Impacts of Broadband on Educational Outcomes in Indiana

Maggie Reeves
O'Neill Honors Thesis
Indiana University

I. Abstract

Income and race based educational success gaps are well explored topics that perpetually expand as new social issues and technologies arise. This paper explores broadband access as another factor widening the gap in educational success between different income areas and races. Broadband is the speed and bandwidth capabilities the internet has to upload and stream sources on technological devices. To explore broadband as a factor, this paper analyzes census data describing the percentages of families with broadband access in Indiana counties and compares it to school district I-STEP+ 10th grade passing rates.When exploring educational success, there are many definitions of success to consider and many outside factors that contribute to it, but comparing these two data sets shows the correlation between broadband and one measure of educational success, standardized test scores. The findings of this research show that, like many other variables, broadband does not directly impact test scores, but may still contribute to overall educational success through its strong correlation to income.The purpose of this research is to explore broadband as a potential indicator for educational success and as a variable preventing the reduction of educational success gaps.

II. Introduction

The United States education system has a history of inequality that is most clearly illustrated today by gaps in the education success of different demographic groups. Prior to the establishment of the first public school in the United States in 1635, education was provided to children by private tutors or their parents in cases where families could not afford a tutor(Race Forward, 2021). Children from lower income families had virtually no access to formal education before the opening of the first public school. This initial inequality led to the rich being able to read and write and the poor focusing on manual skills that would allow them to work and earn a living wage(Brady, 2017). Only a year after this public school was established in Virginia, Harvard was established as the first American higher education institution. While the rich had access to this institution, it was out of reach for lower income children for two reasons: they could not afford the tuition and did not qualify educationally for enrollment, meaning they did not have the formal education required to enroll.

Then in 1647, New England was the first colony to require educational facilities for areas with over 50 families (Sass, 2021). At this point, white children who could not afford tuition of higher institutions or private tutors were still only being educated until the age of 14 (Brady, 2017). This changed in 1821 when the first public high school was established in Boston. In 1867 the Department of Education was founded to deal with the outcomes of the emancipation proclamation and public education issues going forward. Efforts were made to increase educational opportunities for African Americans, such as the establishment of Howard University, however there were still drastic differences in educational access between white children and children of color (Race Forward, 2021). It wasn't until the 1950's that social norms shifted enough in America for academic inequality between races to be addressed. At this point, many African Americans, particularly in Southern America, were segregated into schools with less resources, which usually correlates to worse educational outcomes(Berry, 2011). Eventually, the Supreme Court found segregation in academic institutions unconstitutional in Brown v. Board of Education of Topeka(*Brown V. Board of Education,* 1953), and schools began to slowly integrate. Policies directly following this court decision only served to maintain the race-based success gap bringing us to the divides seen today.

In the past several decades, the historical inequality in educational success between children of different races and incomes has continued to not only persistap but increase (CEPA, 2015). Currently, a new factor is seemingly playing into this educational achievement divide, access to broadband internet connection. Throughout the past few decades, technology has been integrated into educational curricula across the United States (Members of the Technology in Schools Task Force, 2002). The invention and implementation of the internet was a major technological advancement that extensively changed the way education works both inside the classroom and out. A plethora of research has been conducted analyzing the relationship between technological resources, like personal computers, and educational success; however, very little has been analyzed on the local level in regards to access to the internet's impact on standardized test scores (Hampton, 2021; Lee, 2017; Michelmore, 2017). This research plans to take the existing understanding of technology's impact on educational achievement and apply it to the local level with broadband access and standardized test passing rates.

III. Literature Review

A. Education Inequality

Inequality in educational outcomes between different demographic groups has always plagued the United States education system, even before it's official establishment. These differences between outcomes from different demographic groups are often referred to as 'gaps,' which reference the differences between the average educational outcome of two groups. These gaps are based around the idea that if inequality did not exist in education, the average among different groups of people would be relatively the same, or rather that there would be no statistically significant differences in educational outcomes of different groups. The two gaps most relevant to broadband and this research are the income-based education gap and the race-based education gap.

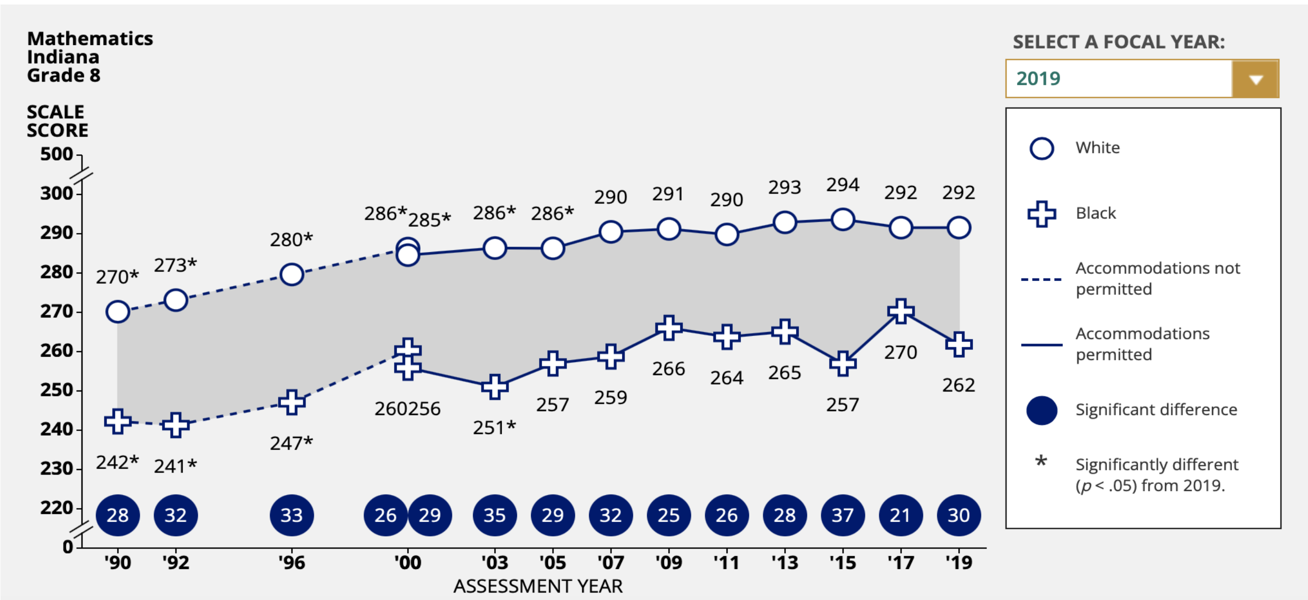
As conveyed above, evidence of the income-based educational success gap can be seen throughout history (Sass, 2021). Overtime, many would assume that the gap between the rich and the poor, in regards to academic success, would have shrunk as more public resources became available; however, one study claims this is not the case. Susan Dynarski and Katherine Michelmore, from Syracus and Michigan University, respectively, claim the difference between the average test scores of the rich and the poor has actually increased 40 percent over the last 30 years (Michelmore, 2017). Their research suggests that many studies measure poverty by those who qualify for free and reduced lunch, which includes different groups of people than those who might be solely economically disadvantaged, causing the estimation of this gap to be much lower than the true gap.

The Economic Policy Institute conducted an analysis that found educational success gaps between different income levels begin to show in children as young as pre-kindergarten. It can only be assumed that a gap existing that young will only increase over time, as there is a lack of development in the skills and knowledge the rest of the education system expands upon (García, 2017).

This assumption is proved true by the Federal Education Department, who found in 2012 that the educational success gap between the rich and the poor had increased 44 percent since 2001. Stanford University professor, Sean Reardon, found that income might play more of a role in educational success than race; for example, predominantly white areas and areas that were predominately black with the same income variances scored had similar average scores(Michelmore, 2017). Despite this study, race as a major factor in educational success cannot be completely ignored.

Brown v. Board of Education, where the United States Supreme Court ruled that educational institutions separated by race were unequal, brought the educational success gap between different racial groups to public attention. Although the academic success gap between students of different races has shrunk by over 40 percent since 1970, there is still a notable divide in the trends of academic success between different racial groups (CEPA, 2015). The National Assessment of Education Progress is the main resource for academic achievement gaps in United States education. They collected data from 8th graders in all Indiana school districts in 2019 and found that the gap between average math test scores of Black students was 27 points lower than the average score of white students, and the average English score was 25 points lower for Black students than white students. The difference between these average scores was found to be statistically significant in both cases. This trend seems to be consistent through other minorities, the only exception being Asian/Pacific Islander students, who scored an average of 7 points better in math than white students in the year 2017 (NAEP, 2020). While they found the score differences to vary every year, looking back as far as 1990, there is consistently still a significant gap between students of different races throughout the years.

Figure 1 - Example of the Educational Success Gap between White and Black students



NAEP. (2020). NAEP Achievement Gaps. The Nation's Report Card. Retrieved 2021, from https://www.nationsreportcard.gov/dashboards/achievement_gaps.aspx.

To further the extensiveness of the gap discussed above, the National Center for Education Statistics looked at the distribution of 8th grade students across the United States in regards to math proficiency and published alarming statistics. Around 50 percent of Black, American Indian, and Hispanic students registered below the basic math level, as opposed to the mere 20 percent of White students at the same level. Only Asian students had a lower below basic percentage than

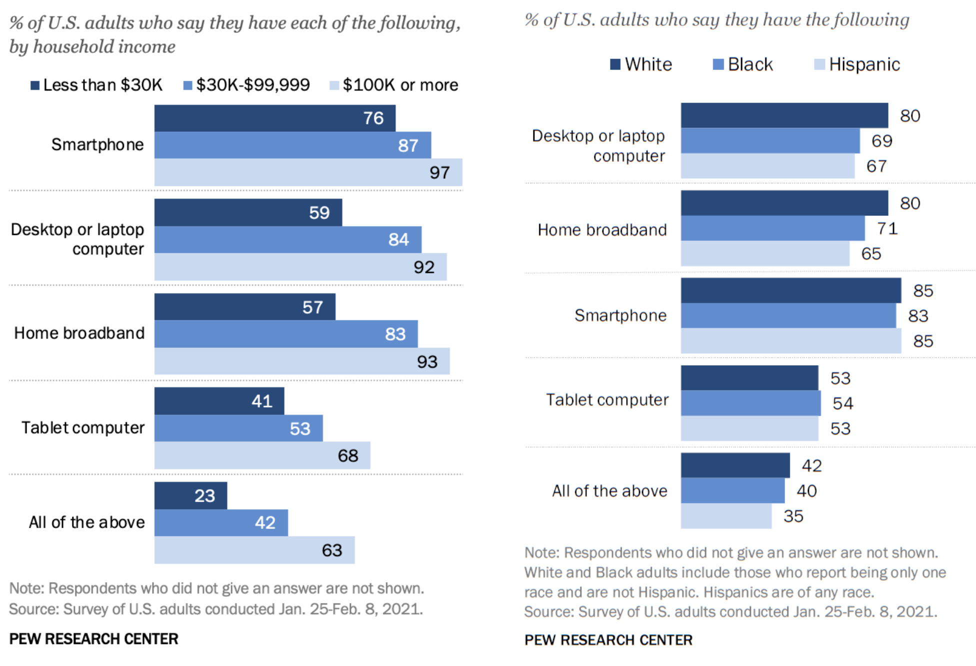
White students at about 15 percent of Asian students registering as below basic in math (NAEP, 2020). This statistically significant difference of not just scores but also proficiency levels displays the significance of the educational success gap between students of different races present to this day.

While the reasonings for these gaps in educational success are impacted by a variety of factors, like nutrition, parental involvement, and school resources, this paper will focus on linking broadband to these gaps and examining the relationship between broadband and educational success. As broadband is a form of technology, access to it, and by proxy access to educational success, is closely related to the concept of the digital divide.

B. Digital Divide

Examining the digital divide in the United States will provide further explanation of its potential impact on educational success. The digital divide is known as the gap between those who can afford access to new technological resources and learn how to use them and those who do not have as much access to technological resources and never learned how to use them in the professional world (Cullen, 2001). When examining the digital divide, race and income usually serve as excellent predictors for which side of the divide a person will be on. To examine the relationship between income and technology, Pew Research Center broke subjects up into three categories, those who made $30,000 or less, those who made between $30,000 and $99,000, and those who made $100,000 or more. In regards to overall access to technology, the lowest income category had about 20 percent less access to technology than the middle income category, which had around 20 percent less access than the highest income category. When focusing directly on broadband, the gap between the middle and the highest income categories was small, but the gap between the lowest and middle categories reached almost 30 percent (Vogels, 2021). That gap is significant when understanding it as people without access to the technology they need to complete school work or gain the knowledge required to have a successful career.

Figure 2 - Pew Research Center Income and Racial Gaps on Access to Broadband



Pew Research Center. Retrieved 2021, from https://www.pewresearch.org/fact-tank/2021/07/16/home-broadband-adoption-computer-ownership-vary-by-race-ethnicity-in-the-u-s/.

When examining this divide in regards to race, the digital disparity is not quite as large. Pew Research Institute found that 42 percent of White adults had access to all technology forms, as opposed to the 40 percent of Black adults and 35 percent of Hispanic adults. This gap did slightly increase when looking specifically at access to broadband, with White adults having 9 percent more access than Black adults, and Black adults having 6 percent more access than Hispanic adults(Atske, 2021). In this research, broadband is one of the terms used to highlight the digital divide, specifically in regards to education.

C. Overlap

While research on the income and racial academic success gaps are highly studied areas of education, the overlap of internet access and resulting educational success is much less studied. The most relevant study is one done on highschool students in rural Michigan, examining the relationship between internet access, or lack thereof, and SAT scores. The idea behind the study is similar to that of this research, as it focuses on the possible link between access to broadband and standardized test scores. The research study surveyed students in grades 8-11 who lived in a rural area and inquired about their access to the internet, relative interest in school, and academic results. The study found that while there is no direct correlation between broadband access and academic success, the two could still be linked similarly to how students who play sports tend to get better grades even though sports and grades are not directly correlated (Hampton, 2021). In other words, internet access does not cause students to get better test scores, but it might be a factor that plays into students' academic performance, much like physical activity from sports does.

IV. Theory

This research takes a more data-driven approach to the potential connection between broadband and educational success. Instead of a localized survey like the Hampton study, this research compares reported I-STEP+ passing rates and United States census data on broadband access with demographic control variables from the National Center of Education Statistics. This potential correlation is especially important in light of the recent pandemic and the transition to online learning. Due to the current studies on how access to technology impacts education (Hampton, 2021; Lee, 2017; Michelmore, 2017), I believe that there will be a strong correlation between I-STEP+ passing rates and access to broadband within school districts when looking only at those two variables alone. However, when other confounding variables are added in, like race and income, I expect a much lower correlation, similar to how better nutrition does not directly link to better test scores when other factors are controlled, but shows a correlation to academic success when directly compared (Florence, 2008).

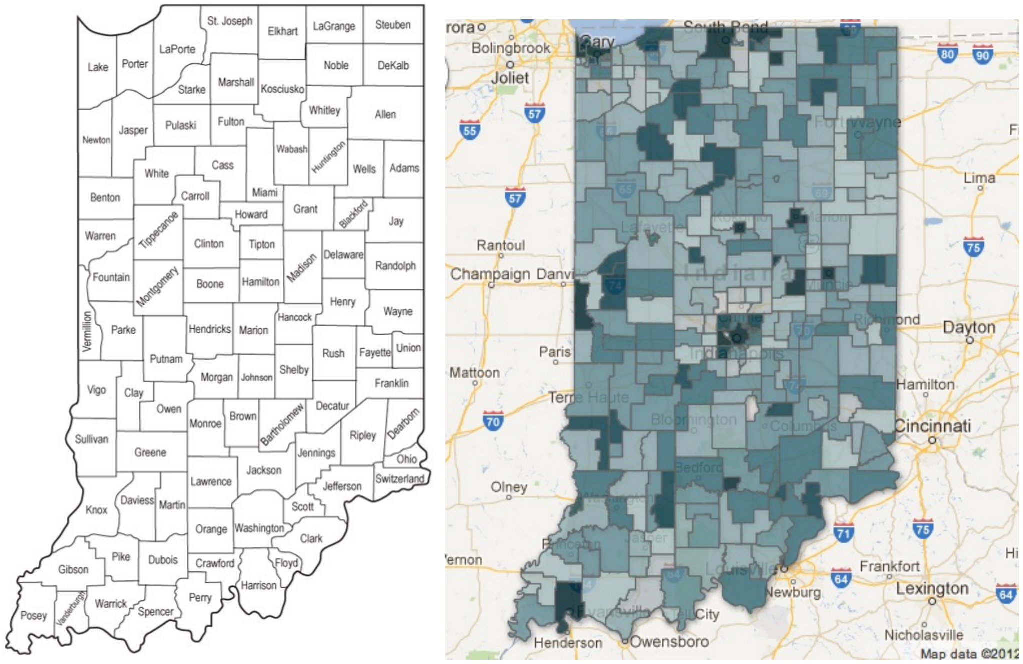
V. Data and Methodology

When it comes to education, it is easiest to compare data on the state level, as education is mainly managed by states, and every state has different policies and demographics that could impact educational outcomes. For that reason, all the data collected and analyzed will be from Indiana, as that is the state most relevant to Indiana University education research. To examine the relationship between broadband and educational outcomes, I will be comparing the percentage of households with broadband access, per the United States census, and the I-STEP+ passing rates of school districts published by the

Department of Education (IDOE, 2018). I-STEP+ is a standardized test all students take in 10th grade, so the reporting of results between districts is fairly consistent. This study will focus on I-STEP+ Passing rates, instead of average scoring for two main reasons. The primary reason being that scientists are moving away from using scores and grades to predict academic success (Cachia, 2018), but standardized testing is still the most consistent, data driven way to analyze. For this reason, the study will focus on the lowest standard for testing, passing.

While this overlap of data seems relatively easy to compare, county lines and school district lines in Indiana do not exactly line up. In order to fix this, I used the county file from The Institute of Education Sciences National Center for Education Statistics to figure out which counties were a part of which school districts. For the school districts that contained more than more counties or parts of different counties, the geographical file contained a variable with the amount of school district land found in each county. For these school districts, I used the land variable to determine a weighted-average for the broadband that was in each school district, assuming that land was similar to population, which is unlikely to hold but was necessary to calculate district-level access to broadband. For instance, if 30 percent of a school district's land area was located in county A and 70 percent of its land area was located in county B, the weighted average broadband value for that school district is 0.3*(County A broadband access) + 0.7*(County B broadband access) = Weighted average broadband access value for the school district.

Figure 3 - Country Lines v. School District Line Maps



Below is a sample table of data for each school school district in regards to broadband access and 10th Grade I-STEP+ passing rates in 2018. I selected a few districts with the lowest access to broadband, a few with average access, and a few with high access to properly summarize the data I found. While all school districts have some access to broadband, there is a significant difference between the districts with the lowest percent access, at 58 percent, and the districts with the highest percent access, at 93 percent. There is also a noticeable difference between the proportion of students that passed all sections of the ISTEP+ in 2018 in these school districts, aligning very closely with their increasing access to broadband.

Figure 4 - Table displaying short selection of school districts broadband access and I-STEP+ passing score proportions

School Districts	ACS_calc	Both Math and ELA Percent pass 2018
Lakeland School Corporation	0.585707666	0.203
Rush County Schools	0.63	0.394
Orleans Community Schools	0.649	0.451
Paoli Community School Corporation	0.649	0.378
Warren County Metropolitan School District	0.762	0.344
Northwestern School Corporation	0.762	0.513
Eastern Howard School Corporation	0.762	0.597
Zionsville Community Schools	0.858	0.608
Carmel Clay Schools	0.931	0.703
Hamilton Southeastern Schools	0.931	0.564
Westfield-Washington Schools	0.931	0.51

***Full Datasheet displayed in Appendix 1*

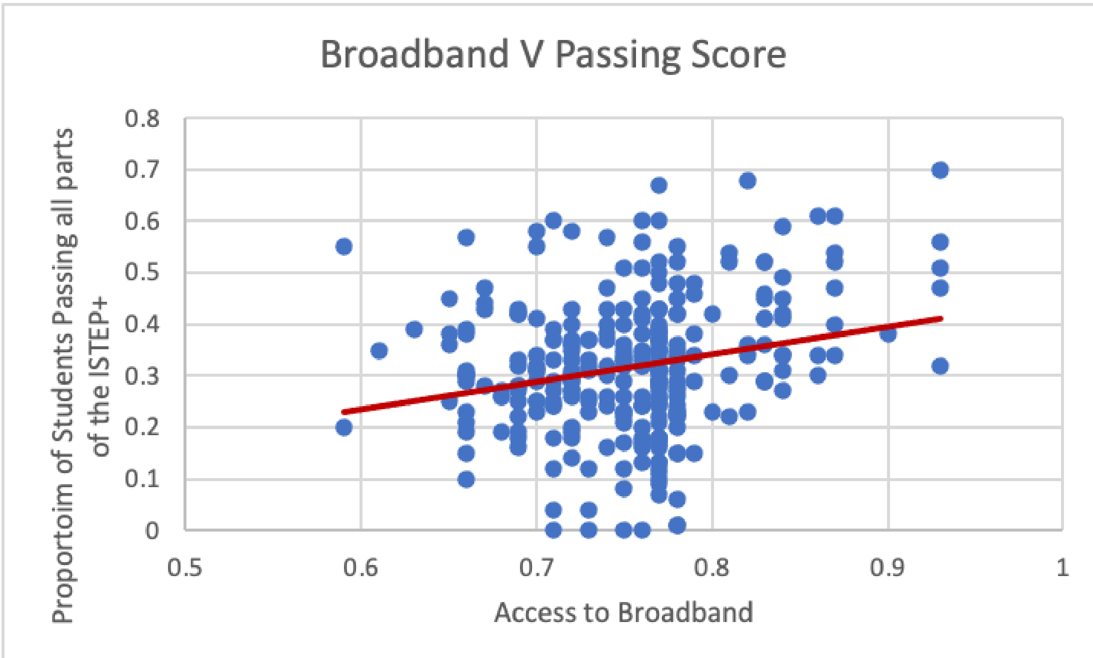
Some limitations I predict are that the actual population of districts is not equivalent to the percent of county land, which will cause some slight misrepresentation of the comparison statistics. I will also be solely focusing on Indiana school districts, which means my results can not be generalized to the United States as a whole. Because I am only looking at Indiana, there will also be some bias in regards to the diversity of students that are being analyzed in my data as Indiana is not the most racially or ethnically diverse state, with 83 percent of Indiana identifying as white (Indiana Population, 2021). However, because I am examining all school districts, I do believe that this bias is as limited as possible. Another limitation to my data is that it is focused mainly on one year.

Without years of data, there is no way to ensure that the data of the year I collected is the trend for Indiana schools and not the exception. Unfortunately, broadband access is measured in many different ways and is a relatively new variable in most data collecting platforms, making it hard to currently compare data sources describing broadband access over extended periods of time. To ensure accurate correlation, this study also includes income and race as control variables to the regression analysis.

Despite the evident limitations, this study draws attention to the finding that the digital divide is also impacting education and lack of broadband access potentially widens the income and race based educational success gaps. Often, when education inequity is examined, the importance of access to resources at home, not only in the school, is forgotten. This emphasis on broadband will help showcase the potential difference access to online resources at home can make in a child's education success. This information is especially relevant as the COVID-19 pandemic has led to more schools implementing more online resources and practices as a way to ensure safety. It is important to understand how this potentially affects children from different backgrounds so schools divert funding accordingly.

VI. Results

Figure 5 - Graph Displaying Correlation between Broadband Access and I-STEP+ Passing Rates in Indiana School Districts



After running a simple regression model, the data exhibits a slight positive correlation between broadband access and the average student passing rate. This was expected, although research (Hampton, 2021; Michelmore, 2017) suggested a potentially higher correlation than the found correlation coefficient of 0.2333, with a p-value of virtually 0. This correlation suggests that there is a relationship between broadband and academic success; specifically as the school district's access to broadband increases by one percent, the average passing rates of students within this district also increase but at a lower rate. It is important to note that correlation does not prove causation, meaning there is no way to analyze if increased access to broadband causes increased passing rates in districts with the current data. While the correlation is not as strong as predicted, the correlation is still statistically significant.

There are a few extreme outliers in the data where a few districts did not administer the I-STEP+, which brings down the correlation coefficient. These outliers can be seen across the x-axis of the graph and cause the trend line to be slightly lower than it otherwise would have. There are also a few outliers where school districts have a higher passing rate but low broadband access. While there is no evident reason for this from the research or data, closer analysis on the districts curriculums, in regards to the standardized test, could be examined to determine if any major difference occurs that relate to standardized test prep or test taking procedures.

In order to ensure that the correlation from the above model is not impacted by confounding variables, as there are a variety of variables that can impact passing rates and children's educational success, like family support and school resources, below is a multiple regression model with the main focus on the demographic variables of race and income. From my research on broadband, two main factors that can predict whether or not people have internet access are race and income, which happen to also be able to predict educational success as well (Hampton, 2021; Lee, 2017; Michelmore, 2017). Since these variables impact both of the research areas, they were important variables to focus on in a regression model to see what the impact of broadband solely is on academic success. These proved to be important variables to include as the f-value from the model below shows the data chosen fits a multiple regression model very well.

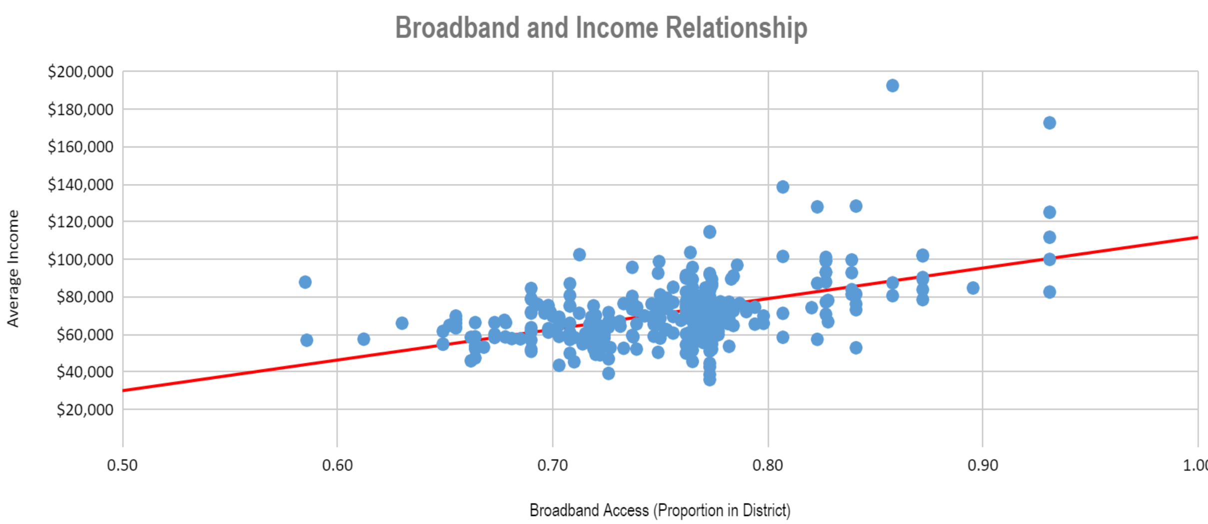
Figure 6 - Multiple regression output with race and income as control variables

Source	SS	df	MS			
				Number of obs	=	288
				F(7, 280)	=	20.52
Model	1.69475255	7	.242107507	Prob > F	=	0.0000
Residual	3.30296931	280	.011796319	R-squared	=	0.3391
				Adj R-squared	=	0.3226
Total	4.99772186	287	.017413665	Root MSE	=	.10861

perpass	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
acs_calc	-.0981301	.1360721	-0.72	0.471	-.3659842	.169724
perwhite	-2.592563	1.597509	-1.62	0.106	-5.737216	.5520897
perblack	-2.78918	1.596844	-1.75	0.082	-5.932523	.3541638
perAI	-.9138479	2.120655	-0.43	0.667	-5.0883	3.260604
perasian	-2.515383	1.615519	-1.56	0.121	-5.695488	.6647219
perother	-2.560957	1.605909	-1.59	0.112	-5.722145	.6002301
avgincome	3.84e-06	4.27e-07	8.98	0.000	3.00e-06	4.68e-06
_cons	2.712796	1.604371	1.69	0.092	-.4453644	5.870957

With the mentioned f-value being so close to 0, it can be concluded that the variables chosen can accurately predict academic outcomes in regards to I-STEP+ passing rates. What is particularly interesting about the regression output is the statistical insignificance of not only broadband but also racial variables. My research on educational success and the digital divide suggested that race would be a more significant predictor for test score outcomes, which proved false in this model with no race having statistical significance. The statistical insignificance of broadband when all the confounding variables are added in is not what I predicted, but it is not altogether unexpected. The Michlemore study from above found that time spent on the internet did not directly correlate to higher educational success, but it did correlate indirectly when other variables were removed. The one variable that showed a statistically significant correlation, despite the other control variables, was income. In regards to test scores, income is a statistically significant predictor when broadband is included.

Figure 7 - Broadband v. Income Relationship Graph



A potential explanation of the change in statistical significance and correlation coefficient in broadband between models is the strong correlation between income and broadband. The correlation coefficient in Figure 7's regression is .53, much higher than any correlation coefficient prior to this test. Upon further analysis, the strong correlation between broadband and income is statistically significant, with a p-value of virtually 0. This strong correlation could partially explain the significant correlation between broadband and I-STEP+ passing rates. If income is strongly correlated to passing rates, and broadband is strongly correlated to income, it would make sense that broadband and passing rates have a strong correlation when no other variables are factored in.

Figure 8 - Multiple regression output with race as control variables

Source	SS	df	MS			
Model	.742639586	6	.123773264	Number of obs	=	288
Residual	4.25508227	281	.015142642	F(6, 281)	=	8.17
				Prob > F	=	0.0000
				R-squared	=	0.1486
				Adj R-squared	=	0.1304
Total	4.99772186	287	.017413665	Root MSE	=	.12306

percpass	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
acs_calc	.5346242	.1319102	4.05	0.000	.2749665	.7942819
percw	-2.649132	1.809954	-1.46	0.144	-6.211922	.9136583
percb	-2.97504	1.809063	-1.64	0.101	-6.536075	.5859949
percAI	-1.239546	2.402338	-0.52	0.606	-5.96841	3.489318
perca	-2.018319	1.8293	-1.10	0.271	-5.619189	1.582551
percother	-2.710913	1.819387	-1.49	0.137	-6.29227	.8704445
_cons	2.570902	1.817655	1.41	0.158	-1.007046	6.14885

To further that point, when income is taken out of the regression model, broadband goes back to having a statistically significant correlation to passing rates. The probable reason for this is that broadband and income are interrelated, so when both variables are added to a regression model, income overpowers any correlation with broadband.

VII. Conclusion and Implications

There is a slight, statistically significant correlation between access to broadband and average passing rates of students in Indiana School Districts when income is not added as a variable in the regression model. While it is not certain, it is probable that the statistical significance of broadband, and its correlation to passing rates, disappears due to its close correlation with income. Because broadband and income are so closely correlated, broadband may be overpowered by income in the regression model. It is also possible that the correlation seen in the initial model is a result of broadband's correlation to income, not test scores. This relationship could be further explored in future research.

This study did find that race played no statistically significant role in passing rates where it's correlation to broadband is concerned. This means broadband access is a better predictor of passing rates in school districts than race. This outcome was not predicted, but aligns well with Professor Rearson's research on income and racial factors in the educational success gap (Michelmore, 2017). Although other data sources suggested race would be a strong control variable for educational success, my research found this to be false when looking at the educational success gaps and broadband.

There are minor implications of this research for public school districts in Indiana. It is important for policy makers to recognize the strong link between broadband access and income level. School districts with children from lower economic backgrounds should look into ways to invest in their communities broadband access as a way to shrink the income-based educational success gap. Unfortunately, this research did not provide substantial insight into the race-based education success gap. In the future, researchers should attempt to measure broadband access against a different measure of academic success to further analyze how broadband access impacts different areas of education.

VIII. Acknowledgements

I would like to thank Professor Ashlyn Aiko Nelson and Professor Dave Warren for advising me in this research and providing essential feedback. I would also like to thank Professor Matthew Bagetta and Patrick Carlin for providing helpful feedback throughout my writing process.

IX. References

Alyahyan, E., & Dustegor, D. (2020, February 10). *Predicting academic success in Higher Education: Literature Review and best practices*. International Journal of Educational Technology in Higher Education. Retrieved 2021, from https://educationaltechnologyjournal.springeropen.com/articles/10.1186/s41239-020-0177-7.

Atske, S., & Perrin, A. (2021, September 10). *Home Broadband Adoption, computer ownership vary by race, ethnicity in the U.S.* Pew Research Center. Retrieved 2021, from https://www.pewresearch.org/fact-tank/2021/07/16/home-broadband-adoption-computer-ownership-vary-by-race-ethnicity-in-the-u-s/.

Barshay, J. (2020, June 29). *A decade of research on education inequality in America*. The Hechinger Report. Retrieved 2021, from https://hechingerreport.org/a-decade-of-research-on-the-rich-poor-divide-in-education/.

Berry, J. R. (2011). (thesis). *Property Taxes & Public Education Funding: Inequality in the System*. Academia. Retrieved 2021, from https://d1wqtxts1xzle7.cloudfront.net/5527791/Property_Taxes___Public_Education_Funding_-_Inequality_in_the_System-with-cover-page-v2.pdf?Expires=1632154185&Signature=TmUwoyodILEmx6yEAVvO8jxuYntaQrL2bkRSviwR3QyX9hHhU1w2FF6WjnbNl3ZWQs9ErKuf24j3WJJrLwCkxc6106fniHFG9lKqIXNHogcEw9TIW9kmekpPYH1sZ~GQLlw4ww4xFUNs8B-1uLpI2VPlkJ2AZwUGwpj9qNES1j

tu4efpdShYbNnjZAmgs9QzMD2WGdaO2TDDNB~adJcH9CEk3xhiIZ8UPoAzm~JWMxNAuveF3U9r5aYyNCFl8UP7Keb2EJLc~Xy-DACkOY~J8Xoa0AFEFt0jPpaHZ9xCAOsuU3p57tWMOmY1RUvvCRhgneAqrLJqcE~PNvNvqs6FPg__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA.

Brady, J. (2017). *Education in the 1800s*.

Cachia, M., Lynam, S., & Stock, R. (2018, October 12). *Academic success: Is it just about the grades?* Higher Education Pedagogies. Retrieved December 1, 2021, from https://www.tandfonline.com/doi/full/10.1080/23752696.2018.1462096%40rhep20.2018.3.issue-V2.

CEPA. (2015). *Racial and Ethnic Achievement Gaps*. The Educational Opportunity Monitoring Project: Racial and Ethnic Achievement Gaps. Retrieved 2021, from https://cepa.stanford.edu/educational-opportunity-monitoring-project/achievement-gaps/race/.

de Bray, C., Musu, L., McFarland, J., Sidney, W.-F., Diliberti, M., Zhang, A., Branstetter, C., & Wang, X. (2019, February). Status and Trends in the Education of Racial and Ethnic Groups 2018. Retrieved 2021, from https://eric.ed.gov/?id=ED592833.

Florence, M. D., Asbridge, M., & Veugelers, P. J. (2008). Diet quality and academic performance. *Journal of School Health, 78*(4), 209-215.

García , E., & Weiss, E. (2017, September 27). *Education inequalities at the school starting gate: Gaps, trends, and strategies to address them*. Economic Policy Institute. Retrieved 2021, from

https://www.epi.org/publication/education-inequalities-at-the-school-starting-gate/#
.

Hampton, K. N., Robertson, C. T., Fernandez, L., Shin, I., & Bauer, J. M. (2021, June 16). *How variation in internet access, digital skills, and media use are related to rural student outcomes: GPA, SAT, and educational aspirations*. Telematics and Informatics. Retrieved 2021, from https://www.sciencedirect.com/science/article/pii/S0736585321001052.

Howard, T. C., & Gay, G. (2020). *Why Race and Culture Matter in Schools: Closing the Achievement Gap in America's c=Classrooms*. Teachers College Press.

Lee, J. (2017, July). *Internet Usage Effect on Educational Attainment: Evidence of Benefits*. View Points. Retrieved 2021, from https://milkeninstitute.org/sites/default/files/reports-pdf/Internet-Usage-and-Educational-Attainment-FINAL.pdf.

Members of the Technology in Schools Task Force. (2002). *Technology in schools*. National Center for Education Statistics (NCES) Home Page, a part of the U.S. Department of Education. Retrieved 2021, from https://nces.ed.gov/pubs2003/tech_schools/chapter7.asp.

Michelmore, S. D. and K., Dynarski, S., Michelmore, K., Masters, W., & Masters, W. (2017, April 20). *Income differences in education: The gap within the gap*. Econofact. Retrieved 2021, from https://econofact.org/income-differences-in-education-the-gap-within-the-gap.

NAEP. (2020). *NAEP Achievement Gaps*. The Nation's Report Card. Retrieved 2021, from https://www.nationsreportcard.gov/dashboards/achievement_gaps.aspx.

Peters, S. J., & Plucker, J. A. (2017, November 7). *Closing poverty-based excellence gaps: Conceptual, measurement, and educational issues - Jonathan A. Plucker, Scott J. Peters, 2018*. SAGE Journals. Retrieved 2021, from https://journals.sagepub.com/doi/abs/10.1177/0016986217738566?casa_token=qw5HRuoDjEcAAAAA%3ArARmBMYFv3mYkq1Xtg2e64PJU_QOBYm_M0zn_myRZlbtTKf1q9qdW0hRUnk6Ohnm-GHVLM_YlQE&journalCode=gcqb.

Race Forward. (2015, October 8). *Historical timeline of public education in the US*. Race Forward. Retrieved 2021, from https://www.raceforward.org/research/reports/historical-timeline-public-education-us.

Sass, E. (2021). *American Educational history: A hypertext timeline*. American Educational History Timeline. Retrieved 2021, from https://www.eds-resources.com/educationhistorytimeline.html.

Vogels, E. A. (2021, September 10). *Digital divide persists even as Americans with lower incomes make gains in tech adoption*. Pew Research Center. Retrieved 2021, from https://www.pewresearch.org/fact-tank/2021/06/22/digital-divide-persists-even-as-americans-with-lower-incomes-make-gains-in-tech-adoption/.

I. Database Resources

Internet access in Indiana: Stats & figures. BroadbandNow. (2021, September 7). Retrieved September 21, 2021, from https://broadbandnow.com/Indiana.

The educational OPPORTUNITY project at Stanford. Opportunity Explorer | The Educational Opportunity Project at Stanford University. (n.d.). Retrieved September 21, 2021, from https://edopportunity.org/explorer/#/map/none/districts/avg/ses/all/3.5/38/-97/.

Doe. (2021, August 23). *Data center & reports*. DOE. Retrieved September 21, 2021, from https://www.in.gov/doe/it/data-center-and-reports/.

Indiana population 2021. Indiana Population 2021 (Demographics, Maps, Graphs). (n.d.). Retrieved October 13, 2021, from https://worldpopulationreview.com/states/indiana-population.

NCES. (2019). *Education Demographic Estimates*. Index. Retrieved 2021, from https://nces.ed.gov/programs/edge/TableViewer/acsProfile/2012.