Team 146

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What role has COVID-19 played in the digital and technological divide in K-12 education?

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Background
What is the digital divide? How is it connected to education?

The digital divide can be defined as the disparity in access to information technologies and digital services between different groups. Before the COVID-19 pandemic, the gap between K-12 students with and without access to high-speed internet access was prevalent. However, it was primarily an issue that affected a student's ability to complete homework that needed internet access to be completed. Whereas, once the pandemic hit, most U.S. school districts shifted to remote learning. Not only would students need internet access after school, but they would also need it to attend school. Students without internet connectivity and digital devices to access it (internet) with were put at great risk for learning loss.

While the divide affects all communities, those who are marginalized, including people of color, low-income individuals, English-language learners, people with disabilities, and populations experiencing homelessness are the most likely to face these problems.

The Problem
What role has the COVID-19 pandemic played in the digital and technological divide in K-12 education?

A staggering statistic from a study done by the Pew Research Center in the spring of 2020 discovered that 36 percent of low-income students couldn't complete their schoolwork because they didn't have a computer compared to 14 percent of middle-income and 4 percent of upper-income students. Students are quick to learn if they are properly supported and guided. However, this is difficult to do when students and schools face so many different challenges. Distance learning, affordability of high-speed internet, the lack of computers/tablets, as well as geographical limitations of broadband connection are all hurdles that students and schools face.

K-12 education plays a very important role not only in the development of a person but also in the development of a country. The existing K-12 digital divide may discourage students from learning and eventually drop out. Poor education can pose socioeconomic problems including higher crime rates and rising unemployment rates. Closing the K-12 digital divide in this new era of remote learning is crucial to improving student enrollment rates and decreasing dropout rates.

Federal and state education departments need to recognize these issues and take steps to close the digital divide to ensure that K-12 students are getting the access to the education they deserve. They also need to understand the problem in order to develop better budgets for education infrastructure. Teachers, guardians, and parents should also be aware of the situation in order to better support K-12 students' struggle.

DATA

Data Sources

The data was pulled from multiple credible sources such as, National Center for Education Statistics: National Household Education Survey (NHES), National Telecommunications and Information Administration (NTIA), and United States Census Bureau: Household Pulse Survey.

The National Household Education Surveys Program produces nationally representative descriptive data on children's and families' educational activities in the United States. Every 3-4 years, NHES conducts surveys on several topics. Early childhood care and education, as well as family involvement in school and homeschooling, are some of the topics that are investigated using the survey. The last time the NHES was conducted was in 2019.

The National Telecommunications and Information Administration is the executive branch agency that is responsible for advising the President on telecommunications and policy matters. NTIA's development policies and programs are focused on expanding access and use of high-speed Internet in the United States and expanding the reach of all users.

The Household Pulse Survey began its first collection phase in April 2020 and is currently in Phase 3.5 of the collection. This survey covers the many effects of the coronavirus pandemic on communities, families, and individuals. We utilized the data that pertained to our topic: device use and internet access for K-12 students.

Data Wrangling and Cleaning

Data tables were downloaded as CSVs from the source websites listed previously. In general, the data cleaning process consisted of extracting the data, clearing original formats, changing table names, removing unneeded columns, and selecting which characteristics we wanted to analyze.

For example, the NTIA data table is difficult to analyze in the original form because the column names and values such as isPerson, isAdult were intertwined and hard to understand. After investigating, unnecessary values were filtered out to make data easier to analyze. Another task was to combine multiple data tables from different weeks. 33 weeks of the Household Pulse Survey for Education data tables are combined using Microsoft Excel power query. Then, pivot tables created to filter desirable characteristics such as income level and race/ethnicity allows easier data analysis.

In addition, the percentage of highly available Internet for educational purposes was calculated by taking the sum of the percentage of always available and usually available Internet for educational purposes. Similarly, the percentage of highly available devices for educational purposes equals the sum of the percentage of always available and usually available devices for educational purposes.

For NHES data, we initially wanted to update one of the tables with new data for 2021. Unfortunately, we were unable to compare internet availability for educational purposes in 2021 to 2020 and 2019 because we could not find precisely how percentages in 2020 and 2019 were calculated. We were aware of the use of margin of errors and response rate, but we were unable to replicate the formula. We decided to use only what data is available to us. We also decided to use NTIA data for the purposes of briefly investigating the digital divide for the general public only, not for K-12 students due to the lack of method to identify K-12 students from NTIA data.
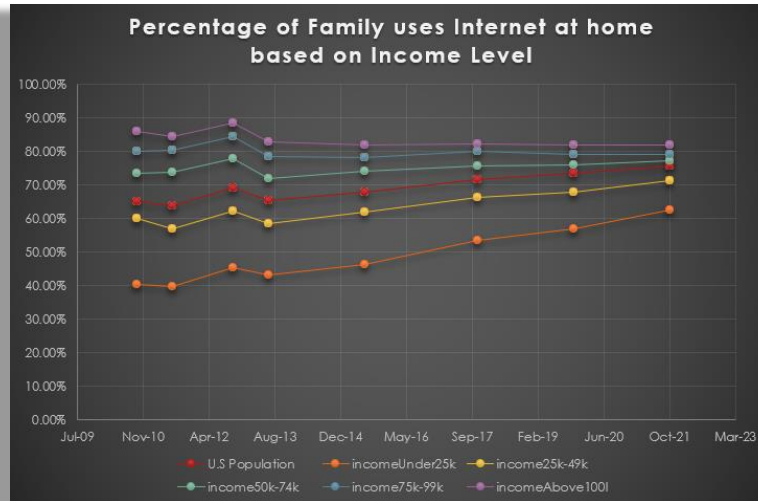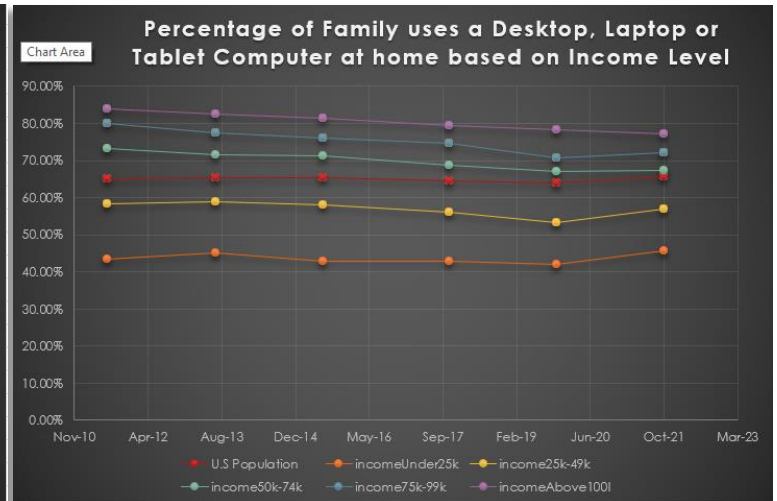
Data Analysis

Figure 3

Percentage of Family uses Internet at home based on Income Level

Figure 4

Percentage of Family uses a Desktop, Laptop or Tablet Computer at home based on Income Level

Figure 2

2019: % of Student's w/ no Internet Access

Figure 1

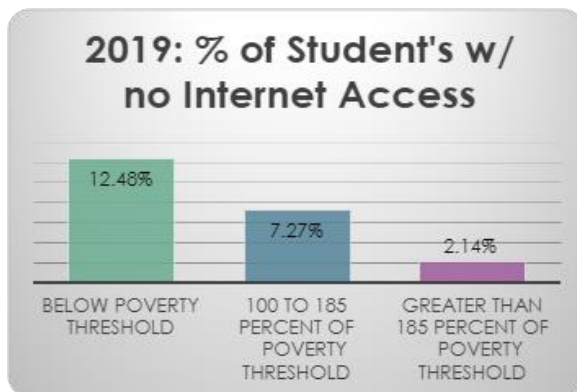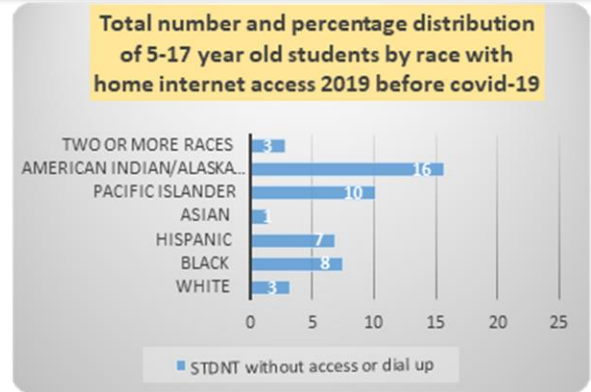Total number and percentage distribution of 5-17 year old students by race with home internet access 2019 before covid-19

Figures 1 and 2 highlight the gap of internet and digital device access based on income level in the general public from 2009 to 2021. The gap in internet access got narrower over the time but the gap for digital devices access remained mostly the same.

Figures 3 and 4 display internet accessibility at home for learning activities based on race and poverty levels. As seen in figure 4, the percentage of students without internet access for learning activities is

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highest among American Indian families while Asian families have the lowest percentage. Figure 3 shows a significantly higher percentage of students with no internet access for families below the poverty threshold.

According to the NHES source, "Poverty threshold is a dollar amount determined by the federal government and updated annually to account for inflation, and which varies depending on a family's size and composition. Thresholds used to define poverty are based on weighted averages from the 2018 Census poverty threshold. In 2018, for example, the weighted average poverty threshold for a family of four was $25,701."

Using the data from Household pulse survey from April 2020 to July 2021, the next 2 charts show the percentage of highly available Internet for educational purposes based on income level or race/ethnicity.
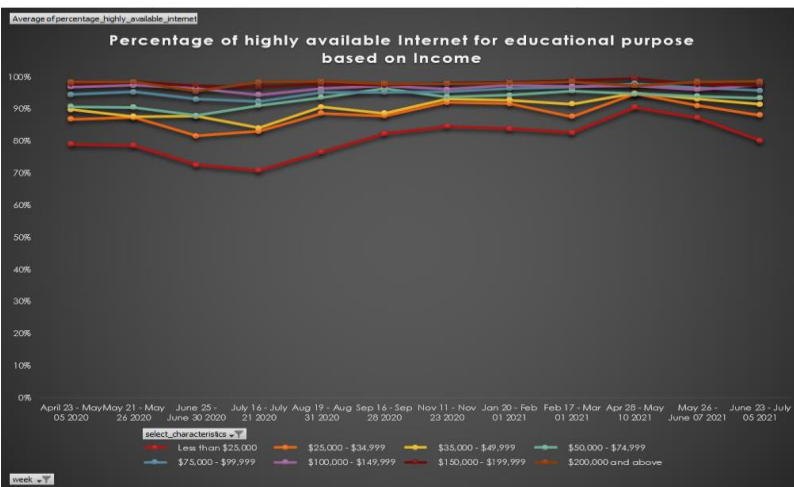

Figure 5

Starting in August 2020, lower income level households (less than 25,000, 25,000 to 34,999) had an increased percentage of available devices and internet for educational purposes, significantly closing the gap with higher income level households. However, the percentage never reached above 90%. Asian households had the highest percentage of highly available Internet for educational purposes.
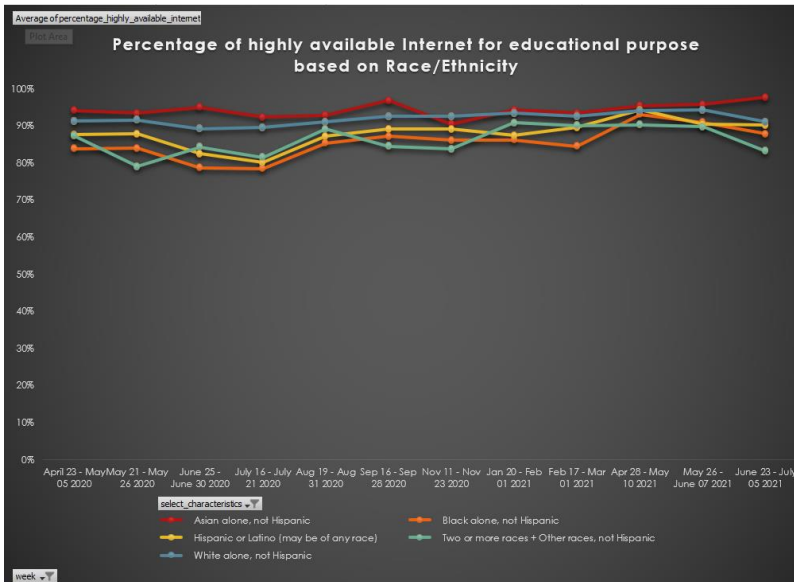

Figure 6

Starting in July/August 2020, Black, Hispanic, and 'Other' race households (which previously had significantly lower percentages) had increased percentages of highly available devices and internet for educational purposes. You can also see the gap drastically closing between White and Asian households, up until May 2021.

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Similar results were found when investigating the charts for highly available devices for educational purposes. The closing gap could be explained by the support of school districts, local government, state government, and federal government during this period. Figure 7 notes a significant increase in the percentage of internet paid by the school or district for families with income less than $25,000 per year. Similar results were found with digital device accessibility data.
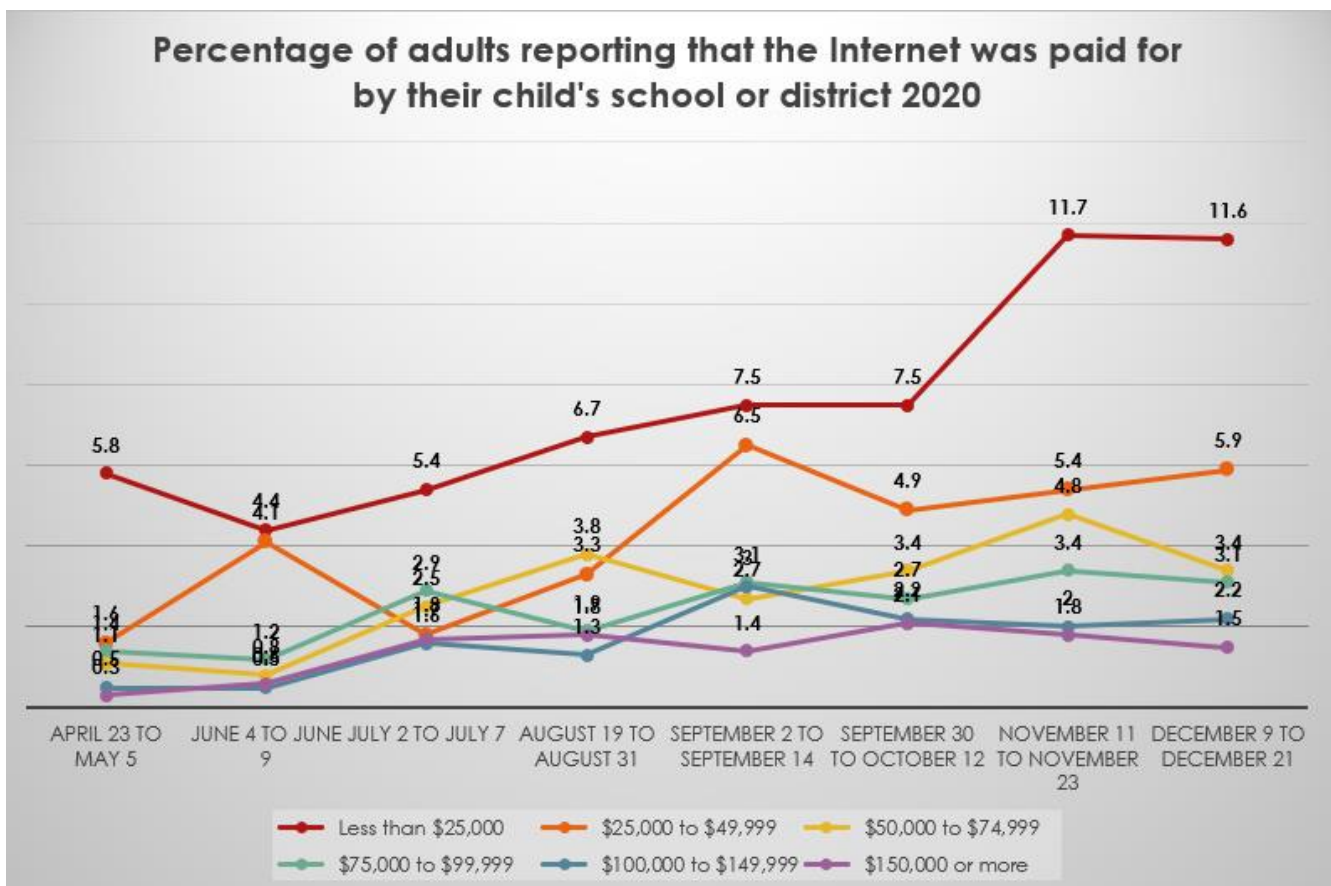

Percentage of adults reporting that the Internet was paid for by their child's school or district 2020

Legend:
- Less than $25,000
- $25,000 to $49,999
- $50,000 to $74,999
- $75,000 to $99,999
- $100,000 to $149,999
- $150,000 or more

X-axis categories: APRIL 23 TO MAY 5; JUNE 4 TO JUNE 9; JULY 2 TO JULY 7; AUGUST 19 TO AUGUST 31; SEPTEMBER 2 TO SEPTEMBER 14; SEPTEMBER 30 TO OCTOBER 12; NOVEMBER 11 TO NOVEMBER 23; DECEMBER 9 TO DECEMBER 21

Figure 7

Dashboard Link

Percentage of K-12 Student's with High Device Accessibility
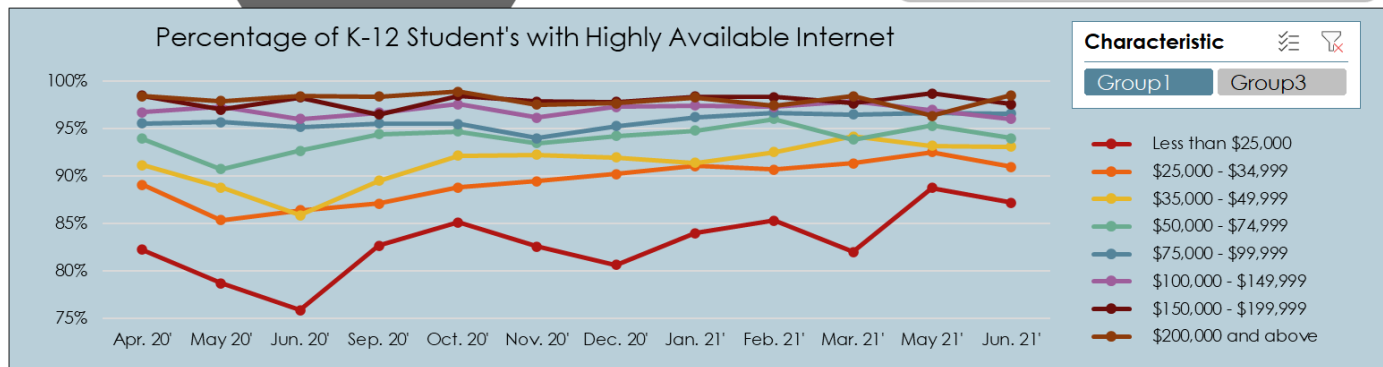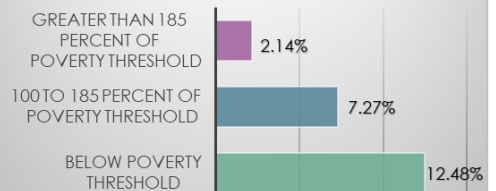
76% of K-12 Classes Moved to Distance Learning Format in June of 2020

31% Increase in the % of adults reporting that computers or digital devices were provided by their child's school or district from Apr. 20' to Dec. 20' amongst households earning $50,000 to $74,999 per year

11.5% Increase in the % of adults reporting that computers were mostly available for educational purposes from Apr. 20' to Dec. 20' amongst Black households

2019: % of Student's w/ no Internet Access

GREATER THAN 185 PERCENT OF POVERTY THRESHOLD	2.14%
100 TO 185 PERCENT OF POVERTY THRESHOLD	7.27%
BELOW POVERTY THRESHOLD	12.48%

Percentage of K-12 Student's with Highly Available Internet

The two interactive graphs at the top and bottom of the dashboard are based on data from the Household Pulse Survey from April 2020 to July 2021 that allow users to explore highly available devices or the internet for educational purposes in households based on selected household characteristics such as Income and Race/Ethnicity. These two charts are connected to their own pivot tables and allow the user to filter what characteristics they would like to see. The bar chart in the middle gives the audience an idea of what internet access looked like before Covid-19. The hexagons contain interesting information found in our EDA. Overall, the dashboard has a cohesive color scale to it but nothing that overwhelms the reader.

CONCLUSION

At the beginning, our thesis was the COVID-19 pandemic would expose and widen the digital divide in K-12 education since the main learning format used had to move from in person to remote. The COVID-19 pandemic did expose the digital divide concerning internet and digital devices access for children in school. Lower-income and minority households started the distance learning period with a significantly lower percentage of highly available internet and digital device access for educational purposes compared to higher incomes and other races. Another research report statistic from Common Sense Media also reported that "up to 400,000 teachers can't teach because of lack of internet" and 37% of students from rural areas are without adequate connectivity. However, as seen in several charts, the gap in internet and digital devices access lessened as COVID-19 progressed. It could be that COVID-19 exposed these inequalities and brought to light what people have never noticed until remote learning became the norm.

Schools and districts did step in to provide the internet and digital devices needed during the pandemic, but the gap remains substantial. There are still families lacking adequate connectivity for educational purposes. President John F. Kennedy said "Our progress as a nation can be no swifter than our progress in education. The human mind is our fundamental resource." Closing the digital divide in K-12 education, which requires attention not only from the government but also from private sectors, should be the first step, a very urgent one, that might make this country great again.

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