

Bridging the Digital Divide: Digital Inequality and Socioeconomic Outcomes in the United States

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Abstract

The digital divide is no longer just a matter of access to the Internet, but rather a social stratification dimension that impacts education, employment, health and civic engagement in the United States. This review collates empirical and theoretical evidence concerning digital inequality and classifies the evidence in three common analytic approaches: the first level divide (access to infrastructure and devices), the second level divide (digital skills and use) and the third level divide (differences in tangible outcomes of technology use). The review is based on data from national surveys, epidemiological analyses of underserved communities at the county level, and qualitative studies of underserved populations, and shows that income, race and ethnicity, geography, age and education continue to be important factors in determining who is connected, who is digitally literate, and who can use connectivity to advance social and economic outcomes. The COVID-19 pandemic is explored as a turning point that revealed and exacerbated these inequities in the learning environment, in telehealth and in working from home. The review concludes with a discussion of federal and state policy responses to the problem (subsidy and infrastructure programs) and a description of areas of longitudinal and causal research that are missing or inconclusive to evaluate whether current policy interventions can encourage longer-term socioeconomic mobility.

INTRODUCTION

Information and communication technologies (ICTs) serve as the backbone of Americans' use for applying for jobs, completing school work, seeking assistance with chronic conditions, and participating in civic activities. With digital participation becoming less of a luxury and more a near requirement for full social and economic inclusion, inequalities in access to and use of digital technologies are a means by which socioeconomic inequities are reproduced and sometimes exacerbated (van Dijk, 2020). The concept of “digital divide” was originally presented as a dichotomous split between “information poor” and “information rich” but the idea of technology based inequality has been challenged for a long time (DiMaggio & Hargittai, 2001; Hargittai, 2002).

The current research, on the other hand, conceptualizes digital inequality as a multi-layered phenomenon, where the first layer of digital inequality is the physical and material accessibility of devices and connectivity, the second layer is the differences in digital skills, the third layer is the diversity of what is done with the internet, and the fourth layer is the differential outcomes that digital engagement creates: educational attainment, employment opportunity, income growth, and health status (van Deursen & van Dijk, 2019; van Dijk, 2005). This review will explore the empirical and conceptual research on digital inequity in the United States through this lens, with a particular emphasis on where digital inequity and income, race/ethnicity, geography, and age intersect and on the implications for socioeconomic outcomes.

The conceptual framework for structuring the review is described in Section 2 of this review as follows: In section 3, the first digital divide in the United States is examined, while the second digital divide is examined in section 4. In Section 5, literature on the connection between digital inequality and education, employment, health, and civic engagement is summarized. Section 6 examines COVID-19 pandemic as an agent of these dynamics. Section 7 presents the literature review of policy responses and Section 8 discusses gaps in the literature and directions for future research.

CONCEPTUAL FRAMEWORK: LEVELS OF THE DIGITAL DIVIDE

The most influential of this literature is the sequential model of technology adoption proposed by van Dijk (2005, 2020) which consists of the following steps: motivation and attitudes, physical access, digital skills, and usage and outcomes. According to the resources and appropriation theory of van Dijk, these inequalities can manifest themselves at any stage of this process, and categorical social inequalities (income, education and position in the labour market) lead to asymmetrical access to digital resources, which in turn leads to unequal participation in society (van Dijk, 2005). Van Deursen and van Dijk (2019) also broke down physical access into three aspects: device ownership, diversity of devices, and costs of having devices, software and subscriptions and proposed that the physical access gap remains and is a determinant of the gap in skills and usage.

The notion of a parallel body of work entails a first divide between access and a second one between skills and use (Hargittai, 2002), and, more recently, a third one between tangible benefits and outcome of internet use (van Deursen & van Dijk, 2014). DiMaggio and Hargittai (2001) were among the first to propose that if the Internet was ubiquitous, the more important aspect of inequality would be the quality and use of the Internet. However, the argument was further developed by Robinson

et al. (2015) who said that access to technology and social advantage are mutually reinforcing and that digital inequalities can be seen as a result as well as a cause of social inequalities. The rest of this review is structured at the following three levels: access, skills and use, and outcomes.

ACCESS INEQUALITY IN THE UNITED STATES (FIRST-LEVEL DIVIDE)

Data from the national surveys indicate that basic Internet access is widespread but not ubiquitous in the United States, and is tightly tied to income, age, and geography. Although the vast majority of adults in the U.S. now use the internet and own a smartphone, there are still some differences in how adults use these technologies based on their education and household income, according to Pew Research Center (2024). More recent tracking data show that home broadband subscription is more likely to be true of adults in the top income group; six-figure income households are more likely to subscribe to home broadband than those in the lowest income group (Pew Research Center, 2026).

Geography exacerbates these income effects. Additionally, high-speed internet access is a community concern at significantly higher rates in rural communities, with the fixed costs of wireline service being higher in low-density areas than suburban and urban communities (Pew Research Center, 2026). Despite accounting for income, there are still significant racial and ethnic differences in access to a traditional computer and high speed home internet: Black and Hispanic adults are less likely than White adults to have a traditional computer and high speed home internet (Pew Research Center, 2026).

Access research has also been transcended from simply connected versus unconnected, to the question of the quality of connections. Households that rely solely on their smartphones to gain access to the internet, but do not have a fixed broadband connection, struggle to do jobs on a larger screen, with stable internet connections or for longer periods of internet use, such as school work, telehealth services, etc. (van Deursen & van Dijk, 2019). The distinction between "connected" and "adequately connected" is the first step in understanding the disconnect between the headline connectivity figures and the access rates.

DIGITAL SKILLS AND USAGE INEQUALITY (SECOND-LEVEL DIVIDE)

There are considerable variations in the capacities required to effectively use digital technologies, and in the way digital technologies are used among people who have access to them. Hargittai (2002) revealed that there are differences between Internet users in terms of operational, informational, and strategic skills, which are associated with education, age, and prior experience with technology but not with access to the Internet. These second-level divisions have proven to be persistent: van Deursen and van Dijk (2014) demonstrated that when access increased more in the Netherlands, it was differences in access in terms of the frequency and variety of internet use – not access per se – that became the main axis of digital inequality, as was the case in other contexts, including in the United States where access increased in domains ranging from higher education to health information seeking (Hargittai & Dobransky, 2017).

There is not an equal level of skill inequality among all age groups. Even older adults, who were connected, Hargittai and Dobransky (2017) have found that their skills were less and their uses of the internet were more limited than those of younger

age groups, and thus their access to reliable health information. Two forms of digital divide were identified to co-exist in higher education, and the barriers to success that students identified were not statistically associated with being first or second generation students or with household income alone in a qualitative study of underserved college students at a U.S. university (see Section 5.1 discussion of online education).

Community-level: Reddick et al. (2020) surveyed residents of a large U.S. city and identified different types of digital exclusion, including a mix of low digital literacy, limited access, and limited device diversity, indicating that access, skills and usage should be assessed separately but as related indicators.

DIGITAL INEQUALITY AND SOCIOECONOMIC OUTCOMES

The third and most policy-relevant, and arguably most important dimension of the digital divide is the impact on outcomes of access and skills disparities. This section provides an overview of the four domains: education, employment and income, health and civic and social participation.

EDUCATION

The most widely documented impact of digital inequity in the U.S. is the "homework gap" - the gap that exists for children who do not have reliable internet access and a specific computer in their home, making it hard to do homework that requires the internet (All4Ed, 2022). Students without Internet access at home spent more time on homework compared to students with Internet access at home and were significantly more likely to not complete the homework assignment because of Internet access or equipment (All4Ed, 2022). In a large-scale study, students with limited access or none to the Internet at home or to a cell phone data plan had lower digital skills, lower homework completion, lower GPA, and less interest in college and/or STEM-related career compared to their peers who had access to a home Internet connection or unlimited cell phone data plan, controlling for other socioeconomic factors (Hampton et al., 2020). Now the Internet and Social is the keen promotional tools for Libraries and online resources as derived by (Ullah et al., 2024).

The disparities aren't just in K-12 learning. However, the online environment continues to exacerbate the inequities between first and second level divides for college students who do not have a reliable device and access to the internet, as shown by Reddick et al. (2020) and other studies on digitally underserved college students in the online environment.

EMPLOYMENT AND INCOME

Access to, and digital skills, are fundamental prerequisites for full engagement in the labour market, while recruitment, remote working and communication in the workplace more often than not takes place online. People without reliable access to the internet, a device or basic digital literacy skills are effectively shut out of an ever-growing number of job postings, online application systems and remote/hybrid work opportunities compared to others who have access to the internet and a suitable device, and who can operate and use digital systems (Lythreatis et al., 2022). According to several reviewers (Lythreatis et al., 2022), digital exclusion is highly concentrated in already low-income and rural communities, which may exacerbate – rather than reduce – existing economic inequalities.

HEALTH

The digital divide is recognized as a social determinant of health. Hargittai and Dobransky (2017) found that people who were less skilled with the Internet were less likely to access accurate health information in a study that had implications downstream and were more likely to come from lower socioeconomic groups. This link was clearly strengthened by the COVID-19 pandemic. Using county-level data, Li (2022) found that the counties that were digitally excluded and had larger populations experienced a higher COVID-19 case rate, higher COVID-19 mortality rate, and lower COVID-19 vaccination rate by January 2022, which is a reflection of the increasing digitization of access to public health information, testing, and vaccination scheduling during the COVID-19 pandemic.

This trend is supported by the research on telehealth. During the pandemic, telemedicine has been a valuable tool, but, as Cheshmehzangi et al. (2022) stated, the increased use of telemedicine could lead to an increase in the number of patients without access to reliable broadband and digital literacy, particularly among older adults and non-English speakers. As Samuels-Kalow et al. (2021) have cautioned, telemedicine systems, if not specifically designed with health-equity in mind, may further widen the gap in access to care and increase the convenience of care for the digitally connected. In particular, qualitative research revealed that community organizations were having problems helping older adults with insurance enrollment during the transition to virtual assistance, with many Medicare beneficiaries lacking devices and internet and being uncomfortable with technology to assist with enrollment (Castillo et al., 2023).

CIVIC AND SOCIAL PARTICIPATION

Beyond material effects, the digital divide has also been theorised as a divide in democratic participation, alongside social and global divides (van Dijk, 2020). Reliable connectivity and sufficient digital competence are increasingly prerequisites for accessing civic resources, civic services and political information, and populations already underrepresented in traditional civic institutions may be underrepresented in the realm of digitally mediated civic life. As such, Robinson et al. (2015) consider it a sign that digital inequality can be a cause and a consequence of social inequality: those who are not fully included in digital access are likely to be similarly excluded from political participation and community organizing and public services. Research Support for social participation is important as derived by (Ullah et al., 2023).

THE COVID-19 PANDEMIC AS AN ACCELERANT OF DIGITAL INEQUALITY

The pandemic served as a natural experiment for the U.S. digital infrastructure, and clearly revealed the socioeconomic costs of digital inequity. In 2020, the sudden switch to virtual learning and the lack of social contacts for digitally disadvantaged students left many lacking the supports and opportunities needed to keep up with schoolwork, which will likely exacerbate achievement gaps that already existed and be difficult to reverse (Hampton et al., 2020). The swift shift to telehealth brought with it the promise of greater access for digitally connected patients, but also introduced new challenges for patients who lack the devices, bandwidth, and digital skills needed to access health services online, as reported in various clinical and health services studies (Cheshmehzangi et al., 2022; Samuels-Kalow et al., 2021).

Perhaps most impressively, Li (2022) showed that digital exclusion had measurable effects at the county level on the health impacts of the pandemic, elevating the digital divide from a convenience issue to an observed factor in increased morbidity

and mortality. Combined, this evidence suggests that digital inequality is not just a symptom of socioeconomic inequality, but an additional pathway through which pre-existing inequalities can be manifested as tangible inequities in health, education, and economic experiences when societies are under stress.

POLICY AND INTERVENTION LANDSCAPE

The first level is the one that has received most policy attention in the USA and is mostly about increasing infrastructure investment or offering access subsidies, and not about investing in digital skills or outcome-oriented support (van Dijk, 2020). Broadband funding for rural and low-income areas has been bolstered through federal programs such as the Federal Communications Commission, and temporary broadband subsidy programs in the pandemic focused on reducing the cost of broadband subscription for eligible households. The "homework gap" in K-12 education has been a topic of inquiry by Congress, with some questions around whether interventions focused on access are enough to address the gap in outcomes among populations not connected (All4Ed, 2022).

Scholars warn that access centered policy is necessary but not sufficient. Van Dijk (2020), however, argues for a "multidimensional policy" which should involve investments in infrastructure, training in digital skills, support in affordability and designing online systems that could be used by populations with different levels of digital-literacy. Community-level activities that can be related to access expansion and skills development as identified in the digital-inclusion surveys include public device-lending programs, digital-navigator services, and locally customized digital literacy training (Reddick et al., 2020).

GAPS IN THE LITERATURE AND FUTURE RESEARCH DIRECTIONS

The evidence base today has several limitations. Second, many of the studies that have examined the relationship between digital inequality and socioeconomic outcomes are cross-sectional, meaning that they can only draw inferences about associations between the two; longitudinal studies, which track individuals and/or households over time as their connectivity and capabilities change, are needed to determine whether and how reducing digital inequalities will result in long-term gains in education, employment, and health outcomes. Second, nationally representative surveys such as Pew Research Center's can give some indication of trends in access and adoption, but few studies have been able to combine fine-grained measures of digital skill and downstream outcomes with nationally representative access measures in the same sample, limiting the ability to tease out the impact of each part of the divide..

Third, the employment and income consequences of these indicators have been relatively less studied than the education and health consequences, even though they are so central in theories of socioeconomic mobility (Lythreath et al., 2022). Moreover, evaluation research of specific policy interventions (e.g., subsidized broadband programs, digital-navigator initiatives) is still limited in scope in comparison to the scale of public investment and can help only minimally distinguish the most effective design of policy interventions for delivering measurable socio-economic benefits. To fill these gaps, more efforts to facilitate collaboration between greater communication scholars/economists/public health researchers and ongoing attempts to conduct multilevel, longitudinal data collection and analysis will be required.

CONCLUSION

The digital divide in the U.S. has evolved beyond a simple dichotomy of "online" and "offline." Digital inequity in the United States is no longer a two-part equation—online vs. offline. The evidence that is reviewed here suggests that access, skills, and outcomes are three distinct, but interwoven layers of disadvantage, all of which go hand-in-hand with income, race and ethnicity, geography and age. Examples of digital exclusion's impact on educational attainment include the homework gap; hiring and employment are increasingly being done online, which reinforces digital exclusion in the labor market; health impacts from a lack of access to information and telehealth services; and a lack of access to civic participation opportunities. These inequities have been starkly illuminated by the COVID-19 pandemic and digital exclusion has been demonstrated to have quantifiable effects on health and educational outcomes in a time of disruption. In addition to infrastructure, closing the digital divide will require policy to develop digital skills, to tackle digital costs and affordability, and to create digital systems, and a stronger evidence base to enable an assessment of the impact of digital interventions over time and place, to identify which interventions offer the greatest long-term economic and social returns from digital connectivity.

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