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Counted as Connected: Mobile-Only Home Internet and the Homework Gap Among Children from 2016 to 2024

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ABSTRACT

Official statistics now count almost every American child as connected at home, yet a child with a capped cellular plan and a smartphone is counted the same as a child with fiber and a laptop. This study asks how far that headline count departs from access that can carry schoolwork. It uses American Community Survey microdata for 3.85 million children aged 5 to 17 in eight survey years from 2016 to 2024, with replicate-weight standard errors. A child is counted as connected when the household has any paid internet subscription and any computing device. A child is schoolwork-ready when the home has a fixed service, such as cable, fiber, DSL or satellite, and a desktop or laptop. Between 2016 and 2024 the connected share rose from 89.2% to 96.7%, but the schoolwork-ready share rose only from 72.4% to 78.9%. In 2024, 11.5 million children were not schoolwork-ready, and 84.5% of them were counted as connected, up from 61.0% in 2016. Their access was thin: most relied on a cellular data plan alone, lacked a desktop or laptop, or both. The income gap in the connected count shrank from 22.6 to 5.2 percentage points, while the gap in schoolwork-ready access remained 32.7 points. Weighted logistic models show that low income, low householder education, limited English, renting, non-metro residence, and Black, Hispanic, American Indian or Pacific Islander identity predict thin access. The measurement system that counts connection has nearly closed the divide on paper while a large mobile-only homework gap remains.

Keywords: homework gap, digital divide, mobile-only internet, American Community Survey, broadband, children

1. Introduction

The "homework gap" names the problem of school-age children who cannot do assigned online work at home because the home lacks a usable internet connection or device (Reisdorf et al., 2019). The pandemic school closures of 2020 turned this gap into a national emergency, as families with weak connections struggled to join remote classes (Domina et al., 2021; Haderlein et al., 2021). Since then, the share of US children counted as connected has climbed close to universal. By the measure used in this study, 96.7% of children aged 5 to 17 lived in a home with a paid internet subscription and at least one computing device in 2024.

That headline figure treats very different homes as the same. A household with a fiber line and two laptops counts as connected. So does a household whose only service is a cellular data plan on a parent's phone. The American Community Survey (ACS), the Census Bureau survey that produces most official estimates of home internet use, records both homes as having a broadband subscription and a computer, because it counts smartphones as computers and cellular plans as broadband. The count is accurate on its own terms. The question is what it hides.

This study treats the counting system itself as a sociotechnical object. A survey classification is a technical system that sorts households into categories, and the categories then shape policy attention (Espeland & Stevens, 1998). The system variables here are the type of connection, such as wired broadband, satellite, a cellular data plan only, or none, and the type of device, such as a desktop or laptop, a tablet, or a smartphone only. These variables decide whether a child can write a long essay, upload a project or join a video lesson without running out of data. Prior research shows that mobile-only access supports a narrower range of online activity than computer-based access (Napoli & Obar, 2014; Correa et al., 2020). The case is one of a system evaluated on one measure and experienced on another: the evaluation measure is any subscription, and the experience depends on what kind.

The study asks three research questions. RQ1: How did the share of children counted as connected, and the share with schoolwork-ready access, change between 2016 and 2024? RQ2: Which connection and device types make up the difference between the two measures, and how does this difference vary by household income, race and ethnicity, metro status and state? RQ3: Which household characteristics predict the absence of schoolwork-ready access when other characteristics are held constant, and did these associations change between 2019 and 2024?

To answer them, the study uses ACS Public Use Microdata Sample (PUMS) files for eight survey years, covering 3.85 million child records. It defines schoolwork-ready access as a fixed home service plus a desktop or laptop, and it defines thin access as being counted as connected without being schoolwork-ready. The main finding is that the gap between the two measures has grown. In 2016, 61.0% of children who were not schoolwork-ready were already counted as connected. By 2024, this share was 84.5%. The divide moved from homes with no connection to homes with a thin one, and the official headline lost sight of it.

2. Related work and framing

2.1 From the access divide to material access

Early digital divide research compared people who had internet access with people who did not (DiMaggio et al., 2001). Critics soon argued that this binary view was too simple, because access itself has levels and conditions (Selwyn, 2004; Warschauer & Matuchniak, 2010). Hargittai (2002) introduced the second-level digital divide, meaning differences in online skills among people who are already connected. Van Dijk (2005) placed physical access within a sequence of motivational, material, skills and usage access, and later reviewed how research had moved from the first of these to the rest (van Dijk, 2006). Once access spread, usage differences grew along lines of education and status (van Deursen & van Dijk, 2014).

A later Dutch study returned to the first level and argued that the access divide had shifted from physical access to material access. Material access means the range of devices and peripherals a person has, the opportunities each device allows, and the ongoing costs of keeping hardware and subscriptions working. This material diversity still shaped skills, uses and outcomes even where nearly everyone was online (van Deursen & van Dijk, 2019). This study applies the same idea to US children. It asks not whether a home is online, but what kind of service and device the home relies on.

Hargittai (2010) showed that even within the "net generation" of young adults, skills and uses varied by parental education and by the quality of access. Gonzales (2016) added the idea of technology maintenance: low-income US residents often had access but struggled to keep it, through cut-off service, broken hardware and limited public access. A later study of college students validated the construct and linked data limits and poorly working laptops to lower grades (Gonzales et al., 2020). These works treat access as unstable and uneven, which a single subscription count cannot show.

2.2 Smartphone dependence and the mobile underclass

Smartphone dependence means relying on a smartphone as the only means of going online. Tsetsi and Rains (2017), using Pew survey data, found that minority, younger, lower-income and less-educated adults were more likely to be smartphone-dependent. Marler (2018) reviewed studies of mobile phones and inequality and concluded that mobile access widens participation but does not erase older divides. Napoli and Obar (2014) went further and described a mobile internet underclass. They argued that mobile access offers less functionality, less open platforms, and less content creation and information seeking than computer-based access.

Comparative studies support this concern. In Chile, where policy promoted mobile connections to close access gaps, mobile-only users had lower skills and a narrower range of online uses than people who also used a computer (Correa et al., 2020). In Detroit, residents who relied on mobile phones engaged in fewer information and health activities than those with a home service contract (Fernandez et al., 2020). A related Detroit study found that neither home broadband nor a mobile plan alone supported the full range of online activities linked to local social capital (Reisdorf et al., 2022). These authors warn against policies that treat non-equivalent modes of access as if they gave equal outcomes.

2.3 Why mobile-only access is thin for schoolwork

Three features of the technology make cellular-only and smartphone-only access a weak base for schoolwork. The first is the data cap. Mobile plans usually limit monthly data, and Prince and Greenstein (2021) found a pattern of mobile internet use by income that suggests caps bind hardest on low-income users. Video lessons and large file uploads use far more data than messaging, so a capped plan can run out midway through the month. Gonzales et al. (2020) found that students reported data limits among their technology problems.

The second feature is screen size and input. Ghose et al. (2013) showed that the small screen of a phone raises the cost of searching and comparing information, so users click mostly on what appears at the top of the screen. Writing an essay, filling in a spreadsheet or reading a long text on a phone is slower and more error-prone than on a laptop. A study of rural Michigan students found that those who depended on a cell phone for internet access scored lower on the SAT than students who were not dependent on a phone (Hampton et al., 2021).

The third feature is sharing. In a smartphone-only home, the device often belongs to a parent, who may take it to work. Katz (2017) described lower-income families as "under-connected", meaning connected in ways that are unreliable, shared or interrupted. School-age siblings must then share a single small screen for homework. The ACS cannot count devices per child, but it does record whether a desktop, laptop or tablet exists at all, which sets a floor on what children can use.

2.4 Homework, outcomes and the pandemic test

Evidence on home technology and student outcomes is mixed, and this study does not claim that a laptop raises test scores. A randomized trial that gave free computers to California schoolchildren found no effect on grades or test scores (Fairlie & Robinson, 2013). Reviews of the K-12 divide find that, as the binary gap in access narrowed, unequal use of technology at home and in school persisted (Dolan, 2016; Warschauer & Matuchniak, 2010). The claim here is narrower: when schools assign online work, thin access makes that work harder to complete at home.

The pandemic tested this assumption. During spring 2020, students with high-speed internet and internet-enabled devices showed higher engagement with remote learning, even after controls for family resources (Domina et al., 2021). Internet searches for online learning resources rose much more in higher-income areas than in lower-income and rural ones (Bacher-Hicks et al., 2021). Black and Hispanic households reported less reliable internet and devices for remote learning (Francis & Weller, 2022). Rural Washington districts reported fewer students with a device adequate for online learning and named smartphone-only connectivity as a barrier (Graves et al., 2021). These studies show that device and connection type mattered when school moved home.

2.5 Gap in prior work

Most national evidence on children's connection type comes from short windows or broad categories. Dolcini et al. (2021) used the Current Population Survey to show that Black, Hispanic and low-income adolescents had lower access and different modes of access in 2015 and 2017. Pandemic studies

used surveys from 2020 and 2021 (Haderlein et al., 2021). No study, to the author's knowledge, has used the full ACS microdata to track cellular-only and smartphone-only access among all school-age children across the pandemic, or compared this experienced access with the headline count. This study fills that gap.

3. Methods

3.1 Data

The data are the ACS 1-year PUMS files for the United States for survey years 2016, 2017, 2018, 2019, 2021, 2022, 2023 and 2024 (U.S. Census Bureau, 2025). Each file is a sample of about 1% of US households, with separate housing and person records. The housing record holds the internet and device items. The person record holds age, race, Hispanic origin and the person weights. The 2020 survey year is excluded because the Census Bureau did not release standard 1-year PUMS files for 2020. The study begins in 2016 because the variable lists for every year from 2016 to 2024 carry the same subscription and device items, which allows a consistent series.

The Census Data API now requires a registration key, so the study downloaded the bulk PUMS CSV files from the Census Bureau archive instead. For each year, code merged person and housing records by household serial number and kept children aged 5 to 17 who live in housing units. Children in group quarters are excluded because the internet items are not asked there. The final sample has 3,852,695 child records, from 471,842 in 2021 to 490,502 in 2017, representing 53.4 to 54.7 million children each year. In 2023 and 2024 the Census Bureau suppressed the internet items for a small number of areas, and the 200 affected child records (93 in 2023 and 107 in 2024) are dropped.

Metro status is not in the PUMS files, so the study built it. Each Public Use Microdata Area (PUMA), the smallest geography in the files with about 100,000 residents, was linked to its census tracts using Census tract-to-PUMA relationship files. Each tract was then linked to its county and to the Office of Management and Budget metropolitan delineations of March 2013 (for 2010 PUMAs, used through 2021) and March 2020 (for 2020 PUMAs, used from 2022). A PUMA is classed as non-metro when most of its tracts lie outside any Metropolitan Statistical Area. Tract counts stand in for population, because tracts are drawn to hold similar numbers of people.

3.2 Measures

The ACS asks whether anyone in the household has access to the internet by paying a provider, has access without paying, or has no access. Households that pay are asked which services they have: a cellular data plan for a smartphone or other mobile device; broadband such as cable, fiber optic or DSL; satellite; dial-up; or another service. A second item asks which devices the household owns: a desktop or laptop, a smartphone, a tablet or other portable wireless computer, or some other computer. All measures describe the household in which the child lives, and estimates are shares of children.

Connection type is coded into six mutually exclusive groups, ordered from fullest to thinnest. Wired broadband means cable, fiber or DSL. Satellite or other service means satellite or another fixed service without wired broadband. Cellular data plan only means a paid cellular plan with no wired, satellite or other service. The remaining groups are dial-up only, access without a paid subscription, and no internet access. A fixed home service means any of the first two groups. Device type is coded in the same way: desktop or laptop; tablet but no desktop or laptop; smartphone only, meaning a smartphone and no other device; and no computing device.

These items work as a sorting system with fixed rules. The device item places a smartphone in the same list as a desktop, so any household with a phone has a computer in the ACS sense. The subscription item lists a cellular data plan next to cable and fiber, and the Census Bureau's published broadband totals add them together. A household answers once for all its members, so the items say nothing about who in the home can use a given device or plan. The analysis below keeps the categories separate and rebuilds the summary measures from them.

Two summary measures carry the argument. A child is counted as connected when the household has any paid subscription and any computing device, including a smartphone. This matches how the ACS headline tables count broadband and computer access. A child is schoolwork-ready when the household has a fixed home service and a desktop or laptop. The study calls the difference thin access: a child who is counted as connected but is not schoolwork-ready. The schoolwork-ready threshold is a judgment, not an official standard. It reflects the three limits of mobile-only access set out in Section 2.3, and Section 6 discusses where it may misclassify homes.

Covariates come from the child and the householder. Household income is grouped into quintiles of the child distribution within each year, which avoids inflation adjustment. Income-to-poverty ratio is grouped as below 100%, 100% to 199%, 200% to 399%, and 400% or more. Race and ethnicity has seven groups: Hispanic of any race, and non-Hispanic White, Black, Asian, American Indian or Alaska Native, Native Hawaiian or Pacific Islander, and multiracial or other. Other covariates are the householder's education, renter status, a limited-English household flag, the number of children aged 5 to 17 in the home, the child's age group and the state.

3.3 Analysis

All estimates use the PUMS person weight. Standard errors use the 80 replicate weights supplied with the files and the successive difference formula, in which the variance is 4/80 times the sum of squared differences between each replicate estimate and the full-sample estimate. Confidence intervals are 95% intervals. For RQ1 and RQ2, the study estimates shares by year, by group and by state. For state comparisons it reports 2016, 2019 and 2024.

For RQ3, the study fits weighted logistic regressions of not being schoolwork-ready on income quintile, race and ethnicity, metro status, householder education, renter status, limited English, number of children, child age and state indicators. It fits the model for 2019, the last year before the pandemic, and for 2024. A third model, for 2024, restricts the sample to children counted as connected and models thin access. Standard errors are clustered by PUMA. Results are reported as average marginal effects, meaning the average change in predicted probability, in percentage points, when every child is moved from the reference

category to a given category. The models describe associations and do not identify causal effects. All code is written in R and runs from the raw downloads to the figures.

4. Findings

4.1 The headline count closed while schoolwork-ready access lagged (RQ1)

Table 1 and Figure 1 show the two measures over time. The share of children counted as connected rose from 89.2% in 2016 to 92.9% in 2019 and to 96.7% in 2024. Over the same period the share with no internet access at all fell from 7.8% to 1.6%. In 2016, 4.2 million children lived in homes with no internet. By 2024 this number had fallen to 0.9 million. On the headline measure, the divide among children has nearly closed.

Table 1. Home internet and device access among US children aged 5 to 17, by survey year (percent, 95% confidence interval)

Year	Sample n	Children (m)	Connected	Schoolwork-ready	Thin access	No internet	Cellular only	Smartphone only
2016	485,749	53.6	89.2 (89.0, 89.4)	72.4 (72.1, 72.7)	16.8 (16.6, 17.1)	7.8 (7.6, 8.0)	11.9 (11.7, 12.2)	6.8 (6.7, 7.0)
2017	490,502	53.6	90.8 (90.6, 91.0)	73.2 (72.9, 73.5)	17.6 (17.4, 17.8)	6.5 (6.3, 6.7)	12.0 (11.8, 12.2)	7.1 (6.9, 7.3)
2018	484,247	53.5	92.0 (91.8, 92.1)	73.9 (73.7, 74.2)	18.1 (17.9, 18.3)	5.5 (5.4, 5.7)	11.8 (11.7, 12.0)	7.4 (7.2, 7.5)
2019	476,951	53.4	92.9 (92.7, 93.1)	74.4 (74.1, 74.8)	18.5 (18.2, 18.7)	4.9 (4.7, 5.0)	11.5 (11.3, 11.7)	7.8 (7.6, 8.0)
2021	471,842	54.7	95.6 (95.5, 95.7)	80.5 (80.3, 80.7)	15.1 (14.9, 15.3)	2.5 (2.4, 2.6)	9.1 (9.0, 9.3)	4.9 (4.8, 5.0)
2022	485,533	53.8	95.6 (95.5, 95.7)	79.6 (79.4, 79.9)	16.0 (15.8, 16.2)	2.3 (2.2, 2.4)	9.3 (9.2, 9.5)	5.3 (5.2, 5.5)
2023	481,624	54.1	96.2 (96.1, 96.3)	79.1 (78.9, 79.4)	17.1 (16.8, 17.3)	1.9 (1.8, 1.9)	9.7 (9.6, 9.9)	5.6 (5.5, 5.8)
2024	476,247	54.4	96.7 (96.6, 96.8)	78.9 (78.7, 79.1)	17.8 (17.6, 18.1)	1.6 (1.6, 1.7)	10.3 (10.1, 10.4)	5.6 (5.4, 5.7)

Schoolwork-ready access moved much less. It rose from 72.4% in 2016 to 74.4% in 2019, jumped to 80.5% in 2021, and then fell back each year to 78.9% in 2024. The decline after 2021 is small but steady, and the confidence intervals for 2021 and 2024 do not overlap. In 2024, 21.1% of children, or 11.5 million, were not schoolwork-ready. This is 13 times the number of children with no internet.

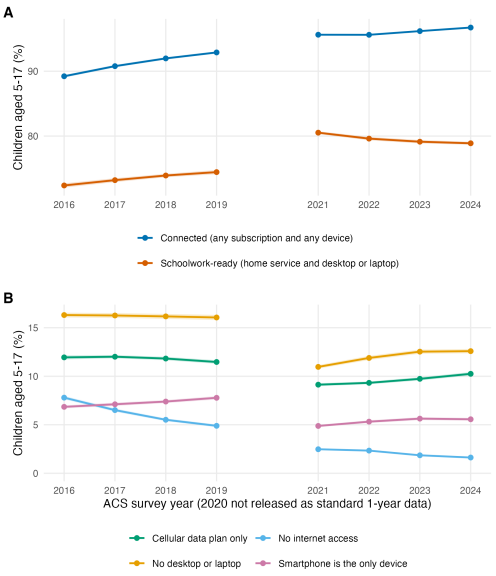


Figure 1. Connected versus schoolwork-ready access among US children aged 5 to 17, 2016 to 2024. Panel A compares the headline count (any subscription and any device) with schoolwork-ready access (fixed home service and a desktop or laptop). Panel B shows the components of thin access. Shaded bands are 95% confidence intervals from replicate weights; most are narrower than the line. No standard 1-year data exist for 2020.

The gap between the two measures is thin access. It grew from 16.8% of children in 2016 to 18.5% in 2019, dipped to 15.1% in 2021, and rose again to 17.8% in 2024. In numbers, 9.0 million children had thin access in 2016 and 9.7 million in 2024. The composition of the children who were not schoolwork-ready changed sharply. In 2016, 61.0% of them were counted as connected, and the rest had no subscription or no device. In 2019 the share was 72.2%, and in 2024 it was 84.5%. The problem that remains is almost entirely one that the headline count records as solved.

Panel B of Figure 1 shows what thin access is made of. The share of children whose household relied on a cellular data plan alone fell from 11.9% in 2016 to 9.1% in 2021, then rose each year to 10.3% in 2024. The share of children in homes where a smartphone was the only device rose from 6.8% in 2016 to 7.8% in 2019, fell to 4.9% in 2021 and rose again to 5.6% in 2024. The share without a desktop or laptop followed the same path, from 16.3% in 2016 to 11.0% in 2021 and 12.6% in 2024. The pandemic years brought a burst of laptops and wired service into children's homes, and part of that gain has since worn away.

Among the 9.7 million children with thin access in 2024, 57.0% lacked a fixed home service and 56.8% relied on a cellular plan

alone. Some 60.0% lacked a desktop or laptop, and 17.1% lacked both. For 28.1% of them, a smartphone was the only device in the home, and for 31.8% the home had a tablet but no desktop or laptop. Thin access therefore takes two main forms that overlap only in part: homes with a computer but only a cellular plan, and homes with fixed service but no computer.

4.2 Who has thin access: income, race and ethnicity, and place (RQ2)

Figure 2 compares the two measures across groups in 2024. On the connected measure, groups look similar. Children in the lowest income quintile were counted as connected at 93.4%, against 98.5% in the highest quintile. On the schoolwork-ready measure, the same children were 59.6% and 92.4%. Thin access affected 33.8% of children in the lowest quintile and 6.2% in the highest. Children below the poverty line show the same pattern, with 92.8% connected but 59.0% schoolwork-ready.

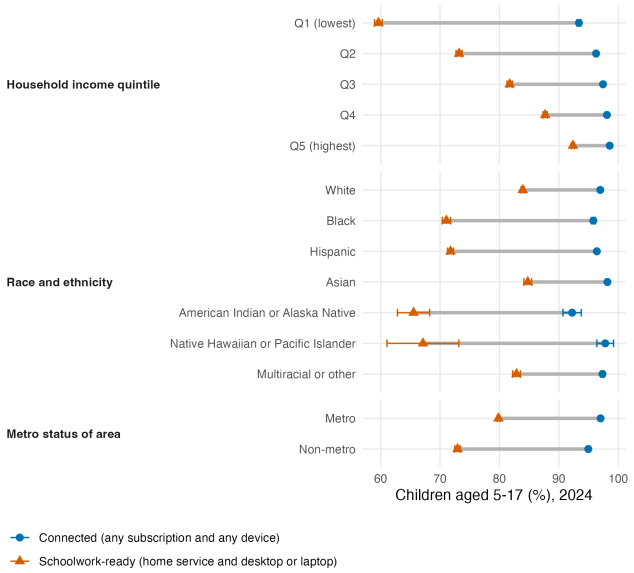


Figure 2. Connected and schoolwork-ready shares of US children aged 5 to 17 by household income quintile, race and ethnicity, and metro status, 2024. The grey bar between the two points is the share with thin access. Error bars are 95% confidence intervals from replicate weights.

The income gap in the headline count closed far faster than the gap in usable access. In 2016 the difference between the highest and lowest quintile was 22.6 percentage points on the connected measure and 46.4 points on the schoolwork-ready measure. By 2024 the connected gap had shrunk to 5.2 points, but the schoolwork-ready gap was still 32.7 points. Thin access, measured as the lowest minus the highest quintile, widened from 23.8 points in 2016 to 27.6 points in 2024. An analyst using the headline measure would conclude that the income divide had almost vanished, which the schoolwork-ready measure does not support.

Race and ethnicity show the same split. In 2024 Black children were counted as connected at 95.8% and Hispanic children at 96.4%, close to the 97.0% of White children. Yet 71.1% of Black children and 71.8% of Hispanic children were schoolwork-ready, against 83.9% of White children. Thin access affected about a quarter of Black and Hispanic children (24.7% and 24.6%) and 13.1% of White children. American Indian and Alaska Native children had the lowest schoolwork-ready share at 65.5%, and 4.6% had no internet at all. Native Hawaiian and Pacific Islander children were counted as connected at 97.8%, but only 67.1% were schoolwork-ready, so 30.7% had thin access. Estimates for these two smaller groups have wider intervals, as Figure 2 shows.

Figure 3 shows which kind of thin access each group had. A cellular data plan alone served 17.1% of children in the lowest income quintile and 4.8% in the highest. A smartphone was the only device for 14.0% of the lowest quintile and 0.9% of the highest. Black and Hispanic children were more likely than White children to rely on a cellular plan alone (13.8% and 13.1% against 8.1%). They were also more likely to live in smartphone-only homes (8.8% and 8.9% against 3.3%). Among American Indian and Alaska Native children, 10.8% lived in smartphone-only homes, and satellite or other services were more common than in any other group.

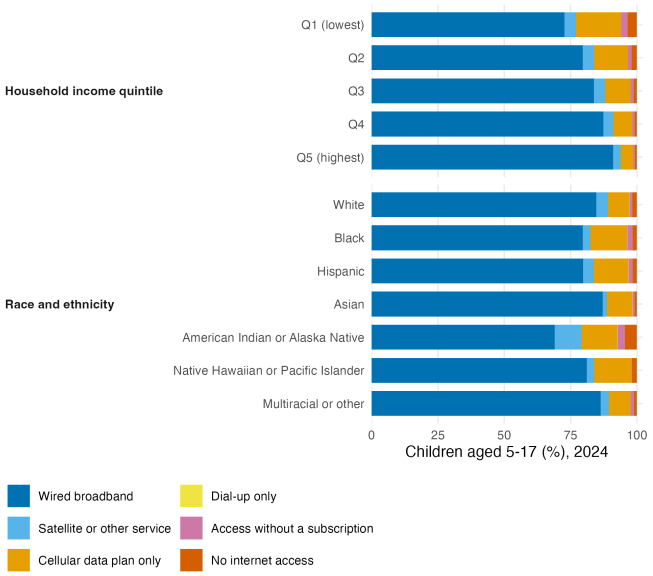


Figure 3. Type of home internet connection among US children aged 5 to 17 by household income quintile and race and ethnicity, 2024. Categories are mutually exclusive and ordered from wired broadband to no internet access.

Place matters as well. In 2024, 95.0% of children in non-metro areas were counted as connected, against 97.0% in metro areas. The schoolwork-ready shares were 72.9% and 79.8%. Non-metro children were more likely to rely on a cellular plan alone (11.9% against 10.0%), to have no internet (3.2% against 1.4%) and to live in smartphone-only homes (7.8% against 5.2%). The non-metro gap narrowed since 2016, when only 84.9% of non-metro children were counted as connected and 11.6% had no internet.

The states show the measurement gap most clearly. In 2016 only 1 of the 51 jurisdictions (the 50 states and the District of Columbia) had a connected share of 95% or more. By 2019 there were 10, and by 2024 there were 47. On the headline measure, the states have converged. Figure 4 shows that the share of children who were not schoolwork-ready still varied more than twofold in 2024, from 12.1% in New Hampshire to 28.9% in Mississippi. In 27 jurisdictions at least one child in five was not schoolwork-ready.

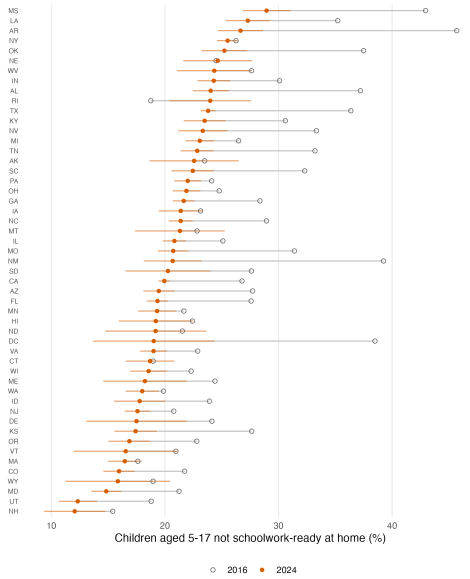


Figure 4. Share of children aged 5 to 17 who were not schoolwork-ready at home, by state, 2016 and 2024. States are ordered by the 2024 share. Bars are 95% confidence intervals for 2024 from replicate weights.

The share of children who were not schoolwork-ready fell in 49 of 51 jurisdictions between 2016 and 2024, with the largest falls in the District of Columbia, Arkansas, New Mexico and Mississippi. Thin access, however, rose in 32 jurisdictions over the same period. Across states, the connected share and the not-ready share were correlated at -0.58 in 2024, so the headline count tells part of the story. It misses the rest. New York had the lowest connected share in 2024 at 93.9%, and its not-ready share of 25.5% was fourth highest. Arkansas was counted as 96.3% connected, close to the national figure, but 26.7% of its children were not schoolwork-ready. State estimates for small states have standard errors of up to 2.7 percentage points, so close rankings should not be over-read.

4.3 What predicts the lack of schoolwork-ready access (RQ3)

Table 2 reports average marginal effects from the three weighted logistic models. Income and householder education are the strongest predictors. In 2024, a child in the highest income quintile was 16.8 percentage points less likely to lack schoolwork-ready access than an otherwise similar child in the lowest quintile. A child whose householder had no high school diploma was 23.2 points more likely to lack it than a child whose householder had a bachelor's degree. These associations were somewhat weaker than in 2019, when the figures were 22.3 and 26.1 points.

Table 2. Average marginal effects on the probability of lacking schoolwork-ready access (percentage points, 95% confidence interval)

Variable	Not ready, 2019	Not ready, 2024	Thin among connected, 2024
Income quintile (ref. Q1, lowest)			
Q2	-9.2 [-10.0, -8.4]	-6.8 [-7.6, -6.1]	-5.9 [-6.6, -5.1]
Q3	-14.6 [-15.4, -13.7]	-10.9 [-11.6, -10.1]	-9.6 [-10.3, -8.9]
Q4	-18.2 [-19.1, -17.3]	-13.8 [-14.6, -13.0]	-12.4 [-13.2, -11.7]
Q5 (highest)	-22.3 [-23.3, -21.4]	-16.8 [-17.6, -15.9]	-15.4 [-16.2, -14.6]
Race and ethnicity (ref. White)			
Black	5.4 [4.4, 6.4]	3.9 [3.0, 4.9]	4.2 [3.3, 5.1]
Hispanic	3.6 [2.8, 4.4]	2.0 [1.2, 2.8]	3.1 [2.4, 3.7]
Asian	-4.8 [-6.1, -3.6]	-0.6 [-1.9, 0.6]	0.5 [-0.6, 1.7]
American Indian or Alaska Native	11.9 [7.9, 15.9]	7.7 [4.7, 10.8]	6.4 [3.6, 9.3]
Native Hawaiian or Pacific Islander	9.3 [3.9, 14.7]	7.8 [2.3, 13.3]	9.3 [3.8, 14.9]
Multiracial or other	-1.0 [-2.1, 0.0]	-0.4 [-1.2, 0.5]	0.0 [-0.8, 0.8]
Area (ref. metro)			
Non-metro	7.4 [6.5, 8.2]	4.5 [3.7, 5.3]	3.7 [2.9, 4.5]
Householder education (ref. bachelor's or higher)			
Some college or associate	8.0 [7.4, 8.6]	6.1 [5.5, 6.7]	5.5 [4.9, 6.0]
High school or GED	17.2 [16.5, 18.0]	15.1 [14.4, 15.8]	13.6 [13.0, 14.3]
No high school diploma	26.1 [25.0, 27.1]	23.2 [22.1, 24.3]	19.5 [18.6, 20.5]
Renter household (ref. owner)	7.1 [6.5, 7.7]	4.8 [4.2, 5.4]	4.5 [4.0, 5.1]
Limited-English household (ref. no)	8.3 [7.0, 9.5]	11.3 [10.0, 12.7]	10.1 [8.8, 11.3]
Children aged 5-17 in home (ref. 1)			
2	-1.4 [-1.8, -0.9]	-1.3 [-1.7, -0.8]	-1.2 [-1.6, -0.7]
3 or more	-0.2 [-0.8, 0.5]	-1.4 [-2.1, -0.7]	-1.8 [-2.4, -1.2]
Child age (ref. 5-10)			
11-13	-2.4 [-2.8, -2.0]	-1.6 [-2.0, -1.2]	-1.6 [-2.0, -1.3]
14-17	-3.4 [-3.8, -3.0]	-2.5 [-2.9, -2.2]	-2.6 [-2.9, -2.2]

Children (unweighted n)	476,951	476,247	461,053
McFadden pseudo R-squared	0.172	0.130	0.126

Several household conditions add to the risk after income and education are held constant. Living in a limited-English household, where no one aged 14 or over speaks only English or speaks it very well, raised the probability by 11.3 points in 2024, up from 8.3 points in 2019. Renting rather than owning raised it by 4.8 points. Living in a non-metro area raised it by 4.5 points, down from 7.4 points in 2019. Compared with White children, the probability was 3.9 points higher for Black children, 2.0 points higher for Hispanic children, 7.7 points higher for American Indian and Alaska Native children and 7.8 points higher for Native Hawaiian and Pacific Islander children. The Asian estimate was close to zero in 2024, after being 4.8 points lower in 2019.

The third model asks who has thin access among children already counted as connected. The pattern is almost the same as in the model for all children. Among connected children, the highest income quintile was 15.4 points less likely to have thin access than the lowest, and limited-English households were 10.1 points more likely. Black and Hispanic children were 4.2 and 3.1 points more likely than White children to have thin access. The groups that the headline count now records as connected are the same groups that the older, cruder divide left out.

One result runs against the sharing argument. Children in homes with three or more school-age children were slightly less likely to lack schoolwork-ready access (1.4 points in 2024). Older children were also less likely than children aged 5 to 10 to lack it. The ACS records whether a household has a laptop, not how many, so these estimates cannot show how a single device is shared among siblings. Larger families may also be more likely to have bought a computer at all.

4.4 Sensitivity to the schoolwork-ready threshold

Because the schoolwork-ready threshold is a judgment, the study repeated the main comparisons with a looser and a stricter version. The looser version counts any paid subscription, including a cellular plan alone, plus a desktop or laptop. Under this definition, 79.7% of children were ready in 2016, 87.0% in 2021 and 86.0% in 2024, and the income gap between the highest and lowest quintile was 27.7 points in 2024. The stricter version requires wired broadband, not satellite or other service, plus a desktop or laptop. Under it, 69.4% of children were ready in 2016, 77.4% in 2021 and 75.6% in 2024, with an income gap of 33.0 points in 2024.

Two results hold under all three thresholds. The ready share fell after 2021, and the income gap in 2024 was between 27.7 and 33.0 points, five to six times the 5.2-point gap on the connected measure. The looser threshold matters most for the size of the problem, not its shape. Even if a cellular plan with a laptop is treated as adequate, 14.0% of children were not ready in 2024 because their home lacked a desktop or laptop or any paid service.

5. Discussion

The findings answer the three research questions with one story. On the official count, the home access divide among US children nearly closed between 2016 and 2024. On a measure tied to schoolwork, more than one in five children still lacked usable access in 2024, and the share has fallen since 2021. The children left behind are no longer mainly unconnected. They live in homes with a cellular plan, a smartphone or a tablet, and the counting system records them as connected.

5.1 How the counting system produces the gap

The ACS internet items are a classification system. They collapse fiber service and a capped phone plan into one category called broadband, and they place a phone in the same category as a laptop. This choice is reasonable for tracking adoption, and the ACS publishes the detail that this study uses. The problem arises when the summary category becomes the policy measure. Espeland and Stevens (1998) describe commensuration as turning different qualities into a common metric, which makes them comparable and hides how they differ. The "connected" count does this for home access, and the hidden difference is the one that matters for homework.

The results show this effect in numbers. The income gap on the headline measure shrank by more than three quarters, from 22.6 to 5.2 points, while the gap on the schoolwork-ready measure shrank by about 30%, from 46.4 to 32.7 points. Forty-seven jurisdictions crossed 95% connected, yet 27 still had at least a fifth of children without schoolwork-ready access. An evaluation based on the headline count would report success. The experience of children in thin-access homes, which earlier field studies describe as unstable and constrained (Gonzales, 2016; Katz, 2017), is not captured by that count.

The stakes go beyond description. If agencies or school districts judge whether access programs are still needed from the connected count, a figure near 100% makes further spending look unnecessary. The data here show that the children who still lack usable access are concentrated in low-income, Black, Hispanic, Native and non-metro homes. A measure that records them as connected can move them out of view at the point where their access is thinnest.

5.2 From no access to material access

The shift in the composition of the not-ready group, from 61.0% connected in 2016 to 84.5% in 2024, matches the move from physical to material access described in the Dutch case (van Deursen & van Dijk, 2019). The access problem for US children is now mostly a problem of which service and which device, not whether any exists. This fits the mobile underclass argument of Napoli and Obar (2014). It also fits evidence that mobile-only users do a narrower range of things online (Correa et al., 2020; Reisdorf et al., 2022). The present data cannot show what children do online. They do show that the groups most often described as mobile-dependent in adult samples (Tsetsi & Rains,

2017) are also the groups whose children most often have thin access.

The two forms of thin access point to different limits. A child in a home with a laptop but only a cellular plan faces data caps and tethering, which Prince and Greenstein (2021) suggest bind hardest on low-income users. A child in a home with wired service but only a phone or tablet faces the small-screen costs that Ghose et al. (2013) describe. A child in a smartphone-only home faces both, and 28.1% of children with thin access in 2024 were in that position. Policies that address only one limit, such as hotspot lending or device lending, will reach only part of the group.

5.3 The pandemic gain and its erosion

The 2021 data show a clear jump in laptops and wired service in children's homes, consistent with the push to equip students for remote learning. Haderlein et al. (2021) document wide differences in families' access to technology and instruction during that period. Between 2021 and 2024, the share of children without a desktop or laptop rose from 11.0% to 12.6%, and cellular-only access rose from 9.1% to 10.3%. These are modest changes, but they reverse the earlier trend. One plausible reading is that some school-issued devices were returned or wore out and that some households dropped home service once remote school ended. The ACS cannot test these mechanisms, and other explanations, such as changes in household budgets or in mobile plan prices, are possible.

5.4 Implications

Three implications follow. First, agencies and schools that report home access should report the connection and device types that the ACS already collects, alongside the subscription total. The schoolwork-ready measure used here can be built from published ACS items. Second, efforts to close the homework gap should treat a cellular plan as a partial connection, and should pair connectivity with a computer. Studies of wireless programs for disconnected students point to the same need to match technical options with household conditions (Reisdorf et al., 2019). Third, groups that the models single out, such as limited-English, renter and American Indian households, face thin access beyond what income predicts, and outreach should reach them directly.

6. Limitations

The study has several limits. The schoolwork-ready measure is a threshold set by the author, not a validated standard. Some homes with only a cellular plan may have unlimited data and fast 5G service, and some homes with a laptop may have one old machine shared by many people. The measure will misclassify both. The ACS does not record speed, data limits, device age or the number of devices, so the study cannot measure these directly. The "other service" category is also ambiguous and may include fixed wireless service.

All measures describe households, not children. A household laptop may belong to a parent who uses it for work. The data do not show whether children use the internet for schoolwork or how well they do in school. The regression models describe associations. They do not show that income or education causes thin access, and unmeasured factors such as local provider prices and school device programs are not included.

The internet items are self-reported by one household member. Respondents may not know which technology delivers their service, and some may report a cellular hotspot or fixed wireless service as "other" or as broadband. Such errors would blur the line between cellular-only and fixed service. They are unlikely to explain the steady income and race patterns in the data, but they add uncertainty to the exact size of the cellular-only group.

The metro classification is approximate. It assigns each PUMA to metro or non-metro by the majority of its census tracts, and some PUMAs mix both kinds of area. The change in PUMA boundaries in 2022 may also add noise to metro comparisons across years. Finally, the series has no 2020 point, and the 2021 survey was collected while many schools were still remote, so the 2021 peak may partly reflect temporary conditions.

7. Conclusion

By 2024 the official count recorded 96.7% of US school-age children as connected at home. On a measure tied to schoolwork, 78.9% had usable access, and 11.5 million children did not. Most of these children, 84.5% in 2024, were counted as connected through a cellular plan, a smartphone or a tablet. The gap between the two measures was widest for low-income, Black, Hispanic, American Indian and Pacific Islander children, for children in limited-English and non-metro homes, and in states such as Mississippi, Louisiana and Arkansas. The homework gap has not closed. It has moved into the category that the counting system treats as closed, and measuring it again requires reporting the type of connection and device as well as their presence.

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Ethics statement

This study is a secondary analysis of publicly available, de-identified data from the US Census Bureau. No human participants were contacted, and no ethics approval was required.

Data availability statement

All data are public. American Community Survey 1-year Public Use Microdata Sample files, 2016 to 2019 and 2021 to 2024, US Census Bureau: https://www2.census.gov/programs-surveys/acs/data/pums/ (documentation at https://www.census.gov/programs-surveys/acs/microdata.html), accessed October 2026. 2010 Census tract to 2010 PUMA relationship file: https://www2.census.gov/geo/docs/maps-data/data/rel/2010_Census_Tract_to_2010_PUMA.txt, accessed October 2026. 2020 Census

tract to 2020 PUMA relationship file: https://www2.census.gov/geo/docs/maps-data/data/rel2020/2020_Census_Tract_to_2020_PUMA.txt, accessed October 2026. Core based statistical area delineation files, March 2013 and March 2020: https://www2.census.gov/programs-surveys/metro-micro/geographies/reference-files/, accessed October 2026. The analysis code will be deposited in a public repository on acceptance; it is withheld during review only to keep the review anonymous.

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