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# Beyond the Glow: Children's Broadband Access, Digital Learning Initiatives, and Academic Achievement in Rural Florida

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The United States has one of the highest levels of Internet penetration in the world, but still has 50 million Internet non-users, many beyond the glow of urban areas. A persistent level of non-adoption stems from adults' lack of perceived need or benefit. Florida's unique move to all digital instructional materials and required online testing and course-taking in 2015 makes home broadband essential for maintaining a learning continuum. To date, little work has been done to determine the degree to which children have continuous access to broadband. In this paper, I present secondary analyses of Census, NTIA, student achievement, and school district data to discover possible connections between broadband access and learning. Results revealed lack of perceived need was the overriding factor for no home broadband. While neither school broadband nor community and district characteristics had significant relationships to one another or to student achievement, rurality had an unmistakable correlation, suggesting that children in rural homes that lacked broadband could be especially disadvantaged. Although existing data sets are imperfect and difficult to compare, initial explorations suggest that Florida's digital learning initiatives will benefit from widespread broadband in rural homes.

Rural America exists beyond the glow of city centers—an often in the shadow of the economic innovation and social amenities found in urban and suburban areas. In an effort to boost rural community development, in August 2015, the United States Federal Communications Commission (FCC) announced $1.5 billion to extend broadband to the country's unserved and underserved rural areas.[1] Still, despite a decade of significant investments by FCC and the U.S. Department of Agriculture (USDA)[2], over half of all rural Americans lack access to broadband service (FCC, 2015) and a vast majority of rural schools still lack access to fiber or mobile networks capable of delivering the connectivity capacity and speed required to support digital learning (Wheeler, 2014).

Schools in rural communities have experienced rippling economic impacts such as shrinking populations, diminished tax revenues, declining state per-pupil allocations, and chronic under-enrollment (Howley & Howley, 2014; Jimerson, 2006). With more than half of all school districts (57%) located in rural areas, over 12 million students, or approximately 24% of our nation's schoolchildren, attend rural schools (National Center for Education Statistics [NCES], 2013). Many school district administrators have turned to virtual schooling to cut costs and provide services (Cavanaugh, Barbour, & Clark, 2009; Provasnik et al., 2007). However, children's access to broadband has been cited as an emerging issue of equal access to educational opportunity nationally (FCC, 2011; Horrigan, 2015), but the need to address this issue has recently gained even more importance due to increasing national emphasis on digital learning materials and virtual schooling (Fox, Waters, Fletcher, & Levin, 2012; SETDA & Education Counsel, 2014).

In 2013, Florida's Governor Rick Scott signed into education statute that all public schools use virtual schooling, online testing, and entirely digital learning materials. This move is significant because not only because Florida has a large, diverse, and socioeconomically challenged rural student population and but also because Florida's mandate is the most ambitious and inclusive measure to date (Mardis & Everhart, 2013) in a a benchmark textbook adoption state (Mickey & Meaney, 2010). Because Florida has uniquely created a need for rural households with school aged children to have broadband, two main research questions guided the investigation of this problem:

1. What are rates of and reasons for broadband non-adoption among households with children in Florida? How does broadband non-adoption relate to income, parent educational attainment, income disparity, race, and locale?

1 FCC (2015, August 27). Carriers accept over $1.5 billion in annual support from Connect America fund to expand and support broadband for nearly 7.3 million rural consumers in 45 states and one territory. Retrieved from https://apps.fcc.gov/edocs_public/attachmatch/DOC-335082A1.pdf

2 USDA (2015, May 29). USDA announces funding opportunity for distance learning and telemedicine projects. Retrieved from http://www.rd.usda.gov/newsroom/news-release/usda-announces-funding-opportunity-distance-learning-and-telemedicine-projec-5

2. To what extent do schools provide broadband access to children in Florida's rural counties? How might broadband availability relate to student achievement?

Through an exploration of data from the 2013 U.S. Census, the National Broadband Map, and the Florida Department of Education, the researcher sought to explore children's home broadband access and digital readiness of Florida's children.

## LITERATURE REVIEW

### Broadband in K-12 Schools

Schools can function as community anchor institutions, along with public libraries and other community centers, in which Internet access is a key vehicle for the delivery of services inside and outside of their physical boundaries. Broadband's importance is accelerating to the point which it has been described as "vital a component of K-12 school infrastructure as electricity, air conditioning, and heating" (Fox et al., 2012, p. 1). However, not all schools are poised to distribute their services due to inadequate connectivity (FCC, 2010a). In rural areas, this paucity can be especially frustrating because schools are often the only sites of broadband Internet access because public libraries or community centers may not be easily accessible to children (Lukenbill & Immroth, 2009).

In many schools, broadband dictates how well teachers integrate the Internet into their classrooms to promote 21st Century skills. While 99% of public schools in the United States reported having Internet access, classroom connections are less frequent (NCES, 2011). Even if classroom access were available, many building-level policies to manage bandwidth impeded the integration of the Internet into teaching and learning (FCC, 2010a). Many (over 80%) of school connections were not meeting school officials' needs because they were overloaded and poorly managed, leading to slow performance or restrictive network management practices (FCC, 2010a) or a lack of teacher innovation (Hunt-Barron, Tracy, Howell, & Kaminski, 2015). 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 of school officials nationally who reported that their networks were too slow to support video streaming (FCC, 2010a). Broadband influenced teachers' uses of the Internet in their classrooms as much as their skills with technology integration (Mardis, 2009).

Although school officials rated email as their districts' most important Internet use, many reported that they would like to scale up the use of digital instructional materials, mobile devices, and wireless networks (Project Tomorrow, 2011). Many district officials reported that their building speeds were about 25% of the recommended speeds of 100 megabits per second (MBPS) (Fox et al., 2012) and that they lacked the funds to upgrade them (FCC, 2010a). Increased pressure on overloaded connections hinders technology implementation, a reality school officials noted in their FCC survey responses and a view that was confirmed in a recent survey of rural elementary school teachers (Howley, Wood, & Hough, 2011). FCC (2010a) survey respondents noted that poor network performance and problematic connectivity were especially present in rural communities. Funding was available for broadband connections in schools, but most school officials noted that, despite a strong desire to improve their schools' Internet access, a lack a funding for equipment and installation was a barrier.

## Home Internet Use in Rural Communities

Nationally, nearly half of rural residents reported that home broadband was not important. Over time, U.S. households without the Internet at home have most often cited a lack of need or interest as the main reason why they did not go online at home. Although 48% of non-using households gave this reason in both 2011 and 2012, the figure rose from 39% in 2013. This percentage was significantly larger than the percentage of rural respondents who reported that a home broadband connection as too expensive, unavailable in their area, or used elsewhere (FCC, 2015).

Although far fewer rural users use their mobile devices to use the Web (NITA, 2014), the percentage of respondents who reported concerns about online safety was not even large enough to merit a reporting category, a result in contrast to other studies that reported strong parental concerns about children's safety online (Lukenbill & Immroth, 2009; Marwick, Diaz, & Palfrey, 2010; O'Keeffe & Clarke-Pearson, 2011; Tripp, 2011). These levels of and reasons for non-adoption mimic the results of the 2009 U.S. Census (NTIA, 2010). As with the 2009 Census, rurality, more than household income, racial and ethnic identity, availability, or access elsewhere, seems to have a relationship to broadband non-adoption (NTIA, 2011). Location seems to trump the "social envelope" that usually relates to investments home technology (Attewell & Battle, 1999; Warschauer & Matuchniak, 2010) with fewer rural residents sensing personal, social, or economic benefit. The research conducted in community adoption has strongly suggested that it is essential that local policymakers promote the importance of broadband for improving quality of life, particularly by engaging parents in educational outreach and diffusion efforts (Whitacre, 2010). Studies of homes and communities in Florida affirmed a lack of perceived need among rural residents (Mardis, 2011) but also suggested that a rural community officials and residents lacked an awareness of opportunities missed due to slow connections (Carmichael et al., 2012).

**Children's broadband use at home.** Householders with school-age children who lacked home Internet service were 7% less likely to report they did not need to use the Internet at home at 47%, compared to 54% of householders without school-age children (NTIA, 2014). This disparity between school and home broadband Internet has created a "homework gap," that disproportionately affect low income and rural students (Horrigan, 2015). However, little available research documents home Internet use by children in the United States, especially in rural locales. Research conducted in the United Kingdom (U.K.) may provide some insights. Three quarters of U.K. homes have broadband Internet access (Ofcom, 2011) and its presence has a compelling relationship with student achievement, regardless of family wealth (Livingstone & Helsper, 2007). These findings are not surprising in light of other research that refutes contemporary perceptions that children use the Internet at home purely for leisure purposes (Davis, 2015; Tripp, 2011) or for engaging in risky online behavior (Livingstone & Helsper, 2007). Many researchers have found that children use their home Internet connections for school work, to gather information about hobbies, and to communicate with peers (O'Keeffe & Clarke-Pearson, 2011; Helsper, van Deursen, & Eynon, 2015) and that these uses can redress skills and knowledge not gained in school (Livingstone & Helsper, 2010). Enyon (2010) stressed the importance of home access to the Internet to support student learning and affirmed that when rural parents understood the benefits of broadband for learning, they were willing to invest in it, even if they had concerns about online safety (Cranmer, 2006; Ofcom, 2009). As researchers associated with the EUKidsOnline project concluded, "[W]e have to face that living in remote areas may still lead to disadvantage due to expensive and slow, or even not existing internet connections. Such a situation prevents opportunities and promotes exclusion" (Paus-Hasebrink, Sinner, & Prochazka, 2014, p.9).

### Mobile Learning in Rural Contexts

A fixed definition of mobile learning is often that of learning activities that are conducted via mobile devices such as smartphones and tablets. However, because mobile learning allows for a personalization of learning that is impossible with desktop computing, it also includes the socio-technical, socio-material, and socio-cultural contexts in which the learning occurs and the way instruction is designed and delivered (Kukulska-Hulme, 2010). The body of children's mobile learning research upon which to draw is relatively small and composed of limited, single site case studies. The rapid evolution of mobile devices has caused problems for meaningful longitudinal work because they become obsolete quickly (Kim et al, 2011). Cultural issues have also prevented the widespread use of mobile devices in educational institutions and healthcare. Seen as disruptive, distracting or causing privacy issues, management policy in many such settings has been one of blanket bans. Research is further frustrated by the growing prevalence of “bring your own device” or “BYOD” policies that enable students to bring their personal devices to school for learning activities (Davis 2015; Jones, Fox, & Neugent, 2015)

Still, mobile devices with cellular Internet connections are becoming increasingly common and have been reported to be gaining traction among teachers and students in rural schools (Hassell & Dean, 2015). While mobile may have shown promise as a solution, scaling challenges remain. Applications to allow mobile users to perform school-related activities equivalent to what can be accomplished on fixed or laptop computers are often unavailable. Rural technology leaders have reported that they lack access to adequate mobile service to offset their challenges with fixed network connections (CoSN, AASA, & MDR, 2014); mobile devices are not a panacea for the lack of robust, reliable rural broadband.

## METHOD

This investigation of home broadband, school broadband, and the relationship between home and school broadband, justified the researcher’s three investigations:

Analysis 1: Examination of U.S. Census School Enrollment and Internet Use Supplement data for Florida;

Analysis 2: Examination of NTIA-provided National Broadband Map program data for Florida;

Analysis 3: Examination of National Broadband Map data, Florida public school district broadband speeds, enrollment demographics, district characteristics, and district achievement data.

## Data Collection and Sample

This study was not designed to be exhaustive, but to provide a snapshot of home broadband adoption and student achievement in Florida. As such, the timeframe of the data was limited to 2013, the most recent common year for the data sets. Note that Florida has one school district per county. Counties and school districts bear the same names and represent equivalent geographic areas.

**U.S. Census data.** The data set for Analysis 1 was drawn from the U.S. Census October 2013 Current Population Survey (CPS) School Enrollment and Internet Use Supplement for Florida residents who reported having school-age children (N=70). The questionnaires used for each data set were included in the documentation for the 2010. The October 2010 Internet Use Supplement includes data that reflect the type of Internet connection utilized at home. The survey also asked respondents 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. Because the U.S. Census data set represented a nationwide sample, the researcher narrowed the data set just to include cases in Florida that included county identifiers, were households that had children enrolled in school up to grade 12, and responded to the Internet Use Supplement.

The 2013 county Gini index, part of the U.S. Census American Community Survey (ACS) variable was added to this data set. The Gini index reflects the inequality among values of income distribution. A Gini index of zero is where all of the income values are the same; a Gini index of one reflects maximum inequality in income.

**National Broadband Map data.** Analysis 2 involved National Broadband Map data collected and maintained by the NTIA and in partnership with each state. These data are organized by Census block and contain information that Internet Service Providers (ISPs) provide about the number of actual broadband customers they have within a given state area. National Broadband Map Census block counts were totaled by county for Analysis 2 and Analysis 3.

**State for Florida data.** Analysis 3 augmented NTIA data with data regarding school district (N=67) characteristics, student achievement, and broadband data compiled from these publicly available sources:

1. The State of Florida Department of Education (FLDoE) provided student enrollment, national school lunch program (NSLP) eligibility, student achievement, and district grade data for 2012-2013 school year. The student achievement data includes district level passing rates on The Florida Comprehensive Assessment Test (FCAT) 2.0 for the 2012-2013 school year. Analysis 3 used reading, writing, mathematics, and science scores from grade 8, as they are a common proxy of district student achievement in Florida (Baumbach, 2004). FLDoE assigns district letter grades based on overall district FCAT performance
2. The National Center for Education Statistics (NCES). Data from this agency included 2013 Florida school district locale and number of buildings per district located with the agency's Common Core of Data School Search tool.
3. The Florida Department of Management Services (DMS). DMS handles school district applications for federal e-Rate connectivity financial assistance. DMS provided 2012-2013 district broadband speed data directly to the researcher.

## Data Analysis

For Analysis 1, the researcher conducted a secondary analysis of U.S. Census CPS School and Internet Use Supplement survey data. The size of the data set limited the number of statistical tests that could be reasonably used. For this reason, the researcher visually inspected the results for patterns that were either remarkably consistent with or in contrast to literature findings. Analysis 2 was also a secondary analysis and involved visually analyzing frequencies. Analysis 3 included two secondary analyses of quantitative data. First, bivariate correlations between county broadband non-adoption levels and district variables were performed. Once significant correlations were identified, the researcher built regression models of the significantly correlating variables along with community and district factors.

## FINDINGS

### Analysis 1. Reasons for and Characteristics of Household Broadband Non-Adoption in Florida as Reported by the U.S. Census

Approximately 3778 Census School Enrollment and Internet Use Supplement survey respondents in Florida reported having children enrolled in school. Although the vast majority of Florida's parents report having a computer (n=2945 or 78%) and Internet access at home (n=2820 or 74.6%), the purpose of this section is present analyses of the 70 households that reported reasons for not having broadband.

**Reasons for broadband non-use.** The two major reasons respondents (N=70) reported for not having broadband at home were that "Don't need it/ not interested" (n=33; 47%) and that it was too expensive (n=28; 40%). A considerably smaller number (n=7; 10%) reported that it was not available in their areas. Only two respondents reported that they could access broadband elsewhere or had other concerns. These responses were disaggregated to examine reasons given for not having broadband in the home by major demographic predictors of broadband use in established by other studies.

**Household annual income and income disparity.** Seventy respondents without home broadband reported their annual income to the Census survey. As Figure 1 depicts, most respondents reported not having broadband at home was that they did not feel that they needed it (n=32). Slightly fewer (n=28) felt as though they could not afford the service. Respondents in higher income brackets mainly reported that broadband was not available in their areas (n=4).

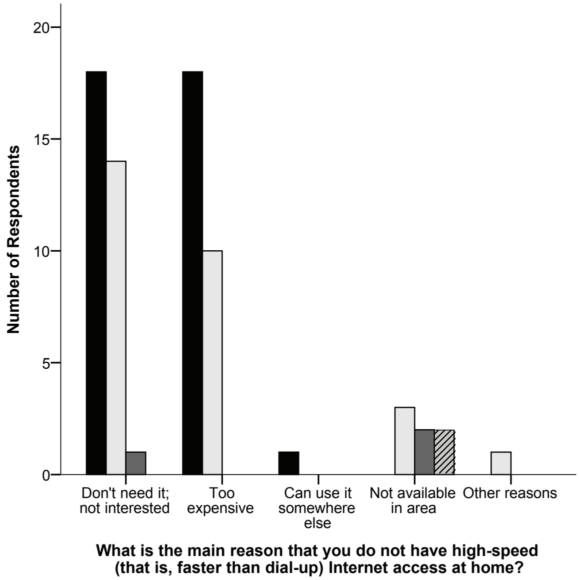


**Figure 1.** Respondents' reasons for not adopting broadband by income range (N=70).

In an effort to determine view annual income in the context of respondents' communities, respondents' relative wealth was examined. The U.S. Census reports the Gini index, a summary measure of income inequality, or the difference between the highest and lowest incomes in an area by quintile. The Gini index varies between zero (Quintile 1) and one (Quintile 5); the higher the Gini index, the wider the gap between rich and poor residents in a community. The Census reported Gini indexes in quintiles that were then compared to broadband non-adoption reasons, as seen in Table 1 (N=56).

**Table 1**

Broadband non-use reasons by county income disparity and annual income (N=56).

| Gini Quintile | Annual Income (USD) | Broadband Non-Use Reason | | | | Total |
|---|---|---|---|---|---|---|
| | | Don't need it; not interested | Too expensive | Not available in area | Other reasons | |
| 1 (.461-.645) | <5000-34999 | 14 | 7 | 0 | - | 21 |
| | 35000-59999 | 7 | 5 | 1 | - | 13 |
| | 60000-99999 | 1 | 0 | 0 | - | 1 |
| 2 (.439-.460) | <5000-34999 | 1 | 3 | 0 | 0 | 4 |
| | 35000-59999 | 5 | 3 | 0 | 1 | 9 |
| | >100000 | 0 | 0 | 2 | 0 | 2 |
| 3 (.422-.438) | 35000-59999 | 2 | - | - | - | 2 |
| 4 (.402-.421) | <5000-34999 | 2 | 0 | - | - | 2 |
| 5 (.207-.401) | - | - | - | - | - | - |
| | Total | 32 | 20 | 3 | 1 | 56 |

Respondents from counties with the highest income disparities, i.e., the first two quintiles, who were in the low end of the income range reported that they either did not feel that broadband was important (n=28) or that it was too expensive (n=18). Three respondents reported that broadband was not available to them. Only six respondents represented the third and fourth (lower levels of inequality) Gini quintiles and they likewise reported a lack of interest (n=4) and availability (n=2). None of the respondents were from counties in the fifth quintile of complete equality.

**Educational attainment.** The highest education level attained by the adults in the households with children (N=69) was also a dimension under study. As Figure 2 indicates, the data showed that respondents with a high school education or less reported that broadband was not important (n=28) or that it was not affordable (n=19). While these responses were shared by participants with higher levels of education (n=5 and n=8, respectively), other notable number of responses centered on a lack of availability (n=7).

**Locale.** Census participants with children who lived within counties classified as "City" or "Suburb" districts provided 95% (n=53) of the responses. These respondents' main reason for not obtaining broadband was that they did not need it or were not interested (n=31). Seventeen respondents felt that broadband was too expensive. Only one suburban resident cited other reasons and three could not access broadband in their areas. Few (n=3) rural users' responses reflected lack of interest or perception of expense. No respondents reported that they could use it somewhere else; had an inadequate computer; or other reasons as explanations for not adopting home broadband.

**Race and ethnicity**. Seventy respondents who reported having children and no broadband at home also provided information about their race or ethnicity. The majority of the members of this group were white (n=46), and regardless of race or ethnicity, most reported that they did not feel broadband was important (n=20) or too expensive (n=17). Some respondents reported that broadband was not available in their areas (n=7), that they could use it somewhere else (n=1), or had other reasons (n=1) for non-adoption.

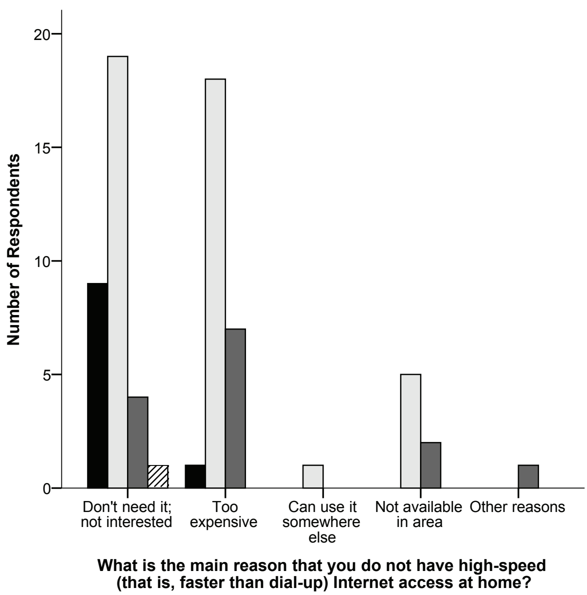


**Figure 2.** Reasons for not adopting broadband by education level. (N=69)

### Analysis 2. Home Broadband Adoption as Reported by the National Transportation Improvement Agency

The NTIA reports of Florida citizens unserved by broadband with Internet Service Provider subscriber data. Table 2 illustrates the population of Florida residents unserved by broadband clustered by county locale.

**Table 2**
Locale and proportion of residents in Florida unserved by broadband (N=949098)

| Locale | Definition | Counties | Population | Unserved (%) |
|---|---|---|---|---|
| City, Large | Territory inside an urbanized area and inside a principal city with population ≥250,000. | 1 | 45530 | 13416 (29) |
| City, Midsize | Territory inside an urbanized area and inside a principal city with population <250,000 and ≥100,000. | 4 | 100601 | 40255 (40) |
| City, Small | Territory inside an urbanized area and inside a principal city with <100,000 | 3 | 47372 | 20808 (44) |
| Suburban, Large | Territory outside a principal city and inside an urbanized area with population ≥250,000. | 14 | 700430 | 510478 (73) |
| Suburban, Midsize | Territory outside a principal city and inside an urbanized area with population <250,000 and ≥100,000 | 5 | 135827 | 52263 (38) |
| Town, Distant | Territory inside an urban cluster >10 miles and ≤35 miles from an urbanized area. | 10 | 112907 | 74841 (66) |
| Town, Remote | Territory inside an urban cluster >35 miles from an urbanized area. | 5 | 75808 | 67423 (89) |
| Rural, Fringe | Rural territory that is less than or equal to 5 miles from an urbanized area or ≤2.5 miles from an urban cluster. | 10 | 249776 | 93180 (37) |
| Rural, Distant | Rural territory >5 miles but ≤25 miles from an urbanized area or >2.5 miles but ≤10 miles from an urban cluster. | 13 | 116322 | 79748 (69) |
| Rural, Remote | Rural territory >25 miles from an urbanized area and is also >10 miles from an urban cluster. | 2 | 11188 | 10103 (90) |
| | Total | 67 | 1595761 | 949098 (60) |

As Table 2 details, of Florida's nearly 1.6 million adult residents potentially served by broadband as reported on the NTIA National Broadband

Map, 949,098 or 60% lack it; the proportion of unserved citizens ranges from 29% in counties classified as “City, Large” to 90% in counties classified as “Rural, Remote.”

### Analysis 3. The Relationship between Home Broadband and Student Achievement

**Correlations between broadband and student achievement**. The purpose of this analysis was to determine if broadband speed correlated with student achievement on standardized tests. Community, district and personal characteristics such as socioeconomic and minority status, English Language proficiency, district locale, per building connection speeds, and school district characteristics did not reflect a significant bivariate correlation with passing scores on the eighth grade reading, mathematics, writing, or science FCAT tests or state-assigned district letter grade (determined by student achievement at all levels on all FCAT tests) as reflected in Table 3.

**Table 3**
Community and district variables with no correlation with FCAT scores and district grades (N=67)

| | |
|---|---|
| Residents Unserved by Broadband | English Language Learner (ELL) Enrollment |
| District Per Pupil Expenditure | Individualized Education Program (IEP) Enrollment |
| Total Minority Enrollment | Library Aides |
| Hispanic Enrollment | Pupil/Teacher Ratio |

In particular, home broadband did not demonstrate a significant correlation with student test scores. However, as Table 4 indicates, some community and district variables did have a relationship to passing scores on the FCAT and the district grade.

**Table 4**
Community and district variables with correlation to FCAT scores and district grades (N=67)

| Variable | Reading 8 | Math 8 | Writing 8 | Science 8 | District Grade |
|---|---|---|---|---|---|
| Locale | -.354** | -.268* | -.406** | -.254* | -.365** |
| Estimated Building Broadband Speed | - | - | - | -.271* | -.258* |
| NSLP | - | - | .304* | - | - |
| Black Enrollment | - | - | .278* | - | - |
| School Librarians | - | - | .247* | - | - |

* $p < .005$ ; ** $p < .001$

As Table 4 shows, enrollment numbers for students eligible for NSLP, i.e., low income students, and black students had a correlation with scores on the eight grade writing test, meaning that where enrollment in these areas was higher, students from these two categories tended to also have higher test scores. Districts with more school librarians also tended to have higher test scores. The most definite correlational relationships existed between district locale and estimated building broadband speed. That is, as the rurality of districts increased, student test scores and district grades fell. Likewise, as the building speed increased, student achievement and district grades fell.

**Regression model.** The researcher included the significant bivariate correlations into five separate regression models that included eight grade writing scores, reading scores, mathematics scores, science scores, and district grade, district location, number of students eligible for NSLP, number of school librarians, and black student enrollment. None of the five models demonstrated any significance, part, or partial correlations.

## DISCUSSION

This study was premised on the idea that “broadband has become *the* enabling technology of learning environments….Home access is arguably as important to the overall quality of the learning experience as access at school—and it is a key strategy in extending learning time (Fox et al., 2012, pp. 3, 25).” In support of this idea, the researcher explored publicly available broadband adoption data in an effort to determine the extent to which Florida's children have access to broadband in their homes and schools and whether, at this time, broadband has any relationship to student achievement.

### RQ1. What are rates of and reasons for broadband non-adoption among households with children in Florida? How does broadband non-adoption relate to income, parent educational attainment, income disparity, race, and locale?

Reports issued by the FCC, U.S. Census Bureau, and NTIA have reported a persistent layer of non-adoption of broadband regardless of availability, costs, and access to it elsewhere. This non-adoption has not demonstrated a relationship with race, but respondents with lower levels of income or education were more likely to not have broadband. However, prior studies have noted that locale seems to play a role: non-adoptions rates are consistently higher in less urban areas. The results of this analysis suggest much the same pattern. Census respondents with children who do not have broadband primarily cite a lack of interest or perceived need for broadband. Respondents who had lower levels of education and income and who resided in counties with the widest income disparities most often gave this reason. Analysis of the Gini indicators confirmed that community factors played a stronger role in broadband decisions than income; even when respondents represented the lowest income levels in their counties, it was the desire to have broadband was absent. However, locale seemed to influence the lack of perceived need more that any other external factor with the majority of rural respondents stating that they did not feel that broadband was important.

These outcomes suggest that though approximately three-quarters of the parents who participated in the Census had broadband at home, there is also a persistent layer of non-adoption that centers on rural areas. As found in empirical studies, rural 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. The findings of this study potentially suggest that Florida's rural communities require outreach targeted at specific benefits to build desire to have broadband in their homes. Given the relationship between educational attainment and income, it is possible that Florida's bandwidth intensive K-12 educational mandates could inspire need.

### RQ2. To what extent do schools provide broadband access to children in Florida's rural counties? How might broadband availability relate to student achievement?

The number of school librarians in a district had a positive relationship with student achievement in writing; this finding is not surprising given the number of studies that have suggested that school librarians play a role in academic success in reading (e.g., Baumbach, 2004; Scholastic, 2008) and science (Mardis, 2007). This discovery is heartening give the potential school librarians have to be important players in digital textbook and virtual learning initiatives. In their roles as school leaders, school librarians provide the technology coordination, support, and leadership necessary to address access issues (Everhart, Mardis, & Johnston, 2011).

While home broadband showed no significant correlation with student achievement, per building speed demonstrated a surprising negative correlation. In districts where the individual school buildings are likely to have faster connections, student achievement is lower overall and in eighth grade science. Black and low-income students also experienced positive correlations with student achievement, counter to prevailing research. The meaning of these unexpectedly observed relationships is a fertile area to explore.

Locale demonstrated the most obvious and consistent correlation with student achievement. As school districts become more rural, their achievement levels tend to decline, thus suggesting that school location is an important factor in student achievement. When this finding is considered in light of the data analysis performed to answer RQ1, it is not surprising that neither race nor socioeconomic status related to presence of home broadband, district speeds, or student achievement. Locale, or more specifically, rurality, seems to be a dominant influence on the decision to have broadband in the home and the environments in which students learn.

Results of this early exploration also suggest that conditions in Florida's rural communities are consistent with prior research, but some a small number of interesting differences to consider. This study's conclusions should be tempered since the Census sample for this study was small and the Census can under-represent rural populations (El Nasser & Overberg, 2012; Steffey, 1997; Winkler, 2009). The NTIA National Broadband Map data set has known problems due to the source of the data, i.e., commercial ISPs and the data's lack of verifiability and exclusion of mobile broadband.

## CONCLUSION

The United States has one of the highest levels of Internet penetration in the world, but it it also has 50 million Internet non-users, almost half of whom live and learn in rural America. The role of rural broadband in learning has been beyond the glow of Internet research. Florida's move to digital textbooks in 2016 provides an opportunity to more strongly define the relationship between locale, home broadband adoption, and student achievement. However, this preliminary research was hindered by the small number of available data sets; the small number of cases represented in those data; known issues with the data sets; and varying units of reporting. Secondary analysis is beset with its own methodological pitfalls related to reusing data, but the importance of broadband for digital learning demands study that, for now, must rely on "best guess" interpretation of these limited and confusing granular sources.

More investigation is also needed into what survey respondents mean when they report that they "don't need" and are "not interested" in broadband. This research would suggest that the response is not a mask for lack of financial resources, but could be a blend of absent digital literacy, lack of perceived direct benefit, cybersecurity fear, or cultural concerns. Given the numerous state and federal initiatives to incentivize broadband adoption, Florida's unique set of educational mandates should provide an increasingly powerful context in which to investigate the complex issue of, as the FCC (2011, p.32), urges, deploying broadband "to all Americans in a reasonable and timely fashion."

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