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Bridging the digital divide: Unmasking socioeconomic barriers to equitable access to digital tools in education

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Abstract

Digital tools, online platforms, multimedia resources, and internet-connected devices are now central to higher and online education. While these technologies offer flexibility and personalized learning, access remains unequal, especially for students from low-income and rural backgrounds. This review examines how socioeconomic factors influence students' ability to access and benefit from digital education. Drawing on research published between 2015 and 2024, it applies Van Dijk's Theory of the Digital Divide and the Framework for Inquiry into the Technological Divide to analyze four levels of access: motivation, material resources, digital skills, and actual use. It also uses a digital inclusion model to explore how income, education, location, and social background shape students' digital opportunities. Studies were organized and managed using the Mendeley reference tool. The findings reveal clear patterns of inequality in device availability, internet access, and digital literacy, all of which affect academic outcomes. The review also highlights how parenting styles, gender norms, and educational settings further influence digital access. These insights call for urgent action. Educational policies must move beyond simply providing technology and instead address the social and cultural barriers that limit full digital participation. The review offers recommendations for a more inclusive approach to ensure that all students, not just the privileged, can succeed in digital learning environments.

Keywords: Digital divide; Socioeconomic inequality; Educational equity; Digital literacy; Access to technology; Inclusion; Online learning; Digital readiness

1. Introduction

Digital technologies have transformed how education is delivered and experienced. Tools such as artificial intelligence (AI), online platforms, and virtual learning environments now support flexible, interactive, and student-centered learning. In response, schools and education systems have increased their investment in digital infrastructure and teaching tools (OECD, 2021; European Commission, 2019). However, the benefits of this digital shift are not experienced equally by all students. Despite growing access to digital tools, many schools, particularly in under-resourced communities, have struggled to fully integrate these technologies into teaching. This became especially clear during the COVID-19 pandemic, when remote learning exposed major gaps in digital access and digital readiness (Daniel, 2020; Di Pietro et al., 2020). Digital resources in education include a wide range of tools: from learning management systems and virtual labs to online libraries, virtual and augmented reality (VR/AR), and various online platforms (Aljawarneh, 2020).

These tools can enhance learning, support different learning styles, promote collaboration and personalized learning environments (Gaol & Prasolova-Førland, 2021; OECD, 2021).They also help students develop essential skills like digital literacy, problem-solving, and adaptability (Bennett & McWhorter, 2021). But for many learners, especially those from low-income or rural backgrounds, access to these tools is limited (van de Werfhorst et al., 2020; Van Dijk & AGM, 2017). This is not only a matter of owning a device or having internet access, it also involves knowing how to use technology effectively, having the motivation to engage with it, and being supported by schools and families in the process (Daniel,

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2020; König et al., 2020; Blaskó et al., 2021; Di Pietro et al., 2020). To understand this layered problem, this review draws on Van Dijk's Theory of the Digital Divide, which identifies four dimensions of access: motivational, material, skills-based, and usage. These levels reflect the progression from simply owning a device to being able to use digital tools for meaningful educational outcomes. The review also applies the Framework for Inquiry into the Technological Divide (West & Heath, 2009), which places digital exclusion within its social context and calls for critical analysis of how power, policy, and social structures affect technology access. Together, these theories provide a structure for examining not just what resources are available, but who can use them, how, and with what results.

Additionally, the review is guided by the conceptual framework of digital inclusion, which emphasizes the need to move beyond access and toward full digital participation. Digital inclusion involves four progressive stages: access, taste, readiness, and literacy (Reder, 2015). Each stage comes with its own challenges. For example, a student may have access to a computer but may not yet feel confident or skilled enough to use it for learning. Others may lack interest in digital tools altogether due to unfamiliarity or low perceived value. Socioeconomic status deeply affects how students' progress along this pathway. Income, education level, geographic location, and home support all play critical roles in determining who benefits from digital education (Jury et al., 2017; Bach et al., 2018). Students from wealthier families are more likely to have access to high-speed internet, modern devices, and supportive learning environments (Cochrane, 2020; Afzal et al., 2023; Hunsucker, 2021).

Meanwhile, those from low-income or remote areas often face multiple barriers at once, including outdated devices, unstable internet, limited digital literacy, and schools that are underprepared for digital learning (Cochrane, 2020; Hunsucker, 2021). This review aims to uncover how these socioeconomic factors interact with digital education. It reviews literature from 2015 to 2024 to map patterns of inequality, understand their consequences, and highlight pathways toward inclusive, equitable digital education systems. By combining theory and evidence, it offers a deeper understanding of how digital access is shaped, not just by technology, but by the broader social and economic conditions that surround students' lives.

1.1. Objectives of the Review

The primary objective of this comprehensive review is to explore how socioeconomic conditions influence students' access to and effective use of digital resources in education. Specifically, the review examines the extent to which factors such as household income, parental education, geographic location, and social inequality shape students' opportunities to engage meaningfully with digital tools, platforms, and learning environments. By analyzing patterns of access, digital readiness, usage practices, and educational outcomes, the review aims to uncover how socioeconomic barriers contribute to the digital divide and reinforce disparities in learning experiences and success. The ultimate goal is to inform more inclusive educational strategies that address not only economic inequality but also the cultural, structural, and contextual challenges that affect digital participation in education.

2. Theoretical Framework

2.1. Van Dijk's Theory of the Digital Divide

Van Dijk's Theory of the Digital Divide, as refined by Van Dijk and Van Deursen (2017), presents a layered and nuanced understanding of digital inequality. Unlike earlier interpretations of the digital divide that focused solely on access to devices and internet, this theory introduces a multi-dimensional framework that identifies four interrelated stages: motivational access, material access, skills access, and usage access. These stages reflect the full journey of digital engagement, from initial exposure to effective use. Each stage represents a potential barrier for individuals and groups, particularly those from lower socioeconomic backgrounds. As such, this theory provides a powerful tool for analyzing how digital inequalities are created, sustained, and experienced differently across populations. The diagram below illustrates the four interrelated stages of Van Dijk's digital divide theory, Motivational Access**,** Material Access**,** Skills Access**, and** Usage Access**.** These stages represent a layered framework for understanding how digital exclusion occurs, especially among socioeconomically disadvantaged learners. The theory highlights that meaningful digital inclusion requires more than just internet access; it demands motivation, skills, and purposeful use.

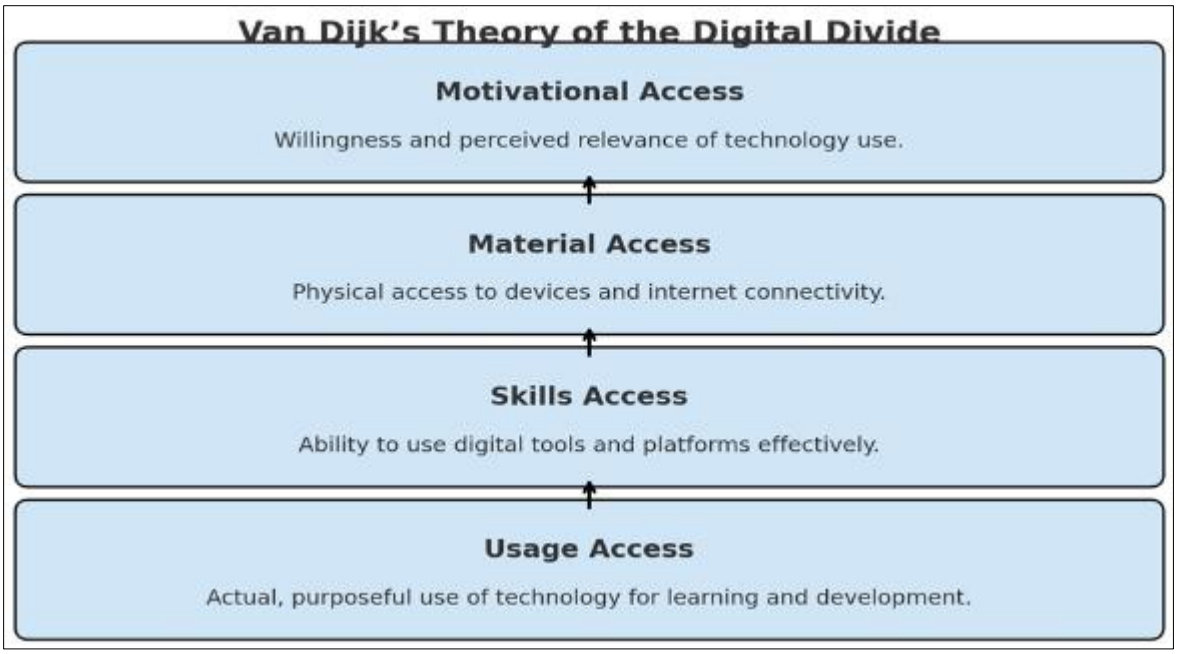


Figure 1 Van Dijk's Theory of the Digital Divide:

- ***Motivational access:*** Motivational access is the first and most foundational stage. It refers to a person's willingness or desire to use digital technology. This stage is influenced by factors such as perceived usefulness, relevance to daily life, and the cultural or social attitudes toward technology within one's environment. Students from families or communities where digital tools are seen as non-essential or even viewed with suspicion may not develop the motivation to engage meaningfully with them. Even if access is provided, a lack of interest can prevent students from making full use of digital opportunities. This is particularly relevant in disadvantaged communities where technology may be viewed as a luxury rather than a necessity.
- ***Material access:*** Material access focuses on the actual possession of digital tools, such as computers, tablets, and smartphones, as well as internet connectivity. This stage is the most commonly measured in digital inequality research because it is the most visible. However, Van Dijk argues that material access alone is insufficient. A student may have a shared device at home or unstable internet that disrupts learning. Others may lack access entirely due to financial hardship, rural location, or unreliable infrastructure. This stage of the model aligns directly with socioeconomic barriers, highlighting how income, geography, and social support determine access to essential educational resources.
- ***Skills access****:* Skills access is the third stage and refers to a person's ability to use digital tools effectively. This includes both technical know-how (e.g., operating a computer or navigating a learning platform) and more complex cognitive skills such as searching for information, evaluating sources, and protecting one's privacy online. Many students from marginalized backgrounds face gaps in digital skills because their schools may not have the capacity or trained staff to teach them effectively. They may also lack guidance at home, especially if their parents or guardians are not digitally literate. This stage is critical, as students who lack digital competence are unable to fully engage with or benefit from online learning environments even if they have the motivation and tools.
- ***Usage access****:* Usage access, the final stage, relates to the ways in which people use technology in practice. It explores the quality and purpose of digital engagement. For instance, are students using the internet for social media and entertainment, or are they using it to complete assignments, build skills, and access educational content? This stage helps us understand that not all digital use leads to empowerment or learning. Usage is shaped by earlier stages, especially skills and motivation, and reflects broader social inequalities. A student with strong digital skills, support from teachers, and a quiet place to study is more likely to use technology in productive and transformative ways than a peer who lacks these resources.

This theory is highly relevant to this literature review because it supports a more complete and layered analysis of digital inequality. Rather than seeing the digital divide as a simple problem of "who has and who has not," Van Dijk's model reveals that inequality is a process influenced by personal, social, and systemic factors. For this review, which seeks to uncover the impact of socioeconomic barriers on digital access in education, Van Dijk's theory offers a structured way to analyze each level of exclusion. It explains why two students in the same school may have vastly

different digital experiences based on their home environment, access to resources, and personal readiness. Furthermore, this framework aligns with the review's aim to push beyond surface-level solutions. Providing devices or internet connections, while necessary, will not address deeper issues of digital engagement unless motivation, skill-building, and meaningful use are also supported. Van Dijk's theory thus strengthens the review's argument that addressing the digital divide in education requires multi-level strategies that account for economic, cultural, and educational inequalities. It encourages a transformative approach one that sees access as a pathway, not a single point, and places equal importance on motivation, support systems, and effective use.

3. Framework for Inquiry into the Technological Divide (West & Heath, 2009)

The Framework for Inquiry into the Technological Divide, developed by West and Heath (2009), offers a critical, justice-oriented lens for examining digital inequality. This model is particularly valuable because it pushes beyond conventional understandings of the digital divide as simply a matter of who has access and who does not. Instead, it invites researchers and educators to view the digital divide as a socially constructed phenomenon shaped by power, politics, and systemic barriers. The framework is organized into three interlinked domains: fifocal vision, technological divide, and outcomes and process. These components work together to guide inquiry from analysis to action, making the framework not only explanatory but also transformative. This visual below presents West and Heath's three-part framework: Fifocal Vision, Technological Divide, and Outcomes & Process. The model encourages a critical, systems-level view of digital inequality, positioning it as a social justice issue. It helps link analysis with action by guiding researchers and policymakers from understanding structural causes to implementing equity-based solutions.

3.1. Description

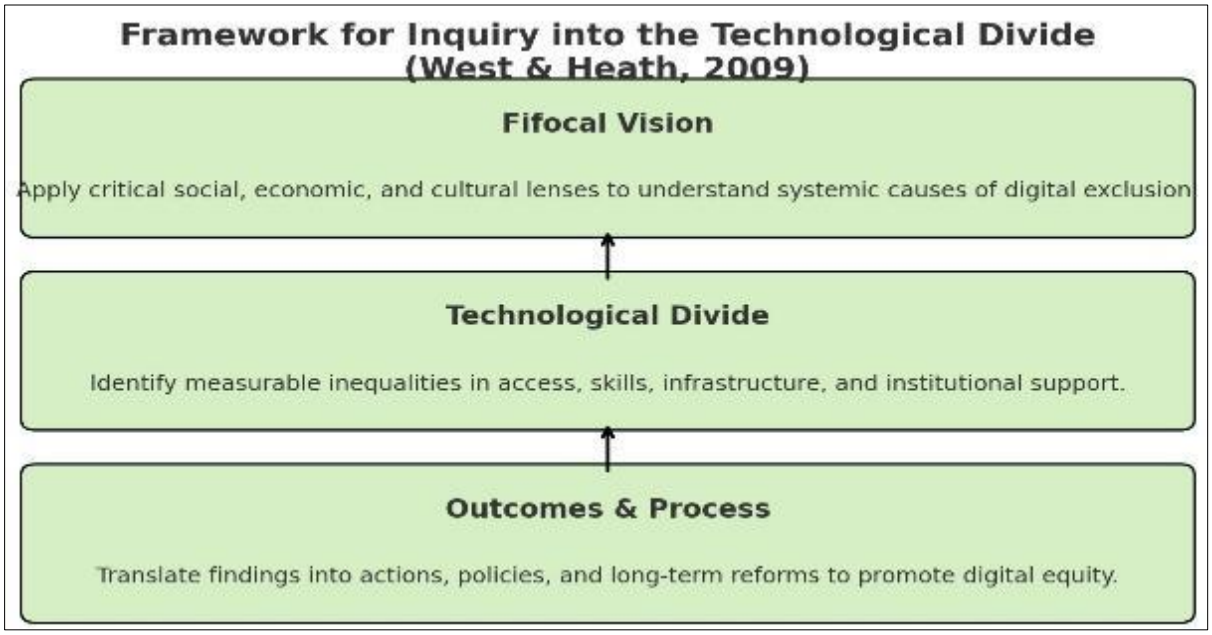


Figure 2 Framework for Inquiry into the Technological Divide (West & Heath, 2009)

The first component, fifocal vision, refers to the use of multiple critical lenses to examine the digital divide in its broader social, economic, and cultural context. It encourages researchers to consider how historical patterns of inequality, such as racial, gender, and class-based disparities, are embedded in access to and use of technology. For instance, when examining why certain student populations fall behind in digital learning, fifocal vision demands we look not just at their individual circumstances, but also at systemic issues like underfunded schools, biased policies, or unequal digital infrastructure. This perspective aligns with the review's goal to highlight that the digital divide is not accidental or isolated, it reflects deeper structures of exclusion that require structural solutions.

The second domain, technological divide, covers the tangible and measurable aspects of digital inequality. These include disparities in access to devices, broadband quality, digital literacy, and the institutional capacity to support digital learning. This domain is especially useful for this review, which focuses on how socioeconomic factors, such as income, parental education, and location, shape these disparities. For example, low-income households may not only struggle to afford technology but also live in areas with weak broadband infrastructure. Schools in marginalized communities may

lack up-to-date equipment or trained staff to support digital education. By naming and categorizing these divides, the framework helps identify exactly where inequities occur and how they compound over time. The final component, outcomes and process, emphasizes that understanding digital inequality must lead to action.

This part of the framework focuses on how research can inform practice, policy, and systemic reform to close the digital gap. It suggests that addressing the digital divide is not a one-time fix but a continuous, long-term process that involves developing inclusive policies, investing in digital equity, and critically evaluating existing systems. This mirrors the review's aim to go beyond identifying problems and offer evidence-based recommendations. It also resonates with the idea that digital inclusion must be embedded in educational policy and supported at all levels from classrooms to national agendas. The value of this framework in the context of this review lies in its holistic and transformative orientation. While Van Dijk's theory helps dissect the layers of individual access, West and Heath's framework zooms out to look at why these disparities persist and how they are reproduced through societal structures. It challenges the idea that digital inequality is merely a technological issue and repositions it as a social justice concern. For this review, which seeks to unmask the socioeconomic barriers to digital access in education, this framework is not only appropriate, it is essential. It supports the argument that equity in digital education cannot be achieved without addressing the structural conditions that produce inequality in the first place.

4. Conceptual Framework

4.1. Reder's Conceptual Model of Digital Inclusion (Reder, 2015; FCC, 2017)

The Conceptual Model of Digital Inclusion, as outlined by Reder (2015) and expanded by the Federal Communications Commission (FCC, 2017), presents a developmental pathway that individuals or groups follow toward full digital engagement. This framework is grounded in the idea that digital inclusion is not just about having access to devices or internet, but also about developing the capacity, confidence, and opportunity to use technology in meaningful and empowering ways. The model identifies four key stages; digital access, digital taste, digital readiness, and digital literacy, each of which presents its own challenges and opportunities, especially for disadvantaged learners. This diagram shows the progression toward full digital participation through four stages: Digital Access, Digital Taste, Digital Readiness, and Digital Literacy. The model emphasizes that digital inclusion is not a static achievement but a developmental process. It aligns with the review's call for long-term support systems that foster motivation, skills, and confidence in technology use.

4.2. Description

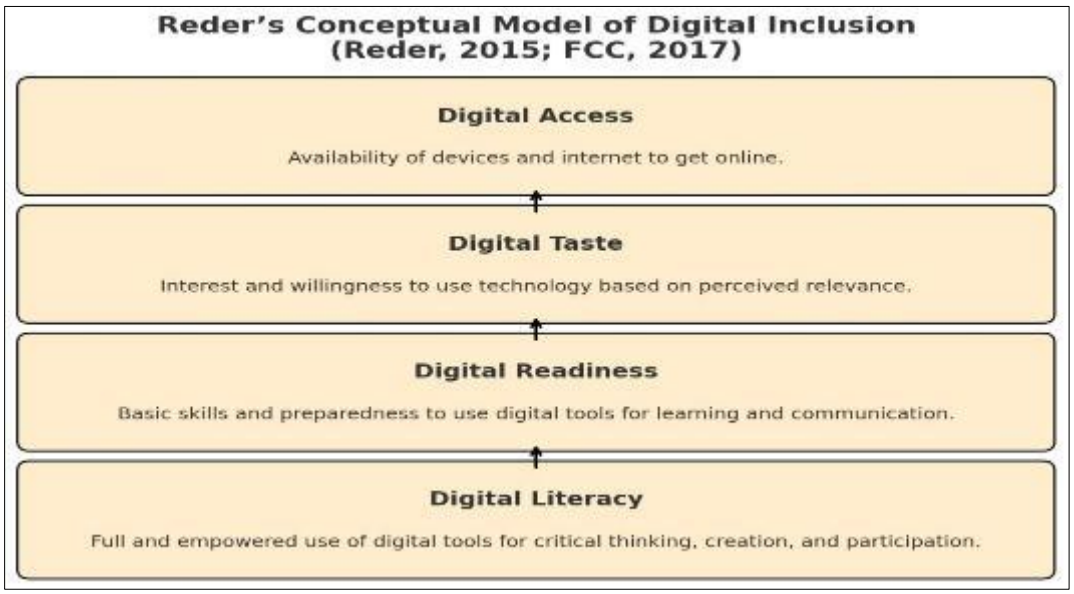


Figure 3 Reder's Conceptual Model of Digital Inclusion (Reder, 2015; FCC, 2017)

- ***Digital access***: This is the starting point and involves the physical availability of devices and internet services. This stage aligns closely with traditional understandings of the digital divide. However, Reder's model makes it clear that access is only the beginning. While many educational interventions stop here, distributing laptops or expanding Wi-Fi coverage. Reder argues that access alone does not guarantee inclusion. In the context of this review, digital access is often shaped by income, geographic location, and infrastructure. Students in rural or low-income communities may experience unstable or limited access, which directly impacts their ability to participate in online learning.
- ***Digital taste****:* The second stage, digital taste, refers to a user's personal interest or willingness to use digital technology. It involves a psychological and cultural dimension, whether someone believes that using technology is relevant, enjoyable, or useful for their goals. This stage is especially important in educational contexts, where students' prior experiences with technology influence their engagement. A student may have access to a laptop but may not feel comfortable or interested in using it for learning, particularly if their peers, parents, or environment do not support or value digital learning. In this sense, taste is shaped by social norms, exposure, and perceived usefulness.
- ***Digital readiness***: This is the third stage and refers to a person's preparedness to use technology for specific purposes. This includes having the skills to perform tasks such as typing, navigating educational platforms, conducting online research, or communicating digitally. A key insight from this stage is that digital exposure does not automatically lead to digital competency. Many students may use smartphones daily for social media or entertainment but still lack the functional skills needed for academic use. This is a major barrier in digital education, where schools often assume readiness but do not always provide the training needed to build it.
- ***Digital literacy:*** The final stage, digital literacy, represents full and effective engagement with digital technology. This includes not only technical skills but also critical thinking, problem-solving, and the ability to evaluate and produce content. It reflects a state of digital empowerment where users can use technology to learn, work, create, and participate in society. In this review, digital literacy is the ultimate goal of digital inclusion, ensuring that all students, regardless of their background, can engage meaningfully with digital tools and platforms. This requires sustained support, access to quality content, and inclusive policies that address underlying barriers. Reder's model aligns perfectly with the goals of this review because it offers a step-by-step understanding of how digital inclusion unfolds and where students are most likely to fall behind. It also reflects the review's belief that inclusion is not achieved by access alone but requires investment in motivation, training, and support systems. The FCC's definition of digital inclusion complements this model by emphasizing five essential elements: robust broadband, appropriate devices, digital literacy training, technical support, and inclusive content (FCC, 2017). This comprehensive view supports the review's argument that equitable access must be seen as a dynamic and evolving process that adapts to learners' needs and contexts.

5. Methodology

This review adopts a systematic and structured approach to explore how socioeconomic factors influence access to digital educational resources. The process followed widely accepted principles for systematic literature reviews, ensuring transparency, consistency, and analytical depth. The review was guided by clearly defined inclusion and exclusion criteria to select empirical studies that provide direct, evidence-based insights into how income level, education background, geographic location, and related social factors shape digital access in education.

To ensure relevance and currency, the review focused on studies published between 2015 and 2024. Eligible studies included those using empirical methods, such as surveys, case studies, interventions, or mixed-method approaches, and specifically addressing the impact of socioeconomic conditions on access to digital resources for educational purposes. Only studies published in English and appearing in peer-reviewed journals or reputable conference proceedings were included to maintain methodological consistency and scholarly quality. Studies were excluded if they were non-empirical (e.g., theoretical papers, opinion pieces, commentaries, or literature reviews), did not directly investigate socioeconomic influences on digital access, were not published in English, or were unavailable in full-text. These criteria ensured the review remained focused on empirical evidence relevant to the intersection of digital education and social inequality.

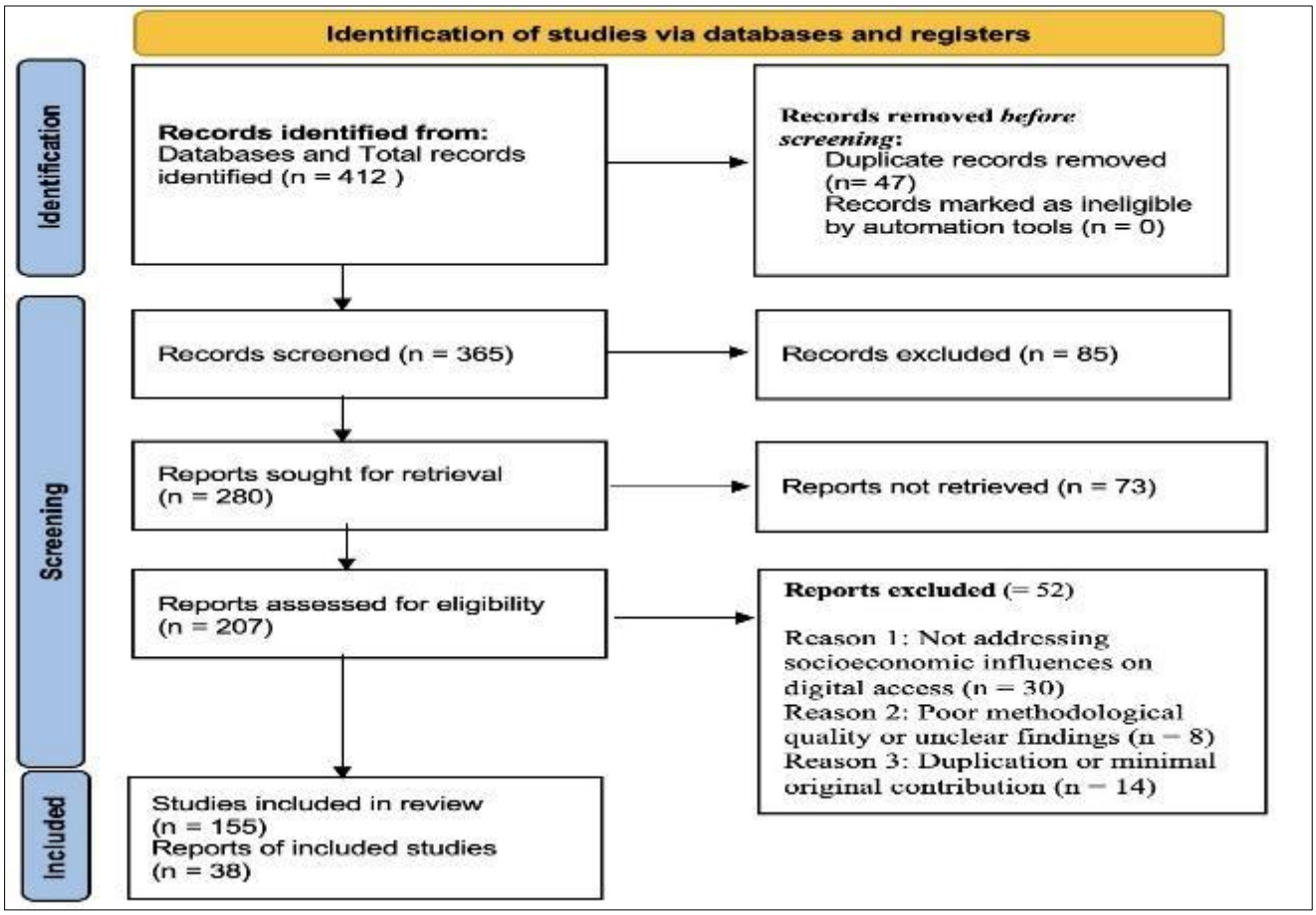
- ***Databases and Sources:*** A comprehensive literature search was conducted across a range of academic databases to capture a broad set of studies from various disciplines. The databases searched included JSTOR, ResearchGate, Google Scholar, Crossref, Wiley Online Library, ERIC, Scilit, and CiteFactor. These sources were selected based on their relevance to education, psychology, and social sciences, ensuring that both disciplinary depth and interdisciplinary breadth were achieved. This strategic mix of databases allowed for a robust and inclusive literature base, capturing research from diverse contexts and methodological traditions. Reference

lists of key articles were also scanned to identify additional relevant studies through backward citation tracking.

- ***Keywords and Search Strategy:*** To capture the full scope of the topic, a set of targeted keywords and search terms was developed. These included: "socioeconomic status," "income," "education level," "economic disparities," "digital access," "e-learning," "online education," "educational equity," "educational technology," "access to education," and "learning resources." These terms were used in various combinations with Boolean operators (AND/OR) to enhance the accuracy and specificity of the search. Synonyms and variations were included to reflect diverse terminologies across studies. This strategy ensured a wide yet focused search capturing all relevant literature on the role of socioeconomic factors in shaping access to digital learning environments.
- ***Screening and Selection Process:*** A structured, multi-phase screening strategy was applied to systematically refine the pool of studies included in this review. This process was designed to ensure that only relevant, high-quality empirical research was analyzed, in alignment with the review's objectives. An initial total of 412 records were identified through comprehensive searches across eight academic databases, including JSTOR, ResearchGate, Google Scholar, Crossref, Wiley Online Library, ERIC, Scilit, and CiteFactor. These databases were selected for their relevance to education, social science, and digital equity research. The search strategy involved specific keyword combinations related to socioeconomic status, digital access, and educational technology, with results limited to studies published between 2015 and 2024. Following identification, 47 duplicate records were removed. The remaining 365 unique records underwent title and abstract screening to determine their relevance to the core themes of the review. At this stage, 85 records were excluded for being unrelated to digital access, lacking socioeconomic focus, or not meeting basic criteria for inclusion. This left 280 records for full-text retrieval. Of these, 73 articles could not be accessed due to paywall restrictions, language limitations, or incomplete records, resulting in 207 full-text reports for eligibility assessment.
- The eligibility review focused on ensuring that studies met the predefined criteria: empirical methodology, direct investigation of socioeconomic influences on digital education, methodological clarity, and relevance to the review's research questions. During this stage, 52 reports were excluded. Specifically, 30 articles did not explicitly explore the relationship between socioeconomic status and digital access, 8 were deemed to lack sufficient methodological rigor or transparency, and 14 offered minimal original contributions or duplicated findings already captured by other studies. Ultimately, 155 studies were determined to meet all inclusion criteria and were incorporated into the review's broader analysis. From this pool, 38 studies were selected as the core dataset based on the depth and clarity of their findings, the relevance to the research questions, and the strength of their contributions to understanding the intersection of socioeconomic status and digital educational access. This multi-step process ensured that the final review sample was both methodologically robust and thematically aligned.
- ***Data Extraction and Analysis****:* For each of the 38 core studies selected, data were extracted using a standardized protocol to ensure consistency across the review. Key information collected from each study included authorship, year of publication, country or region of focus, research design, and methodological approach. Additionally, data on the specific socioeconomic indicators under investigation, such as household income, parental education, or geographic location were recorded. The type of digital access addressed (e.g., device ownership, internet connectivity, digital literacy, usage frequency) and the primary findings or conclusions of each study were also documented.

To analyze the collected data, a thematic synthesis approach was employed. This qualitative method allowed for the grouping and coding of findings across studies to identify recurring themes, cross-cutting barriers, and common patterns related to digital inequality. The synthesis process enabled a nuanced interpretation of how different socioeconomic variables influence digital access in education, helping to reveal both the direct and indirect ways in which inequality manifests. This method also made it possible to explore relationships between access, usage, and broader social factors, offering a multi-dimensional understanding of digital inclusion. Through this analytic approach, the review draws evidence-based conclusions about the structural and contextual challenges facing students from lower socioeconomic backgrounds in accessing and benefiting from digital educational resources.

Table 1 Outlines the PRISMA-based flow of the screening and selection process used in this review



5.1. Review on Socioeconomic Barriers to Equitable Access in Digital tools in Education

This review summarizes findings from 29 academic studies on how socioeconomic status (SES) shapes students' access to digital education. As digital tools become essential for learning, gaps in access remain widespread. These gaps are driven by overlapping factors including income, location, parental education, family support, gender, and mental health. Students from higher-income, urban families tend to have better access to devices, internet, and digital guidance. In contrast, those from low-income or rural backgrounds often face multiple barriers, including limited digital skills and support. The research shows that digital inequality is complex and cannot be solved by simply distributing devices. Real solutions require addressing the broader social and economic conditions that affect how students engage with technology in education.

Kwakye, Kibort-Crocker, Lundgren, and Pasion (2021) found that students from low-income households face serious limitations in accessing essential digital resources, particularly high-speed internet and personal computing devices. These limitations are even more severe in rural areas, where internet infrastructure is either weak or entirely unavailable. Their study highlighted how geographic isolation adds to the challenges already faced by low-income families. As a result, students in these environments often struggle to attend virtual classes, complete online assignments, and fully engage in digital learning. The findings underline how both economic hardship and location significantly affect a student's ability to access and benefit from digital education.

Li, Peng, Yang, and Chen (2020), along with Paulus, Spinath, and Hahn (2021), further explored the broader educational effects of this unequal access. Their research found that students from low socioeconomic backgrounds are not only less likely to have reliable digital tools, but they also receive less support at home. In many cases, parents lack the digital literacy needed to assist their children or have limited time due to work or other responsibilities. This absence of home-based support affects students' confidence and comfort in using technology, reducing their engagement with digital learning platforms and narrowing their participation in classroom activities that depend on online tools.

Jones and Smith (2020) expanded on these findings by directly linking digital inequality to academic performance. Their study found that students who lacked adequate access to devices and internet, and who received minimal academic support at home, were less engaged in learning overall. These students completed fewer assignments, participated less in online discussions, and had fewer opportunities for academic enrichment. Over time, these disadvantages negatively affected their academic outcomes and limited their educational achievement. The study concluded that digital access must be viewed not just as a matter of technology, but as a critical factor influencing long-term educational success.

In response to these challenges, Atobatele et al. (2024) examined various government-led and nonprofit initiatives aimed at reducing the digital divide. Their research assessed programs such as the provision of free or low-cost internet, laptop or tablet distribution to students in need, and community digital literacy training. While the study acknowledged short-term improvements in access due to these efforts, it also highlighted several limitations. Many of these programs lacked continuity, long-term planning, and sufficient funding. As a result, their positive impact often faded once initial resources were used up or project funding ended. The authors stressed that solving digital inequality requires a long-term strategy that includes consistent investment, strong community partnerships, and alignment with wider educational reforms that address structural inequality.

Choung and Manamela (2018) focused specifically on digital inequality among youth in South Africa. Their study illustrated how lack of access to digital tools and infrastructure affects not just academic performance, but also the overall quality of education and youth development. According to the authors, digital technologies, when accessible can empower young people by allowing them to engage with information, express their ideas, and participate more actively in their learning. The research argued that access to ICTs is not just about learning outcomes but also about inclusion, participation, and empowerment. However, without adequate training and infrastructure, these potential benefits remain unattainable for many marginalized youth, particularly those in low-income or rural communities.

Chiao and Chiu (2018) examined how both gender and family socioeconomic background influence students' ICT skills and competence. The study found that female students performed better than male students in technical tasks and higher-level ICT functions. This challenges traditional assumptions that males are more technologically inclined and suggests that gender-based digital divides may operate differently than expected. The researchers also found a significant relationship between a mother's level of education and her child's ICT proficiency. Children whose mothers had higher levels of education were more likely to develop strong digital skills, indicating that parental education, particularly maternal influence, is a key factor in a child's digital development. This finding points to the importance of household educational environments in fostering digital competence alongside access to technology.

Cochrane (2020) offered a more comprehensive framework for understanding digital access by extending the conversation beyond material resources. Drawing on Bourdieu's theory of capital, the study introduced the idea that social and cultural capital play crucial roles in shaping how students interact with digital tools. Social capital refers to relationships and networks that provide support, while cultural capital includes knowledge, attitudes, and behaviors that affect learning. According to the study, students who lack these forms of capital may struggle to navigate digital spaces effectively, even if they own devices or have internet access. For example, students from homes where education is not actively supported may not receive encouragement or guidance to engage meaningfully with digital learning. The study concluded that bridging the digital divide requires more than distributing hardware; it also demands investment in student support systems, family engagement, and the development of digital skills across all socioeconomic groups.

Jury et al. (2017) investigated the academic experiences of university students from low socioeconomic status (SES) backgrounds and uncovered an often-overlooked dimension of educational inequality: the psychological and emotional challenges that persist even when digital access is available. Their study found that students from disadvantaged socioeconomic groups often struggle with internal barriers such as self-doubt, fear of judgment, and a deep sense of not belonging in academic spaces. These students frequently experience stereotype threat worrying that their performance will confirm negative societal beliefs about their background which can lead to stress, anxiety, and reduced academic motivation. Even when they have the same technological tools as their peers, these psychological factors negatively affect their academic engagement and performance. The authors concluded that improving digital access alone is not sufficient to support low-SES students. Higher education institutions must also create inclusive, psychologically safe environments that address emotional well-being and foster a sense of academic belonging and self-efficacy.

Pratama (2017) explored how socioeconomic status influences digital device ownership among university students. The study clearly showed that students from higher-income families were significantly more likely to own advanced computing devices such as desktop computers and tablets. These students also tended to own more than one device, which provided them with greater flexibility in how and where they could engage in academic activities. The study also revealed a gender-based trend: female students were more likely to own tablets, which may reflect different usage

preferences or purchasing patterns. Interestingly, the study did not find major differences in device ownership when analyzing students by academic major, location, age, or year of study. This suggests that income is the most consistent and powerful predictor of digital device ownership in higher education. The findings emphasize that students from lower-income households are at a disadvantage not only in terms of access to technology but also in their ability to benefit from its full academic potential.

In a longitudinal study, Niyigena et al. (2020) examined how students' information and communication technology (ICT) fluency develops over time during university education. Their findings showed a clear trend: students who had regular access to personal computers showed consistent improvements in their ICT skills from their first to fourth year of study. Conversely, students with limited or no personal access to computers struggled to develop these essential skills at the same pace. The study highlighted that early and consistent use of digital tools is critical for building technological confidence and competence. It recommended that universities should invest more in accessible computer labs, expand the use of mobile-compatible educational platforms, and offer additional ICT support services. These efforts would help reduce digital skill gaps and better support students, especially those from under-resourced backgrounds.

Bae and Lai (2020) studied the impact of school-level SES and classroom learning conditions on student engagement in science education. They found that students in high-SES schools had more access to inquiry-based, hands-on learning experiences that are known to foster interest, motivation, and deeper understanding in science. These schools were often better equipped with lab facilities, instructional materials, and experienced teachers who could implement active learning strategies. In contrast, students in low-SES schools had fewer opportunities for interactive or practical science learning, which led to lower levels of engagement. The study concluded that student engagement is not only influenced by personal effort or curiosity but is also heavily shaped by the quality of the learning environment. Well-resourced classrooms, effective teaching, and equitable access to educational materials are all necessary to ensure meaningful engagement and achievement in science subjects across all socioeconomic groups.

Rahiem (2020) conducted a qualitative study during the COVID-19 lockdown to understand how university students in Jakarta adapted to remote learning. The study highlighted several practical challenges that students faced in trying to continue their education online. Many students had to share a single device with siblings or parents, making it difficult to attend online classes or complete assignments on time. Others used outdated smartphones or computers that were incompatible with modern e-learning platforms. Unreliable internet connections, expensive data plans, and electricity issues further disrupted their learning. In addition to these infrastructure problems, students also reported lacking the digital skills needed to navigate virtual classrooms or troubleshoot technical issues. Rahiem's study emphasized that addressing digital inequality requires more than providing hardware, it also requires improving internet infrastructure, reducing the cost of access, and offering training programs to improve students' digital literacy and independence.

Hunsucker (2021) analyzed the relationship between socioeconomic status, attendance, and academic progress in an online learning setting during the 2019–2020 school year. The study used data from a virtual K–8 school in Tennessee and found that students from lower-income households, identified by their eligibility for free or reduced lunch, had higher rates of absenteeism compared to their more affluent peers. This suggested that SES affects not only physical access to education but also the consistency with which students can participate in online instruction. However, when the study measured academic progress using English Language Arts (ELA) growth scores from the NWEA assessments, it found no significant differences between students of different income levels. This indicates that while low-SES students may face more barriers to consistent attendance, the structure and delivery of quality online instruction may help reduce achievement gaps if it is thoughtfully designed and equitably supported. The findings point to the importance of building flexible and responsive online learning environments that can adapt to students' diverse needs and realities.

Khasawneh (2021) investigated the challenges of equitable access to online learning and proposed several strategies to reduce inequalities. The study emphasized that socioeconomic disparities do not only determine whether students have access to online education, but also shape the quality and consistency of their engagement. Among the strategies identified were the use of differentiated teaching methods tailored to diverse learner needs, the expansion of digital tools and platforms, and proactive outreach to underserved and marginalized communities. Khasawneh also advocated for the importance of equity-driven policies that promote long-term access, rather than short-term solutions. The findings suggest that improving access alone is not sufficient educators and institutions must also ensure that learning environments are inclusive, responsive, and sustainable.

Domina et al. (2021) focused on the engagement of elementary students during remote learning amid the COVID-19 pandemic. The study revealed that student participation in online education was significantly influenced by both racial background and parental education levels. Students whose parents had lower educational attainment were more likely

to struggle with staying focused, completing assignments, and navigating remote learning systems. The study highlighted that these engagement issues were not necessarily due to a lack of interest from the students, but rather to limited home support and reduced familiarity with academic structures. Domina and colleagues suggested that incorporating socio-emotional learning opportunities and interactive, student-centered activities could increase motivation and involvement in remote settings, particularly for students facing structural disadvantages.

Nursamsu et al. (2021) assessed the digital readiness of schools across Indonesia by analyzing disparities in ICT infrastructure and digital learning conditions. The study used a combination of statistical modeling and event-based analysis to show that schools in wealthier or urban regions had better access to the internet and computing devices, leading to higher student engagement and better educational outcomes. In contrast, schools in less developed or rural areas struggled with weak infrastructure and inconsistent digital access. The authors stressed the urgent need for national strategies that address regional inequalities by investing in infrastructure, internet expansion, and equitable distribution of technological resources.

Mollborn et al. (2022) explored how children's screen time habits varied across different social classes and how these patterns aligned with pediatric health guidelines. The study found that children from higher-income families were more likely to exceed recommended screen time limits, but their use of technology was often structured around educational content or creative activities. In contrast, children from lower-income households generally had less access to educational media, and their screen use was more likely to go unsupervised due to limited parental availability or digital literacy. These findings reflect broader class-based differences in parenting practices and available resources, highlighting how social class shapes not just the quantity of screen time, but its quality and educational value.

Elliott (2023) surveyed college students to examine how socioeconomic status influences the type and quality of computing devices they own. The study found that students from higher-SES backgrounds were more likely to own advanced devices like laptops, while those from lower-income households often relied on basic or shared devices such as Chromebooks or smartphones. The study also found that Pell Grant recipients and first-generation college students had fewer digital resources overall, reinforcing the persistence of the digital divide within higher education settings. The research concluded that to support equitable academic outcomes, institutions must consider both the presence and quality of students' digital access.

Afzal et al. (2023) conducted a wide-ranging analysis of digital disparities through multiple demographic lenses, including age, gender, location, and income. The study found that students in rural and remote areas, particularly from low-income households, faced the most significant challenges in maintaining consistent internet access. In addition, gender differences were observed, with male students more likely to report consistent access to personal digital devices. The research also noted that older students often had better access to upgraded technology. To close these gaps, the authors recommended the expansion of school-based technology centers and the promotion of public-private partnerships to increase resource distribution and digital inclusion.

Gunawardena and Dhanapala (2023) explored the experiences of students from disadvantaged backgrounds in online learning environments. Their study highlighted the specific difficulties faced by students who required assistive technologies or more inclusive digital tools, resources that were often unavailable or not properly integrated into educational platforms. The researchers strongly recommended the application of Universal Design for Learning (UDL) principles, which support flexible learning pathways for students with diverse needs. Additionally, they emphasized the importance of professional development for teachers to better understand and implement inclusive, technology-enhanced instruction that responds to these challenges.

Gohar et al. (2023) conducted teacher-focused research to design better e-learning strategies for out-of-school children. The study gathered insights from educators on how to increase accessibility and inclusion in remote learning environments. Teachers emphasized the need for culturally relevant materials, localized content, and flexible learning models that accommodate the varied circumstances of students who are not part of the formal school system. The findings support evidence-based policymaking and advocate for more teacher-led development of digital learning frameworks that serve marginalized and at-risk learners.

Wang et al. (2023) examined how students' perception of their own social status referred to as subjective socioeconomic status affects their engagement in e-learning. The study used a serial mediation model to demonstrate that students who saw themselves as higher in social status tended to show stronger engagement in digital learning. This was partly because these students also reported higher levels of perceived social support and self-efficacy. The research highlighted that psychological factors such as confidence and perceived belonging play a crucial role in digital learning

participation. As a result, interventions that aim to strengthen students' self-belief and social networks could be effective in improving digital learning engagement, especially among those who feel marginalized.

6. Findings and Discussion

This review reveals that access to digital tools and internet connectivity remains strongly shaped by socioeconomic status (SES). Students from low-income households are consistently less likely to have access to high-speed internet or personal computers, as shown by Kwakye et al. (2021) and Elliott (2023). These disparities are even more severe in rural areas, where limited infrastructure compounds digital exclusion (Nursamsu et al., 2021; Afzal et al., 2023). In contrast, students from higher-income families tend to own multiple, more advanced devices, giving them greater flexibility and access to online learning resources (Pratama, 2017). The role of the home environment is central to shaping students' engagement with digital learning. Many students from low-SES households face challenges such as limited parental support due to low digital literacy or lack of time. Studies by Li et al. (2020) and Paulus et al. (2021) highlight how these constraints can weaken students' ability to navigate digital platforms independently. Parental education, particularly that of mothers, was found to positively influence students' ICT competence (Chiao & Chiu, 2018), while the nature of parental guidance often determines whether children's screen time is educational or purely recreational (Mollborn et al., 2022).

These gaps in access and home support directly affect students' academic engagement and performance. Jones and Smith (2020) found that limited access to technology, paired with weaker academic support, results in reduced engagement and poorer outcomes. In lower-SES schools, the lack of interactive learning opportunities, especially in subjects like science—further diminishes interest and achievement (Bae & Lai, 2020). Yet, some studies offer hope. Hunsucker (2021) demonstrated that well-designed online instruction can narrow these gaps, with students showing consistent literacy development even in contexts of higher absenteeism.

Beyond physical and technical access, psychological and emotional barriers also influence digital learning outcomes. Jury et al. (2017) identified low self-confidence, stereotype threat, and a sense of social exclusion among low-SES students, which undermined their academic motivation. Similarly, Wang et al. (2023) showed that students' perception of their own socioeconomic standing influenced their digital learning engagement through self-efficacy and perceived social support. These findings point to the invisible but powerful emotional costs of inequality that persist even when devices and internet are available.

ICT skills, closely tied to early and consistent access, were another critical factor. Niyigena et al. (2020) found that students with regular exposure to computers over several years developed stronger digital fluency. Those without early access struggled to catch up, even when given similar tools later. Cochrane (2020) added that social and cultural capital played a significant role in shaping how meaningfully students engaged with digital tools access alone was not enough. Several studies evaluated interventions aimed at closing the digital divide, including device distribution programs, subsidized internet, and digital literacy training (Atobatele et al., 2024; Khasawneh, 2021). While these initiatives showed positive short-term impacts, their long-term success was limited without policy continuity and broader institutional support. Gunawardena and Dhanapala (2023) emphasized the importance of designing inclusive digital education platforms based on Universal Design for Learning (UDL), which accommodate diverse learning needs. Gohar et al. (2023) and Domina et al. (2021) reinforced this by advocating for localized content, teacher-driven strategies, and socio-emotional learning approaches to improve engagement, especially for students outside mainstream education.

Taken together, the research illustrates that the digital divide is not simply about lacking a laptop or Wi-Fi. It is about overlapping barriers that reflect and reinforce existing social inequalities. These studies show that digital exclusion is deeply embedded in structural issues, poverty, geography, parental education, and systemic marginalization. Access to devices is only the beginning. Students need supportive environments, both at home and at school, to use digital tools effectively. A quiet place to study, parents who can assist or encourage them, and previous exposure to digital platforms are all critical to meaningful learning. Economic inequality translates directly into educational inequality. Students in well-resourced households enjoy stable internet, multiple devices, and high levels of parental support. Those in lower-income households face ongoing disruptions, minimal resources, and school systems that are not always equipped to respond to their needs. These structural disadvantages create gaps that widen over time. Even when students from low-SES backgrounds gain access and develop skills, the emotional burden of marginalization, such as fear of failure, lack of belonging, or internalized stereotypes, can severely limit engagement and learning outcomes.

This body of research calls for a deeper shift in how digital education challenges are understood and addressed. Distributing devices and internet access is a necessary first step, but it is not enough. Without long-term investment, cross-sector collaboration, and inclusive policy design, many of these interventions fall short. One-time programs lack

sustainability. What is needed is systemic change, recurring funding, professional development for educators, robust digital inclusion frameworks, and intentional strategies that reach all learners. Gunawardena and Dhanapala's (2023) vision of Universal Design for Learning shows what inclusive digital education can look like: adaptable, flexible, and student-centered. Gohar et al. (2023) remind us that the insights of teachers, who know the day-to-day realities of marginalized learners, must inform digital education policy and design. Ultimately, bridging the digital divide is not just a matter of connectivity; it is a matter of justice. It requires recognizing that digital learning is shaped by culture, emotion, identity, and opportunity. A just and equitable digital future demands that every student, regardless of income or location, is equipped not only with devices, but with the confidence, support, and tools to thrive.

6.1. Recommendations and Future Studies

The results of this review show that socioeconomic status significantly shapes access to and engagement with digital resources in education. Barriers to digital learning are not limited to device ownership or internet connectivity but extend into students' social environments, psychological well-being, skill development, and educational opportunities. Grounding the following recommendations in Van Dijk's Theory of the Digital Divide (which distinguishes motivational, material, skills, and usage access), the Framework for Inquiry into the Technological Divide by West and Heath (2009) (which calls for a multidimensional understanding of access), and Reder's Model of Digital Inclusion (which emphasizes long-term integration of digital practices into everyday life), we propose strategies at the policy and educational levels, and outline areas for future research.

Governments should commit to sustained investment in digital infrastructure, particularly in rural and low-income urban areas where geographic location compounds economic disadvantage. Research by Nursamsu et al. (2021) and Kwakye et al. (2021) underscores how location amplifies barriers to digital access. Public investment must go beyond short-term fixes, prioritizing broadband expansion, the installation of community Wi-Fi hotspots, and the development of public access points such as libraries and community centers. In addition, subsidized data plans should be made available to support ongoing access for students and families in underserved communities.

To address material gaps directly, targeted subsidy programs for disadvantaged households should be implemented. Building on the work of Atobatele et al. (2024), these subsidies must support not only initial access to digital devices and internet connectivity, but also ensure long-term affordability. Such initiatives require stable funding streams and collaboration across government, private, and civil society sectors to guarantee continuity rather than one-time distributions.

Public-private partnerships offer a powerful mechanism to expand the reach of digital education. By aligning efforts between governments, technology providers, and non-governmental organizations, large-scale resource distribution, teacher training, and localized innovation become more feasible. Afzal et al. (2023) point to the effectiveness of institutional partnerships in reducing demographic disparities and strengthening support systems for underserved learners. Digital platforms must also meet standards that ensure inclusive design. Mandating Universal Design for Learning (UDL) principles across all educational technologies is critical for accessibility. As Gunawardena and Dhanapala (2023) emphasize, platforms that are not inclusive by design exclude students with disabilities and diverse learning needs. UDL compliance should be a non-negotiable policy standard for digital tools used in educational settings.

Digital literacy must be embedded throughout the curriculum to ensure all students acquire essential skills. As Niyigena et al. (2020) and Cochrane (2020) show, integrating digital fluency into every subject from early education onward is key to developing sustained competence. This includes basic operational skills, safe online behavior, and the ability to create and critique digital content. Supporting families is equally important. Since parental involvement strongly influences students' digital engagement (Li et al., 2020; Paulus et al., 2021), schools should provide accessible digital literacy training for parents. These workshops or online modules can help bridge the home-school digital gap and align with Reder's broader vision of integrating digital practices across entire households.

Teacher training must also evolve. Educators need professional development focused on inclusive and flexible online pedagogies. Training should address how to differentiate instruction, incorporate culturally relevant materials, and embed socio-emotional learning into digital teaching practices. Domina et al. (2021) and Gohar et al. (2023) highlight the importance of preparing teachers to meet the diverse needs of students in virtual environments.

Finally, schools should adopt a whole-school equity framework for digital education. This involves institutionalizing practices that ensure technology is implemented with equity in mind. Regular assessments of access gaps, development of targeted support plans, and the active inclusion of marginalized student voices in decision-making processes are essential. As Jury et al. (2017) and Wang et al. (2023) argue, creating psychological safety and a culture of inclusion is

just as critical as providing devices and internet access. Future research should move beyond short-term outcomes and examine the long-term impact of digital access and inclusion initiatives. This includes tracking how well students retain digital skills over time, how sustained access affects their academic performance, and whether these interventions improve their readiness for employment. Understanding these long-term effects is essential for evaluating the true sustainability and effectiveness of digital education strategies

7. Conclusion

This review has shown that digital inequality in education is not simply a matter of who owns a device or who can connect to the internet, it is a reflection of deeper social and economic inequalities that affect students' daily lives. Access to technology is influenced by household income, geographic location, parental education, and broader support systems. But even when digital tools are present, unequal digital literacy, psychological barriers, and inconsistent learning environments continue to limit many students' ability to fully participate in and benefit from digital education. The reviewed studies make it clear that digital inclusion must be approached as a long-term, systemic issue. One-time device distributions or short-term connectivity solutions may help in the moment, but without sustained investment in infrastructure, inclusive pedagogy, family and community engagement, and student well-being, the digital divide will persist. A meaningful solution requires coordinated efforts across policy, education, and technology sectors, guided by principles of equity, access, and adaptability. To build a more inclusive digital education system, we must think beyond devices. We must build environments where all students, not just those with economic advantage can thrive. This means making learning platforms accessible, training educators to meet diverse needs, and designing policies that don't just fill gaps, but remove the structural barriers that created them. Only then can digital education become a true equalizer an opportunity, not a privilege.

Compliance with ethical standards

Disclosure of conflict of interest

The author declares no conflicts of interest.

Statement of ethical approval

This review is based entirely on publicly available secondary data and did not involve human participants. All sources have been properly cited, and intellectual property rights have been respected. As such, no additional ethical approval was required.

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