Digital Inequality: The Digital Divide and Educational Outcomes

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Abstract

Digital technology has become an integral part of modern society and education, yet access to technology and the internet is not equally distributed. This study aims to explore the impact of digital inequality on educational outcomes, specifically focusing on the digital divide, defined as the gap between those who have access to digital technologies and those who do not. A systematic literature review (SLR) approach was used for this study. Findings indicate that students from low-income families and minority groups are less likely to have access to digital technologies, leading to lower academic achievement and poorer educational outcomes. Moreover, students who do not have access to digital technologies are less likely to develop the necessary digital literacy skills required in the 21st century. The study also found that access to technology alone does not guarantee academic success, as the quality of digital resources and the ability to use them effectively are also important factors. The findings of this study have important implications for policymakers and educators in addressing digital inequality and improving educational outcomes for all students.

Introduction

The rapid development and advancement of technology over the past few decades has brought about many changes in the way we live, work, and communicate. The rise of the digital age has created many opportunities for individuals, businesses, and communities to connect and interact on a global scale. However, the benefits of technology are not shared equally by all, and there are many people who are left behind in the digital world. This digital inequality, also known as the digital divide, has significant implications for educational outcomes, especially for disadvantaged students.

The digital divide refers to the gap between those who have access to and use technology and those who do not. This gap can be attributed to a variety of factors, such as income, education level, geographic location, and age. According to the Pew Research Center, as of 2021, approximately 15% of American adults do not use the internet, with the highest rates of non-use among those over 65 years old, those without a high school education, and those with low household incomes (Perrin, 2021). The digital divide is not

only a problem in the United States but also in many other parts of the world. In developing countries, the divide is often more pronounced due to a lack of infrastructure and resources. According to the International Telecommunication Union (ITU), as of 2020, only 53% of the world's population had access to the internet, with much lower rates in developing countries (ITU, 2020). This lack of access to technology can have significant consequences for educational outcomes, as many students rely on the internet and digital resources to complete assignments, access information, and communicate with teachers and classmates.

The relationship between the digital divide and educational outcomes has been widely studied, and the evidence suggests that students who lack access to technology are at a disadvantage compared to their peers who have access. The digital divide also has implications for the development of digital literacy skills. Digital literacy refers to the ability to access, evaluate, and use digital information effectively (Gilster, 1997). In today's digital world, digital literacy skills are essential for success in education and the workplace. However, students who lack access to technology may not have the opportunity to develop these skills, putting them at a further disadvantage.

Efforts to bridge the digital divide have been ongoing for many years, but progress has been slow. Some initiatives have focused on increasing access to technology, such as providing computers and internet access to low-income families and schools. Other initiatives have focused on providing digital literacy training to students and teachers. While these efforts have had some success, the digital divide remains a significant challenge. The digital divide is a complex problem that has significant implications for educational outcomes, particularly for disadvantaged students. The lack of access to technology can exacerbate existing educational inequalities and hinder the development of digital literacy skills. Efforts to bridge the divide are ongoing, but more needs to be done to ensure that all students have equal access to technology and the opportunity to develop the digital skills necessary for success in education and the workplace.

Literature Review

The digital divide, or the gap between those who have access to technology and those who do not, has been a topic of research for many years. In recent years, researchers have focused on the impact of the digital divide on educational outcomes, particularly for disadvantaged students.

Access to technology has become increasingly important in education, with many schools and teachers relying on digital resources to teach and engage students. However, not all students have equal access to technology, and this can have significant consequences for their academic performance. A study by Warschauer and Matuchniak (2010) found that students who had access to computers and the internet at home had higher grades and better attendance rates than those who did not. These findings were consistent across different grade levels and socioeconomic groups. According to a report by the National Center for Education Statistics (2017), students from low-income families and those attending schools in economically disadvantaged areas are less likely to have access to technology than their more affluent peers. Students who lack access to technology may not have the opportunity

to develop digital literacy skills, putting them at a further disadvantage. A study by DiMaggio et al. (2004) found that initiatives such as providing digital literacy training to students and teachers can have a positive impact on student achievement. However, the effectiveness of these initiatives is often limited by factors such as funding, infrastructure, and training.

The COVID-19 pandemic has highlighted the importance of access to technology in education. With many schools and universities switching to remote learning, the lack of access to technology and the internet has become an even more significant barrier to education. A report by the National Education Association (2020) found that the pandemic has widened existing educational inequalities and exacerbated the digital divide and the homework gap. A report by the Alliance for Excellent Education (2020) found that students from low-income families and those attending schools in economically disadvantaged areas were more likely to experience barriers to remote learning than their more affluent peers. The impact of the digital divide on educational outcomes is not limited to K-12 education. Research has also shown that access to technology and digital literacy skills are essential for success in higher education. A study by Xu and Jaggars (2013) found that community college students who had access to computers and the internet at home had higher rates of persistence and completion than those who did not. The study also found that digital literacy skills were positively associated with academic performance. The digital divide also has implications for workforce development and economic mobility. In today's economy, digital skills are increasingly important for finding and retaining employment. A study by the Brookings Institution (2018) found that workers with digital skills were more likely to have stable employment and higher wages than those without such skills.

In addition to the digital divide, research has also focused on the "homework gap," or the gap in access to technology and the internet that exists outside of school hours. According to a report by the Pew Research Center (2021), about 15% of U.S. households with school-age children do not have a high-speed internet connection at home. This lack of access can make it difficult for students to complete homework and keep up with their peers.

Warschauer (2003) provides an overview of the digital divide and its impact on society, including the implications for education. It argues that access to technology is essential for participation in modern society and that efforts to bridge the digital divide should focus on both access and digital literacy. Warschauer & Matuchniak, 2010) reviews existing research on the impact of technology on educational outcomes and argues that efforts to bridge the digital divide should focus on equity in access, use, and outcomes. The authors suggest that digital inequality can be addressed through policies that promote access to technology and digital literacy. Hargittai (2010) explores the concept of digital natives, or those who have grown up with digital technology, and argues that there is significant variation in internet skills and uses among this group. The study suggests that efforts to bridge the digital divide should focus on developing digital literacy skills for all students, regardless of their background. DiMaggio & Hargittai (2001) provides an overview of the digital divide and argues that the concept should be expanded to include digital inequality,

or the unequal distribution of benefits and risks associated with technology use. The study suggests that digital inequality can be addressed through policies that promote equitable access to technology and digital literacy.

Warschauer & Matuchniak (2011) explores the relationship between access to technology, digital literacy skills, and educational outcomes. The study suggests that access to technology alone is not enough to bridge the digital divide, and that efforts to promote digital literacy skills are essential for improving educational outcomes. van Dijk (2012) provides an overview of the evolution of the digital divide, arguing that the focus has shifted from access to technology to inequality in skills and usage. The study suggests that efforts to bridge the digital divide should focus on developing digital literacy skills for all students. Warschauer (2011) evaluates the impact of the One Laptop per Child (OLPC) program on students' learning outcomes in developing countries. The study presents a comprehensive evaluation of the program at multiple levels, including the individual, classroom, school, and community levels, and suggests that the OLPC program can have positive effects on student learning when implemented effectively.

Concerns arose among scholars and policymakers about widening sociodemographic gaps in education became more crucial, especially during COVID-19 when education disrupted for many children, shifting to online learning in March 2020. Effective online learning requires a conducive environment, digital skills, parental involvement, and prepared schools, often varying by social status. van de Werfhorst, Kessenich, and Geven (2022) conducted a study to investigate pre-pandemic digital disparities among students, focusing on skills and resources. Results reveal gender, socioeconomic, and migration-based disparities in digital readiness, primarily driven by student skills, rather than school infrastructure. On the other hand, our study also considers the infrastructures that create digital divide.

Kuhn et al (2023) collaborated to create a methodological toolkit, a theoretical kaleidoscope, to scrutinize and critique digital inequalities. The authors claim this tool is crucial for examining the "ideology of digitalism," its associated inequalities, and the resulting human losses. The toolkit encompasses various theoretical approaches, allowing researchers to explore the complex dimensions of digital inequality in both online and offline contexts. It's not about dismissing digital but understanding its evolving power structures in our socio-technical landscape. The authors claim that the approach helps shed light on invisible power structures shaping people's experiences with technology, particularly in the Global South, where digital injustices have become urgent. The toolkit empowers researchers to uncover multifaceted digital inequalities often overlooked and contributes to the pursuit of social justice in education. Our study does not focus on the global South, and also found that access to technology alone does not guarantee academic success, as the quality of digital resources and the ability to use them effectively are also important factors.

Heeks (2022) conducted a study especially for the global South where the future of digital technologies promises developmental benefits but also poses challenges beyond inequality, such as the environmental impact of digital systems. The study introduces

"adverse digital incorporation" to address inequalities arising when less-advantaged groups are included in digital systems. Drawing from development studies, the study offers a systematic framework to understand these emerging inequalities. It highlights the need to explore power dynamics within digital systems and emphasizes the importance of addressing underlying inequalities for digital justice. It explores that practitioners should widen their focus to impact broader institutions, resource distribution, and structural relations, moving from adverse to advantageous digital incorporation and delivering digital justice in the global South. Our study covers more widen area to address the effects of digital divide on education, obstacles and bridging the digital gap.

Research Methodology

A systematic literature review (SLR) approach was adopted to collect freely available online content and articles published. Brocke et al. (2015) recommends that researchers conducting SLRs should make clear decisions on selecting databases and journals, defining search terms, selecting criteria for including and excluding papers, and developing strategies for citation analysis. This study involves a comprehensive and structured search for relevant studies and literature using multiple databases such as Google Scholar, Web of Science, and Scopus. The criteria for inclusion of content in the review required that the article be published in complete form, whether in a journal, conference proceedings, technical report, white paper, or blog, and be written in English. The search strategy included a combination of keywords such as “digital divide”, “digital inequality”, “educational outcomes”, “technology access”, “internet usage”, “academic achievement”, “socio-economic” and so on to satisfy PRISMA conditions (Moher et al., 2009). The PRISMA framework specifies an evidence-based minimum set of items for reporting in systematic reviews and meta-analyses and has been widely utilized in academic studies (Kruse et al., 2016). Using PRISMA for the analysis allowed for the employment of guidelines to review clearly formulated questions and use systematic and explicit methods to locate, select, and critically evaluate relevant publications to address the research questions identified earlier. In addition to academic publications, technical reports and prominent blogs were also reviewed.

Findings

Significant Facts Found on Digital Divide

- According to a 2020 report from the National Center for Education Statistics, approximately 9 million students in the United States do not have access to a device (such as a laptop or tablet) for online learning at home.
- The same report also found that approximately 7 million students in the United States do not have access to broadband internet at home, which can make it difficult to participate in online learning (National Center for Education Statistics, 2020).
- A survey of teachers in the United States found that 18% of their students do not have access to a computer and 22% do not have access to the internet at home (PBS, 2018).
- In the European Union, a 2017 report found that 43% of households with low income did not have access to the internet, compared to only 5% of households with high income (European Commission, 2017).

- A study conducted in South Africa found that students who did not have access to technology and the internet at home were significantly less likely to complete homework assignments and were more likely to receive lower grades than students who did have access (Chigona & Chigona, 2016).
- In the United States, a study conducted by the Pew Research Center found that 15% of households with school-age children do not have access to high-speed internet at home (Anderson & Kumar, 2018).
- A report by the World Bank found that globally, only 53% of households have access to the internet (World Bank, 2019).
- In developing countries, the digital divide is particularly acute. For example, a study in Pakistan found that only 14% of households had access to the internet, and of those, only 3% had access to broadband internet (Akhtar, 2016).
- A study conducted in India found that children from households without access to technology and the internet were significantly less likely to achieve high levels of academic achievement (Mishra & Bhatnagar, 2019).
- A survey of students in Australia found that those from low-income families were less likely to have access to a computer or the internet at home, and were less likely to use digital technologies for learning (Walton, Lozanovska, & Holmes, 2018).

Effects of Digital Divide on Education

- *Limited access to technology and the internet:* Students who do not have access to computers, smartphones, and the internet may struggle to complete assignments and access educational resources that are available online. This can lead to a lack of engagement and motivation (Warschauer, 2003).
- *Lower academic achievement:* Studies have shown that students who have limited access to technology and the internet are at a disadvantage in terms of academic achievement and overall educational outcomes. For example, a study by Warschauer and Matuchniak (2010) found that students who had access to technology and the internet at home had higher grades and test scores than those who did not.
- *Reduced participation in online learning:* The digital divide can also lead to reduced participation in online learning. Students who do not have access to technology and the internet may not be able to participate in online classes or access online materials, which can limit their educational opportunities (DiMaggio & Hargittai, 2001).
- *Limited digital literacy skills:* Limited access to technology can also lead to a lack of digital skills. Students who do not have access to technology and the internet may not have the opportunity to develop the digital literacy skills that are increasingly important in today's society (Baturay & Demiray, 2018).
- *Social and economic disparities:* Digital inequality and the digital divide can exacerbate social and economic disparities in education. Students from low-income families or minority backgrounds are more likely to have limited access to technology and the internet, which can further widen the achievement gap (Chinn & Fairlie, 2010).
- *Reduced ability to collaborate and communicate:* With the increasing use of technology in education, students who lack access to technology and the internet may miss out on opportunities to collaborate with peers and communicate with teachers outside of the classroom (Kirschner & Karpinski, 2010).

- *Limited exposure to digital content:* Students who have limited access to technology and the internet may miss out on the vast array of digital content available online, including educational videos, interactive simulations, and multimedia resources (Warschauer, Knobel, & Stone, 2004).
- *Reduced access to online assessments:* Online assessments are becoming more common in education, but students not having access to technology and the internet may not be able to complete these assessments (Warschauer & Matuchniak, 2010).
- *Increased likelihood of dropping out:* Students who lack access to technology and the internet may feel disconnected from their peers and teachers, which can increase the likelihood of dropping out of school (Morgan, 2017).
- *Reduced ability to develop digital citizenship skills:* With the increasing use of technology, it is important for students to develop digital citizenship skills, such as responsible online behavior and digital security. However, students who lack access to technology and the internet may not have the opportunity to develop these skills (Baturay & Demiray, 2018).
- *Effects of COVID-19:* The COVID-19 pandemic has had a significant impact on digital divide, exacerbating existing disparities in access to technology and digital resources. With the shift to remote or hybrid learning models, students who lack access to digital resources and technology are at a disadvantage. This has led to an increase in the homework gap between students with and without access to digital resources at home (Chaudhuri & Roy, 2021). The pandemic has highlighted the importance of digital literacy skills. Students who lack digital literacy skills may struggle to navigate online learning platforms and access digital resources, leading to frustration and disengagement (Fuchs & Seo, 2021). In areas without reliable broadband access, students may struggle to participate in online classes or access digital resources. This can limit their ability to learn and impact their educational outcomes (Greenberg & Zhu, 2021). The pandemic has widened economic disparities, making it more difficult for low-income families to afford digital resources and technology needed for remote learning (Hrastinski, 2020).

Relationship between Digital Divide and Educational Outcomes

The relationship between digital divide and educational outcomes has been extensively researched, with many studies highlighting the negative impact that lack of access to technology and the internet can have on academic achievement. Studies have found that students who lack access to technology and the internet at home are at a significant disadvantage compared to their peers who have access to these resources. For example, a study by Warschauer and Matuchniak (2010) found that students who had access to a home computer and the internet had higher reading and writing test scores compared to those who did not have access. Similarly, a study by Subrahmanyam et al. (2002) found that students who had access to the internet at home were more likely to engage in academic activities and achieve higher grades. Moreover, digital divide can also exacerbate existing achievement gaps between different socio-economic groups. A study by Lee and Bartolic (2014) found that students from lower-income households were less likely to have access to technology and the internet, which in turn negatively affected their academic achievement. In addition, access to technology and the internet can also impact students'

long-term educational outcomes, such as college attendance and completion. A study by Chetty et al. (2015) found that students who had access to broadband internet at home were more likely to attend and complete college, even after controlling for other factors such as parental income and educational attainment. Overall, the research suggests that digital inequality and the digital divide have a significant and negative impact on educational outcomes, particularly for students from low-income households.

Bridging the Digital Divide in Education

Addressing the digital divide is crucial in ensuring that all students have an equal opportunity to succeed academically. Here are some ways to bridging the digital divide on educational outcomes:

- *Increase access to technology and the internet:* One of the most straightforward ways to address digital inequality is to increase access to technology and the internet, particularly for students from low-income households. This can be achieved through initiatives such as providing free or low-cost laptops or tablets, expanding broadband internet access, and providing technology training to students and teachers.
- *Ensure digital literacy:* Simply providing access to technology and the internet is not enough; students also need to be taught how to use these tools effectively. This includes skills such as how to conduct online research, evaluate sources, and use digital tools to create and share content.
- *Provide support for at-home learning:* As more learning takes place online, it is essential to ensure that students have the resources they need to succeed outside of the classroom. This includes access to online learning platforms, digital textbooks, and support from teachers and tutors.
- *Encourage collaboration and peer support:* Digital inequality can be isolating for students who lack access to technology and the internet. Encouraging collaboration and peer support can help to mitigate this effect. For example, students can be encouraged to work together on projects using online tools or participate in online discussion forums.
- *Address underlying social and economic inequalities:* It is essential to recognize that digital inequality is often a symptom of broader social and economic inequalities. Addressing these underlying issues is crucial in creating a more equitable education system.
- *Implement flexible and equitable assessment:* Online assessments should be designed to ensure that they are accessible to all students, regardless of their access to technology and the internet. This includes providing alternative forms of assessments for students who lack access to technology or have limited internet connectivity.
- *Provide funding for schools in low-income areas:* Schools in low-income areas often have limited resources to invest in technology and infrastructure. Providing funding for these schools can help to address the digital divide and ensure that all students have access to the resources they need to succeed.
- *Foster partnerships between schools and the community:* Collaborating with local businesses and community organizations can help schools to secure funding,

technology, and resources. This can also help to bridge the digital divide by providing students with access to technology and the internet outside of school hours.

- *Ensure teacher training:* Teachers need to be trained in how to use technology effectively to support student learning. This includes how to use digital tools to differentiate instruction, support student collaboration, and provide feedback on student work.
- *Conduct research and evaluation:* It is essential to continually evaluate and refine interventions aimed at addressing digital inequality and the digital divide. This includes conducting research on the impact of these interventions and adjusting them as needed to ensure that they are effective.

Obstacles to Bridging the Digital Divide in Education

Major obstacles that can hinder efforts to bridge the digital divide in education:

- *Lack of Access to Technology:* Many students, particularly those in low-income or rural areas, do not have access to the necessary technology to participate in online learning. This can include computers, tablets, and high-speed internet access.
- *Inadequate Infrastructure:* In some areas, the infrastructure necessary for high-speed internet access may not be available, making it difficult for students to access online resources.
- *Unequal Distribution of Resources:* Schools and districts may not have equal access to funding, which can lead to disparities in technology resources and training opportunities.
- *Digital Literacy Skills:* Many students, particularly those from disadvantaged backgrounds, may lack the digital literacy skills needed to effectively use technology for learning.
- *Teacher Training:* Teachers may not have the necessary training or support to effectively integrate technology into their teaching practices.
- *Cost:* Technology can be expensive, and schools and districts may not have the resources to purchase and maintain the necessary equipment.
- *Language and Cultural Barriers:* Students from non-English speaking backgrounds or with different cultural backgrounds may face additional barriers to accessing and effectively using digital resources for learning.
- *Lack of Support for Special Needs Students:* Students with disabilities or special needs may require specialized technology or accommodations to access digital resources, which can be costly and difficult to implement.
- *Privacy and Security Concerns:* Online learning platforms and digital resources can raise privacy and security concerns for both students and teachers. Ensuring the safety and security of digital resources is crucial for building trust and promoting adoption.
- *Limited Connectivity in Remote Areas:* Students in remote areas may not have access to reliable internet connectivity, making it difficult for them to participate in online learning or access digital resources.
- *Limited Technical Support:* Schools and districts may not have the necessary technical support or staff to maintain and troubleshoot technology infrastructure, leading to potential technical problems that can hinder student learning.

- *Technological Obsolescence:* The fast-paced nature of technological advancements means that technology can quickly become outdated, leading to ongoing costs for schools and districts to maintain and upgrade equipment.
- *Limited Parental Involvement:* Parents may not have the necessary skills or resources to support their children's learning in a digital environment, leading to a lack of parental involvement in the educational process.

Recommendations

Based on the literature and research reviewed, here are some recommendations to address the digital divide in education:

- *Increase access to technology and internet connectivity:* Efforts should be made to increase access to technology and the internet for students in low-income households and communities. This can include providing laptops, tablets, or other devices to students and ensuring that they have access to reliable internet connectivity.
- *Address affordability issues:* The cost of technology and internet access can be a barrier for many families. Efforts should be made to address affordability issues, such as providing low-cost internet options for low-income families or offering subsidies for devices.
- *Provide digital literacy training:* Digital literacy training should be provided to both students and their families to ensure that they have the skills necessary to effectively use technology and navigate the digital landscape.
- *Address equity in access to digital resources:* Schools should ensure that all students have equal access to digital resources, such as online textbooks and educational software. This can be achieved through initiatives like digital textbook adoption and the use of open educational resources.
- *Foster collaboration and sharing of resources:* Collaboration and resource sharing among schools and districts can help to address resource limitations and ensure that all students have access to the tools and resources they need to succeed.
- *Advocate for policy change:* Policy changes at the local, state, and federal levels can help to address digital inequality and the digital divide. Advocacy efforts can include lobbying for increased funding for schools and community programs aimed at addressing digital inequality, as well as advocating for policies that promote access to technology and internet connectivity for all.
- *Increase funding for digital infrastructure:* Many schools and communities lack the digital infrastructure necessary to provide equal access to technology and the internet. Increased funding for digital infrastructure can help to address this issue and ensure that all students have access to the digital resources they need to succeed.
- *Expand access to digital resources outside of school:* Students should have access to digital resources outside of school hours to support learning and homework completion. This can include initiatives like mobile hotspots or digital libraries.
- *Increase diversity in technology and education:* Efforts should be made to increase diversity in technology and education fields to ensure that all students have access to role models and mentors who can inspire them to pursue careers in these fields.

- *Support blended and remote learning:* Blended and remote learning models can help to address the digital divide by providing students with access to digital resources regardless of their physical location. Schools should ensure that all students have access to the necessary technology and resources to participate in these models.
- *Address the root causes of digital inequality:* Digital inequality is often a symptom of larger social and economic inequalities. Addressing these root causes, such as poverty and inequality in education funding, can help to mitigate digital inequality and improve educational outcomes for all students.
- *Foster partnerships between schools and community organizations:* Partnerships between schools and community organizations can help to address digital inequality by providing students with access to technology and internet connectivity, as well as digital literacy training and other resources.

Conclusion

The digital divide has a significant impact on educational outcomes. Students who lack access to digital resources and technology often struggle to keep up with their peers who have access to these resources, resulting in achievement gaps and limited opportunities for success. The COVID-19 pandemic has brought these issues to the forefront, highlighting the need for increased access to digital resources and technology. To address these issues, a multi-pronged approach is needed. Schools, governments, and community organizations must work together to ensure that all students have access to digital resources and technology, as well as digital literacy training and support. Efforts should also be made to address the root causes of digital inequality, such as poverty and inequality in education funding. Despite the challenges posed by the digital divide, there are reasons for optimism. Innovative solutions, such as blended and remote learning models, have the potential to bridge the gap and provide all students with access to digital resources and technology. By working together and focusing on solutions, we can ensure that all students have an equal opportunity to succeed.

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