections are less frequent (National Center for Education Statistics [NCES], 2010). Even if classroom access is available, many building-level policies impeded the integration of the Internet into teaching and learning. Many (over 80%) of school connections were not meeting school officials' needs because they were overloaded and poorly managed, leading to slow performance or restricted use (Federal Communications Commission, 2010). For example, in a study done in Michigan, education officials reported having to develop and enforce bandwidth use policies that limited video streaming and other high-capacity uses; the Michigan finding was confirmed by the overwhelming majority (n=934 or 89%) of a nationwide survey of school officials (N=1060) that reported that their networks were too slow to support video streaming (FCC, 2010). This factor influenced teachers' use of the Internet in their classrooms as much as their skills with technology integration (Mardis, 2009). The FCC (2010) noted that poor network performance and problematic connectivity was especially present in rural communities.

Despite the money available for broadband connections in schools, most (n=827 or 78%) of the 1060 school officials surveyed cited that, despite a strong desire to improve their schools' Internet access, a lack a funding for equipment and installation as a barrier (FCC, 2010). For these reasons, adoption is not instant and cannot be assumed. A study in rural Kentucky revealed that targeted marketing to community members and parents was required to gain essential support that led to broadband adoption that would enhance education as well as other community services (LaRose, Strover, Gregg, & Straubhaar, 2011).

More than ever, schools are seen as community anchor institutions, along with health care facilities, public libraries, and other community agencies, in which Internet access is not only a key vehicle for the delivery of services to constituents who may not be able to physically engage with the institution. Indeed, many calls have been made to fundamentally redefine the meaning of schooling and re-envision the infrastructure of education to include immersive experiences, informal opportunities, and greater continuity between home,

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school, and workforce participation, all of which are enhanced by ubiquitous, reliable high speed networks, or "cyberinfrastructure" (National Science Foundation [NSF], 2007).

Broadband for learning. Although school officials rate email as their districts' most important Internet use, many reported that they would be scaling up the use of digital textbooks, handheld devices, and information resources (FCC, 2010). This increased use is sure to add to the pressure on overloaded networks and exacerbate issues with classroom-level implementation, a reality school officials noted in their survey responses.

In public schools in the United States, textbooks are important supports for a number of teaching and learning activities. Textbooks help to standardize the material teachers present in content areas; ensure that classroom content is aligned to mandated curricula; provide a focal point for instructional activities; support pedagogical approaches; and give structure to homework. As technology and Internet have gained presence in classrooms, instructional materials and activities have become digitally rich and the use of digital textbooks is rapidly gaining ground in education at all levels. This lack of physical access is complicated by information needs that occur beyond the school day or in the case of schooling that occurs in a virtual format (Moyle, 2010).

Rural areas are hit hardest by a lack of connectivity, and this rural-to-urban variation has perpetuated a digital divide that once fell solely along economic lines. Increasingly, learning with technology has gone beyond mastering curriculum into real life opportunities like job application, college enrollment, and driver's training. Moreover, bandwidth is a key aspect of parental involvement as many schools have created networks for information distribution through the use of email lists, broadcast messages, and blogs. It is commonplace to access school websites featuring newsletters, calendars, lunch menus, and school and faculty contact information (Mardis, Everhart, Johnston, Baker, & Newsum, 2010). All of this information serves to keep schools in touch with the communities they serve. In rural areas, schools function as community anchor institutions when public libraries are not available or users' language skills cause then to be reticent to engage with a wide range of community sources (Lukenbill & Immroth, 2009).

Home Internet use

Studies have been done on children's reasons for non-use of broadband in homes, but because parents are financial gatekeepers, understanding parental adoption of broadband is key to exploring the nature of children's use (Livingstone, 2003; Livingstone & Helsper, 2007). Over the last decade, home broadband adoption has risen steeply from slightly less than 4% to almost 64% of homes having high speed connections (NTIA, 2010). Broadband adoption has risen to 5.6 million homes despite variations in income, race and ethnicity, gender, employment status, and location.

However, a significant portion of households lacks broadband. The U.S. Census collected Internet non-use data from their 2009 nationwide stratified sample participants and found that, across the years during which data has been collected (i.e., 1997-2009), a persistent 30% of households in rural, town, suburban, and urban locales have not adopted broadband with 23% reporting that they do not use the Internet in any location (12,880 or 23%). As Figure 1 depicts, though non-users in every locale reported cost (10,640 or 19%), lack of connection or computer availability (12,320 or 22%), access elsewhere (560 or 1%), or lack of skill (2240 or 3%), a lack of interest of perceived need (26,320 or 47%) was the dominant reason for not obtaining broadband connections for their homes The remaining participants either declined to answer the question or cited other reasons for their non-use (6160 or 11%) (U.S. Department of Commerce, 2009).

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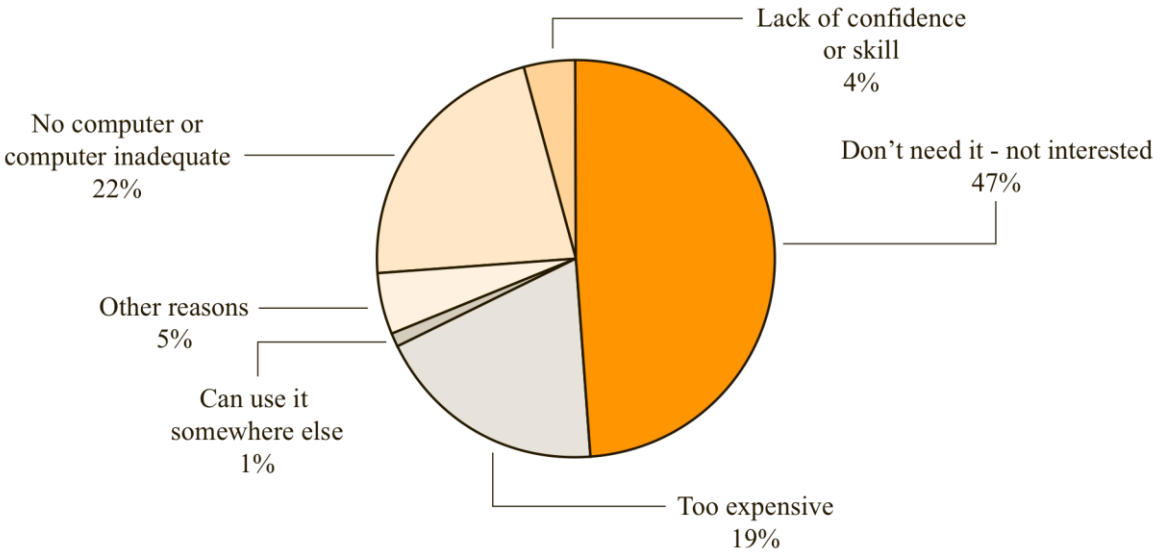

Figure 1. Households in the United States reporting broadband non-use reasons (N=56,000). Chart reproduced from U.S. Department of Commerce (2010).

Home Internet use in rural communities. Despite the increased presence of broadband throughout rural communities that has been credited with the potential expand educational opportunities and contribute to community identity, the extent to which an expansion of broadband has resulted in educational attainment, economic development, workplace retraining, and enhanced services for anchor institutions remains elusive (Schafft, Alter, & Bridger, 2006). It is possible that it is too early to see the culmination of a more educated, rooted, and more socially and civically engaged community, but extensive federal investment in rural broadband is leading to a closer look at broadband's benefits (Klecum, 2008). A study of broadband use in rural counties in Texas revealed that home use was related to the ethnic identity of the family. Hispanic immigrant families were less likely to have home broadband because they felt that the investment was unnecessary and that unsupervised Internet use posed risks to children (Lukenbill & Immroth, 2009). Instead, these families relied on public and school libraries to access information. Another study of Hispanic immigrant families in urban Los Angeles revealed much the same concerns about safety and use elsewhere by parents (Tripp, 2011).

When U.S. Census (2009) data are disaggregated to more closely examine Internet non-use by urban or rural locale (N=12,467), they reveal that, again, the reason for non-use is lack of interest. Table 1 compares Census data reported rates of Internet non-use for urban (n=8902) and rural (n=3469) locales in the entire United States.

Table 1. Comparison of Internet non-use between urban and rural locales in the United States. Table reproduced from U.S. Department of Commerce (2010).

	All		Urban	Rural
Distribution of main reason by households (%)				
Don't need it – not interested	47.2		46.0	51.5
Too expensive	18.6		19.5	15.6
Can use it somewhere else	1.4		1.6	0.7
Not available in area	0.7		0.5	1.1
No computer or computer inadequate	22.3		22.1	23.0
Privacy and security	0.3		0.3	0.3
Concern for children's access	0.1		0.1	0.1
Lack of confidence or skill	4.3		4.5	3.7
Other reasons	5.1		5.4	4.1

The majority of the Census participants reported that they did not perceive a home broadband connection as important (n=5884), lacked a computer (n=2780), or too expensive (n=2319). The least cited reason for not

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having a home broadband connect was concern for children's safety (n=12), a result in contrast to prior studies which reported parents' concerns about children's safety online (Marwick, Diaz, & Palfrey, 2010; O'Keeffe & Clarke-Pearson, 2011). When the data are disaggregated to urban and rural populations, the reasons remain ranked in the same order, although it should be noted that over half (51.5% or 1787) of the rural residents who participated in Census survey felts that home broadband was not important.

These Census findings confirm a series of studies conducted by the Pew Internet & American Life project (Horrigan 2005, 2007, 2008, 2009; Horrigan & Murray, 2006; Horrigan & Smith, 2007; Smith, 2010) which demonstrated that, though broadband adoption was steadily increasing in the United States, it lagged in rural areas and that consistently, a significant portion of residents in all geographic locales who resisted broadband adoption cited a lack of perceived need. The Pew team also found that in their analysis of Census data they found two types of non-users: those who did not use the Internet at all and thus perceived no value in it and those who could use the Internet elsewhere and thus perceived no need to pay for home connection. However, Horrigan (2007) of the Pew team demonstrated that residents who adopted broadband used this enhanced capability to see information unavailable to them through any other means and often, this information helped them to become more informed, active citizens.

Two qualitative studies of rural Pennsylvania broadband use in 2005-2006 (Glasmeier, Benner, Ohedar, & Carpenter, 2008; Schafft, Alter, & Bridger, 2006) lend some insight into the reasons why rural residents may not perceive broadband as important. Adults who participated in the study stated that they had not experienced benefits from broadband in their community, although researchers observed increased parent involvement and civic participation. Researchers recorded positive effects on parental involvement in education and community identity but some purported benefits economic impact, for example, were difficult to determine. Therefore, income-minded rural residents did not recognize the value broadband brought to their communities because they did not experience transactional benefits of broadband for economic benefit and overlooked or did not recognize the value of transformational uses for learning and community building.

These same findings were confirmed in a study of broadband adoption in rural Oklahoma and Kentucky (LaRose, Strover, Gregg, & Straubhauer, 2011). Though the lack of broadband Internet use was often thought by local policymakers in both states to be a matter of a lack of network infrastructure, once broadband connectivity was in place and financial incentives were offered to residents, adoption still lagged due to community members' lack of perception of need for broadband. The research conducted in this area strongly suggested that it is essential that local policymakers promote the importance of broadband for improving the quality and accessibility, particularly in terms of benefits for elementary and secondary education by engaging parents in educational outreach and diffusion efforts (Whitacre, 2010).

Children's Internet use at home: A case study in mixed results from the UK

An average of 36% of youth in the UK have broadband Internet access in their home (Livingstone & Helsper, 2007). When use data are disaggregated in terms of socioeconomic status (SES), the presence of home Internet has compelling effects on student achievement. Livingstone & Helsper noted:

> In other words, children from lower SES homes who have home internet access use it just as much as those from higher SES homes: it seems that providing home internet access in low SES households helps to close the gap in use, potentially reducing disadvantage…SES differences in amount of use disappear if just those with home access are compared…We conclude that providing home access can alleviate but not overcome the relative disadvantage of coming from a low SES household in terms of the breadth of internet use, this warranting continued attention to socioeconomic disadvantage in relation to internet use. (pp.7,12,13).

These findings are not surprising in light on research findings that refute contemporary perceptions that children use the Internet at home purely for leisure purposes (Tripp, 2011) and youth self-reports of engaging in risky online behavior (Livingstone & Helsper, 2010), many researchers have found that the top three reasons children use their home Internet connections in the United States is for school work, gathering information about hobbies, and to communicate with peers (Livingstone & Helsper, 2010; O'Keeffe & Clarke-Pearson, 2011) and that each of these applications offers powerful potential to redress skills and knowledge not gained in school (Livingstone & Helsper, 2010). Enyon (2010), stressed the importance of

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home access to the Internet to support student learning in Britain and affirmed the effectiveness of diffusion efforts in rural areas to decrease the number of non-using children and parents. When parents understood the impact broadband could have on student learning and how student with broadband at home were at an educational advantage, parents in rural areas of the UK were willing to invest in it, even if they had concerns about online safety (Cranmer, 2006).

Results of other research conducted with youth throughout Britain (Selwyn, 2006) yielded surprising results: although students recognized that their home technology environments and their school technology environments were often in stark contrast, for the most part, students accepted their schools as technology-limited environments. They expressed resignation and few expectations that schools could or should be places where technology is integrated widely and deeply. Selwyn's research suggested that students who were "net-savvy" also grew to be "school-savvy;" students saw their schools as places where technology was only as good as its educational applications required. This pragmatism was balanced by children's interest in using technology at home and lack of home technology was seen as a far worse condition that poor school technology (Livingstone, 2003; Lewin, Mavers, & Somekh, 2003).

Despite having access to broadband at home and school, some children in a 2007 UK study remained infrequent or non-users of the Internet (Enyon, 2009). The persistent presence of nonusers was attributed to a lack of perceived need. Lacking opportunities at school, in some instances, children do not develop the capacity to envision how the Internet would help them find information, communicate with others, or entertain themselves (Livingstone & Helsper, 2007). Holmes (2011) affirmed these findings from other researchers and developed a typological model that acknowledged that some children, regardless of access or opportunity, would be low level Internet users, in much the same way some adults remain low level users. However, Holmes' research did not account for geographical location or parental use of the Internet; he merely maintains that not all children will become Internet users.

Home broadband adoption seems to be a matter of perceived value that is expressed through statements of affordability and interest and less a matter of requisite skills or equipment. A synthesis of prior research suggests that regardless of time or context, home broadband has clear advantages for student learning but adoption is hindered by parents' lack of perceived value for use. A lack of home can also extend to children's reluctance to use the Internet at school because they have not experienced online activities enough to understand how they might be helpful or enough skill to confidently accomplish desired tasks. These phenomena were most notably amplified in rural areas even when other predictors of use and student achievement, socioeconomic status, parental educational attainment, and race, were taken into account. Studies of how well Internet use at school related to Internet use at home found that fundamental changes in the types of student activities performed on the Internet was essential to furthering the case for its value at home. These studies pointed to the need for curriculum, not connectivity, to be the constant linking home and school experience for maximum student benefit (Lewin, Mavers, & Somekh, 2003) and that schools, while connection rich, were equipment and management poor, often to the extent of negatively impacting children's experiences with technology at school.

Method

This section details the data and analysis approaches used in the study.

Data Collection and Sample

Two sets of data were analysed: U.S. Census data and Florida Department of Education broadband and student achievement data.

U.S. Census data. The first data set was drawn from the U.S. Census October 2009 Current Population Survey (CPS) (N=54,324) with the CPS October 2009 School Enrollment and Internet Use Supplement (N=12,467). These data were the most current CPS data with the School Enrollment and Internet Use Supplement. The data reflect responses to the Census questionnaires at CENSUS LINK.

The CPS has been conducted monthly for over 50 years. The U.S. Census staff obtains interviews from about 54,324 households monthly, scientifically selected on the basis of area of residence to represent the nation as

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a whole, individual states, and other specified areas. Each household is interviewed once a month for four consecutive months one year, and again for the corresponding time period a year later. This technique enables us to obtain reliable month-to-month and year-to-year comparisons at a reasonable cost while minimizing the inconvenience to any one household. Although the main purpose of the survey is to collect information on the employment situation, a very important secondary purpose is to collect information on demographic characteristics such as age, sex, race, marital status, educational attainment, family relationship, occupation, and industry.

The October 2009 Internet Use Supplement asked each household whether someone in that household used the Internet and what kind of Internet connection technology was utilized at home (the respondent was asked to choose from three options: "dial-up" telephone service, "broadband," or "something else"). The survey also asked households in which no one used the Internet or where a "dial-up" telephone service was utilized, to state their main reason for not using broadband Internet services. Using these data, one can therefore identify households and individuals who use broadband Internet at home to connect to the Internet.

The October 2009 Current Population Survey (ftp://www.bls.census.gov/pub/cps/basic/200901/oct09pub.dat.gz) and 2009 Internet Use Supplement (ftp://www.bls.census.gov/pub/cps/supps/oct09pub.dat.gz) data set were downloaded from http://www.bls.census.gov/cps_ftp.html. The questionnaires used for each data set were included in the documentation for the 2009 CPS (ftp://www.bls.census.gov/pub/cps/basic/200901/jan09dd.txt) and in the October 2009 School Enrollment and Internet Use Tech Documentation (http://www.census.gov/apsd/techdoc/cps/cpsoct09.pdf).

Florida student achievement and school broadband data. The second set of data was compiled from publicly available student achievement data from the State of Florida Department of Education (http://fcat.fldoe.org/results/default.asp) integrated with data obtained from the Florida Department of Management Service (http://www.dms.myflorida.com/index.php/content/download/61612/264749/version/1/file/FL+School+District+Broadband+Data.xls).

To ensure consistent time frames of analysis, student achievement and connectivity data from 2009 were used. Connectivity includes information about the district including its 2009 enrollment, the number of school buildings in the district, the district per pupil expenditure, the speed of the connection coming into the district in megabits per second (mbps), the number of connections that branch off the district connection, and the 2009 cost for that connection.

The student achievement data reports results of The Florida Comprehensive Assessment Test®, which measured student success with the Sunshine State Standards in reading and mathematics (grades 3-10), science (grades 5, 8, and 11), and writing (grades 4, 8, and 10). This study will report reading scores, as they are a common proxy of student achievement in Florida (Baumbach, 2004).

Sample

Because the Census data set represented a nationwide sample, the researcher narrowed the data set just to include data collected in Florida. These data were then grouped by county. Florida is one of the few states in the United States for which each county represents a school district. That is, Florida has 67 counties and thus 67 school districts. Using the U.S. Department of Education's National Center for Education Statistics (NCES) Common Core of Data tool, the researcher determined the locale designation for each county/school district. The Appendix 1 depicts the entire data set (N=40) ultimately used in this study's analyses organized by counties/school districts (n=5). The Appendix 1 includes case number, race, income, employment status, parent educational attainment, number of children in the household, school levels of children in the household.

Data Analysis

The size of the data set limited the number of statistical tests that could be reasonably used. For this reason, the researcher decided to analyze the data set with frequencies and then visually inspect the data set for patterns that were either remarkably consistent with or in contrast to literature findings.

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Limitations

This study has a number of limitations that must be acknowledged. First, the data sets are drawn from 2009 and the data may not take into account a number of recent federal initiatives to fund broadband in rural areas and any Internet developments in the last two years that could have raised demand. Second, the study sample is small and this hinders. Third, the U.S. Census stratified sample excludes highly rural counties in Florida, so results presented here may not be typical of all rural communities. Finally, this research was designed to be highly exploratory and not to draw definitive conclusions.

Findings

This section will present the findings of analyses of Census data relating to broadband non-use among all Florida participants and then separately by participants in non-rural and rural school districts. After a closer examination of rural participants with children, the section will conclude with a characterization of broadband and student achievement in Florida's rural school districts.

Broadband non-use by Census participants in Florida

As the Appendix 1 illustrates, the Census data contained only 40 of 297 cases from participants who did not have broadband at home who also lived within the boundaries of school districts. Table 2 illustrates the school district locales in Florida included in the Census data.

Table 2. Reasons by broadband use given by Census participants in Florida organized by school district locale (N=297).

Reason for not using broadband at home	NCES District Locale					
	City: Midsize	City: Small	Suburb: Large	Suburb: Midsize	Rural: Fringe	Total
Don't need it, not interested	4	2	15	0	6	27
Too expensive	5	4	82	12	20	123
Can use it somewhere else	1	7	32	2	7	49
Not available in area	0	0	4	0	0	4
No computer or computer inadequate	3	0	57	0	5	65
Concern for children's access	0	1	2	0	0	3
Other reasons	2	0	21	1	2	26
Total	15	14	213	15	40	297

Census participants who lived within the boundaries of districts classified as various sizes of "City" or "Suburb" districts comprised 87% (n=257) of the Census participants. Their main reasons for not obtaining broadband service were that it was too expensive

Non-rural users compared to rural users. Although, as Figure 2 shows, main reason participants in non-rural areas reported for not adopting home broadband was that it was too expensive (n=103). Not having adequate computer access (n=60), access to the Internet elsewhere (n=42), not feeling home broadband was important (n=21), or other reasons comprised the majority of the remaining reasons (n=24) while no availability in the area (n=4) and concern for children's safety (n=3) were much less frequently stated reasons for not adopting home broadband.

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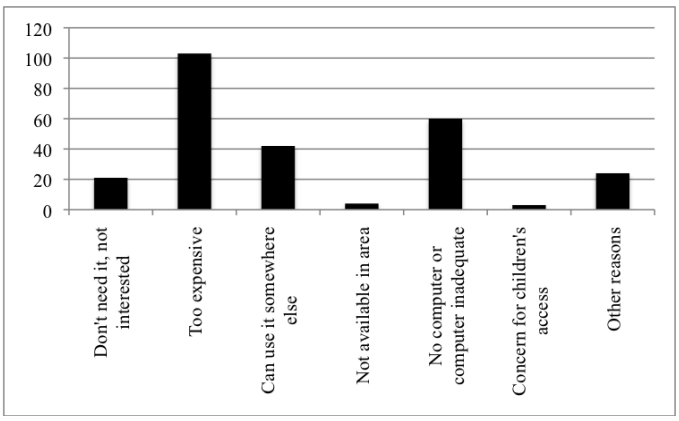

Figure 2. Broadband non-use reasons provided by Census participants in Florida non-rural school districts (N=257).

In comparison, when Census participants in Florida's rural school districts (N=40) were asked for their reasons for not adopting broadband, they also responded that home broadband was too expensive (n=20); they could use it somewhere else (n=7); they did not perceive it to be important (n=6); their computer was adequate (n=5), and other reasons (n=3). No respondents answered that broadband was not available in their area and that their decision not to adopt it centered on concerns for their children's safety online.

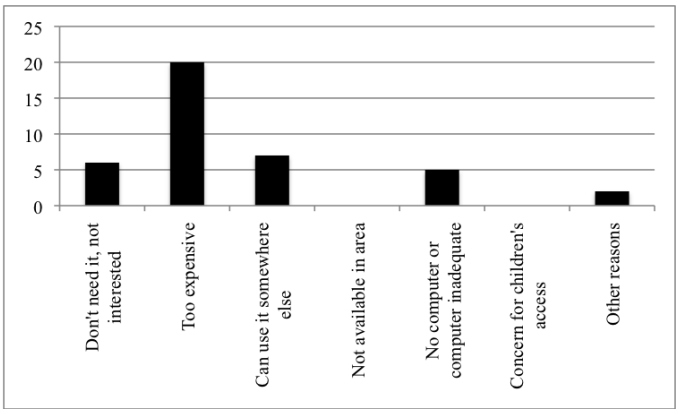

Figure 3. Broadband non-use reasons provided by Census participants in Florida rural school districts (N=40).

Rural users with children. Because the intent of this analysis was to determine home broadband's use for children, cases in which households reported having children were examined more closely. Table 3, a subset of the data presented in the Appendix, presents the Census participants in rural districts with children (n=6). For each participant, the table reports the school district, case number from the Appendix, race, employment status, annual family income, highest level attained by parent, number of children under age 18, school grades of children, and the reason given for not adopting home broadband.

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Table 3. Census participants in rural school districts with children who report reasons for not having broadband at home.

County/ District	Case	Race	Employed	Income (USD)	Parent education	Child < 18	Grade	Reason for no broadband
Lee	LE3	Hispanic	Yes	40000-49999	< 1st grade	1	7	Too expensive
	LE5	Hispanic	Yes	< 5000	< 1st grade	1	6	Too expensive
	LE6	Hispanic	Yes	< 5000	< 1st grade	1	7	Too expensive
	LE13	Hispanic	Yes	25000-29999	Some high school	1	8	No computer/computer inadequate
Marion	MA3	Hispanic	Yes	< 5000	Elementary	1	9	Too expensive
St. Johns	SJ2	Black	Yes	30000-34999	Some college	1	9	Too expensive

The respondents in this group were U.S. citizen born in the United States and represented minority groups with five stating that they were Hispanic and one who self-identified as Black. They were all employed, but their family incomes ranged from less than $5000 USD (n=3) to $25,000-$29,999 USD (n=1) to $30,000-$34,999 USD (n=1) between $40,000-$49,999 USD (n=1). Many (n=4) had less than a high school education while two other respondents in this group attended high school or college. These six households only reported one child per household younger than 18 years old; all children were in grades 6-9, meaning that they were between approximately 12 and 15 years old.

School district connectivity and student achievement

School district and student achievement data were compiled for the five counties in which respondents with children reported not using broadband in their homes. Appendix 2 illustrates each of the district attended by the children of the Census respondents who did not have broadband at home. The table reports the district enrolment, number of schools per district, district per pupil expenditure, current connection in megabits per second, speed to district (mbps); number of connections networked in school district; and annual connection cost. For each county's student achievement data, the table reports grade level; number of students tested; percent of students in poverty; percent of students who achieved levels 3-5; percent of white students who achieved levels 3-5; percent of black students who achieved levels 3-5; and percent of Hispanic students who achieved levels 3-5.

As Appendix 2 shows, district connectivity differs vastly across the districts in the 3 counties reflected in Table 3. The Lee county school district has the slowest connection speed at 6 mbps for 125 schools at an annual cost of $19,019.28. Marion and St. John's each had 45 mbps connections with 68 and 41 schools respectively with an annual cost of $51,355.80. All districts showed lower reading achievement among minority students and this problem uniformly worsened as children were tested at higher grades. Minority student achievement was lower in Lee versus Marion and St. Johns counties, even though Lee had higher per pupil expenditures and slightly lower rates of poverty. District expenditures and poverty levels are predominant indicators of student achievement (Baumbach, 2004), but in this instance when achievement appears to be positively related to broadband speed as well, this factor was worth consideration.

Conclusion

Early results of this exploration suggest that conditions in Florida's rural communities are consistent with prior research, but some a small number of interesting differences to consider. Note that as pointed out in the Limitations section, these conclusions should be tempered since the sample for this study was small and the investigations were meant to be preliminary,

In response to the first research question, "What are the reasons for broadband Internet non-use in rural homes with children in Florida? How do these reasons compare to non-rural counties in Florida," results from the small sample of Census participants suggest that regardless of income level, Florida's rural and non-rural residents do not subscribe to broadband because they perceive it to be too expensive. Many participants mentioned that they did not perceive broadband to be important or did not have adequate

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computer technology. As found in empirical studies of rural communities in Kentucky, Oklahoma (LaRose, Strover, Gregg, & Straubhauer, 2011), and Pennsylvania (Glasmeier, Benner, Ohedar, & Carpenter, 2008; Schafft, Alter, & Bridger, 2006), and the UK (e.g., Enyon, 2009), residents required a demonstration of clear financial benefit to their communities before they perceived broadband as important even if benefits to education and community identity were readily apparent. A delay between availability and adoption is not unusual and initial rejections of efforts to close the digital divide are often based on perceived expense (Newholm, et al, 2008). The findings of this study potentially confirm that Florida's rural communities require outreach targeted at specific benefits to build desire to have broadband in their homes.

Research question two asks, "What are the possible impacts on rural children in terms of student achievement and technology participation?" However, research also suggested that adopting broadband had cultural roots as well (Lukenbill & Immroth, 2009). That is, research has demonstrated that Hispanic households in which parents traditionally prized time spent working over personal discovery on the Internet (Tripp, 2011) resulted in parents' lack of understanding of the Internet's educational advantages. If this happens to actually be the case, an examination of the broadband access available in the respondents' school districts suggests that school access is likely infrequent and slow. While some districts are worse off than others, Lee county, the district from which 4 of the 6 in-depth examinations illustrated in Table 3 were drawn, splits a single 6mbps connection 89 ways and then connects at least 125 school buildings. This connection plan means that for this district, the best-case scenario for building-level connectivity is about 49Kbps per second, or slower than a 56K dial-up modem.

As a result or perhaps by coincidence, student achievement in reading in these districts flags as children progress through school, regardless of district per-pupil expenditure or poverty level for the district. More in depth research is required to determine how exactly home broadband could offset this decline, but Florida's impending move to digital textbooks is likely to bring the issue to the foreground. Parents who had never considered an Internet connection important for their household may be forced to reconsider if their children's academic success and ability to complete homework is dependent upon an Internet-connected device.

Finally, in this study, the researcher considered the possible implications for school libraries as well as for future research and policymaking. Because the families with children who did not adopt broadband because it was too expensive were all minorities and minorities show diminished academic achievement, policymakers should use initiatives like digital textbooks to target this achievement gap and equip minority students with the technology and opportunities to make learning a seamless home to school continuum. In all probability, this effort will require cultivating community buy-in for the importance of broadband and computer expenditures to support student achievement, particularly at the secondary level (grades 6-12).

In their roles as school leaders, school librarians provide the technology coordination, support, and leadership necessary to address access issues. As one of the only faculty members who works across curriculum areas and grade levels, the school librarian has unique knowledge of classroom activities throughout the schools and places in which technology would enhance learning. Moreover, it is the school librarian who often provides desktop-level technology support and liaises with district-level technology staff to identify the needs of teachers and students. The school librarian has a number of roles to play in the deployment of digital textbooks and the research presented here and conducted by others suggests that an often-neglected role is helping parents understand how broadband can be used at home to enhance children's learning.

Three key learnings:

- Reasons for not adopting home broadband center on parents' perceptions of expense and need. Adults require clear definition of economic benefit to change perceptions;
- Rural school districts with stronger broadband connections also have stronger student achievement in reading even when district per pupil expenditure and poverty are considered. However, research suggests that a home-school connectivity continuum is important;
- Further research is needed to more strongly define the relationship between locale, home broadband adoption, and student achievement. Florida's move to digital textbooks by 2016 provides an opportunity

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to collect data and draw more specific conclusions that can impact similar initiatives throughout the world.

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Statement of Originality

This statement certifies that the paper above is based upon original research undertaken by the author and that the paper was conceived and written by the author alone and has not been published elsewhere. All information and ideas from others is referenced.

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Appendix 1. Detailed description of cases in sample.

County	Case	Race	Employed	Income (USD)	Parent education	Child < 18	Grade	Reason for no broadband
Lake (n=6)	LA1	White	Yes		High school	1		Don't need it/not interested
	LA2	White	Yes		High school	1		Don't need it/not interested
	LA3	White						Don't need it/not interested
	LA4	White	Yes	5000-7499	High school			Don't need it/not interested
	LA5	Black	No		High school			Too expensive
	LA6	White	Yes	25000-29999	Associate degree			Too expensive
Lee (n=18)	LE1	Hispanic	Yes	40000-49999	High school	1		Too expensive
	LE2	Hispanic	Yes	40000-49999	High school	1		Too expensive
	LE3	Hispanic	Yes	40000-49999	< 1st grade	1	7	Too expensive
	LE4	Hispanic	Yes	< 5000	< 1st grade	2		Too expensive
	LE5	Hispanic	Yes	< 5000	< 1st grade	1	6	Too expensive
	LE6	Hispanic	Yes	< 5000	< 1st grade	1	7	Too expensive
	LE7	White	Yes	30000-34999	Some college	0		Can use it somewhere else
	LE8	White	Yes	30000-34999	High school	0		Can use it somewhere else
	LE9	White	Yes		High school	0		Other reasons
	LE10	White	Yes		Some college	0		Other reasons
	LE11	Hispanic	Yes	25000-29999	< 1st grade	3		No computer/computer inadequate
	LE12	Hispanic	Yes	25000-29999	< 1st grade	3		No computer/computer inadequate
	LE13	Hispanic	Yes	25000-29999	Some high school	1	8	No computer/computer inadequate
	LE14	Hispanic		25000-29999				No computer/computer inadequate
	LE15	Hispanic		25000-29999				No computer/computer inadequate
	LE16	Black	Yes		High school	1		Can use it somewhere else
	LE17	Black	Yes		Some college	1		Can use it somewhere else
	LE18	Black						Can use it somewhere else
Marion (n=5)	MA1	White	Yes	15000-19999	Some high school	0		Can use it somewhere else
	MA2	White	Yes	15000-19999	High school	0		Can use it somewhere else

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	MA3	Hispanic	Yes	< 5000	Elementary	1	9	Too expensive
	MA4	Hispanic	No	< 5000	Elementary	0		Too expensive
Marion	MA5	Hispanic	Yes	< 5000	Some college			Too expensive
Osceola (n=8)	OS1	White	Yes	75000-99999	High school	0		Don't need it/not interested
	OS2	White	Yes	75000-99999	High school	0		Don't need it/not interested
	OS3	Hispanic	Yes	7500-9999	High school			Too expensive
	OS4	Hispanic	Yes	40000-49999	Middle school	0		Too expensive
	OS5	Hispanic	Yes	40000-49999	Some high school	0		Too expensive
	OS6	Hispanic	Yes	40000-49999	High school	2		Too expensive
	OS7	Hispanic		40000-49999				Too expensive
	OS8	Hispanic		40000-49999				Too expensive
St. Johns (n=3)	SJ1	Black	Yes	30000-34999	High school	1		Too expensive
	SJ2	Black	Yes	30000-34999	Some college	1	9	Too expensive
	SJ3	Black		30000-34999				Too expensive

Shaded areas represent questions to which participants did not provide responses.

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Appendix 2. County details of school district connectivity and student achievement

County/ District (Enrollment)	Schools Per District	District Per Pupil Expenditure 2009	Current Connection to District (mbps)	Number of Connections in School District	Annual Broadband Cost	Grade	Number of Students Tested	% Students in Poverty	% Students Levels 3-5	% White Students Levels 3-5	% Black Students Levels 3-5	% Hispanic Students Levels 3-5
Lee	125	$7,347	6	89	$19,019.28	6	5996	56	66	75	46	58
(634,375)						7	5557	56	67	76	46	59
						8	5588	43	54	66	32	34
						9	5379	35	46	56	24	34
Marion	68	$7,066	45	51	$51,355.80	6	3095	60	67	73	52	59
(328,656)						7	3095	57	65	71	49	56
						8	3295	40	51	59	30	43
						9	3158	36	46	53	25	38
St. Johns	41	$7,215	45	34	$51,355.80	6	2193	58	79	82	54	72
(178,025)						7	2267	56	80	82	55	68
						8	2266	44	69	72	38	63
						9	2266	35	62	66	25	54

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