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DIGITAL INEQUALITY, SOCIAL INCLUSION, AND EDUCATIONAL OPPORTUNITIES IN CONTEMPORARY SOCIETY

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ABSTRACT

The use of digital technologies has become the medium of access to instruction, learning materials and institutional communication but the assumption of connectivity as a means of educational inclusion is challenged. This is a critical and integrative review that explores the role of digital inequality in the social inclusion and education opportunity in today's societies. The review employed a transparent, non-systematic design with a combination of keyword searching web-based scholarly records, backward citation tracing and explicit relevance and credibility criteria. Selected peer-reviewed studies were thematically compared in terms of structural drivers, digital skills/digital meaningful use, intersecting disadvantages, educational participation, and policy response. The synthesis shows that inequalities in devices, connectivity quality and skills are always related to socioeconomic status, geography, gender and disability, while physical access alone has had mixed impacts on education. Experimental and quasi-experimental studies demonstrate that pedagogical and household support is necessary in order to achieve a strong or mixed effect. The review suggests a conversion framework which involves structural conditions, access to material, skills and meaningful use, and institutional support in determining whether digital resources can be an educational opportunity and therefore social inclusion. The framework is a conceptual synthesis and is not an empirically tested causal model. Policy implications point towards coordinated, multi-layered approaches that integrate the following: affordable connectivity, devices, skills development, accessible design, and teacher preparation and are measured with opportunity-oriented indicators. The evidence is hindered by cross-sectional design, lack of uniformity across geographic areas, and lack of uniformity across measures.

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1. Introduction

Digital technologies have been used in enrolment, teaching and learning, assessment and communication in education systems. Students are more and more requiring technological equipment, connectivity and functional skills to access courses, submit assignments and access support. The same technology can exacerbate differences in participation due to differences in affordability, quality and capability. These dependencies have become apparent and COVID-19's transition to remote learning highlighted that digital inequalities join with social disadvantage (Beaunoyer et al., 2020; Van Lancker & Parolin, 2020).

The study of research has long transcended the dichotomy of access. Hargittai (2002) revealed that individuals with similar access vary significantly in online skills and subsequent studies made a distinction between inequalities in access to materials, in skills and uses, and in tangible outcomes (Scheerder et al., 2017; van Deursen & van Dijk, 2019). Being online is therefore not enough for meaningful education participation to be possible. It's contingent upon learners' ability to utilize technology with devices, instruction, and time for outcomes that are valued by their educational context. This is warranted by experimental evidence: Free home computers have not systematically been found to improve achievement (Fairlie & Robinson, 2013; Malamud & Pop-Eleches, 2011).

These differences can be significant when it comes to social inclusion. Education is a main pathway to the labour market and civic engagement and differential exposure to digital technologies in education can create a differential exclusion. Social inclusion and educational opportunity are however two different things. Being formally enrolled in a course does not necessarily mean that learners are included in the practices of the course; inclusion can also be achieved outside the education system. Policies based on the concept of connectivity may confuse these levels.

The knowledge-based scholarship is dispersed. The notions of skills and use have been differentiated in communication research. In the field of economics, there have been intensive studies on the provision of devices and broadband. There are contributions from education research related to pedagogy and teacher practice, as well as capital and intersectional lenses from sociology, and capability-based accounts of exclusion from development studies. Institutionally distinct strands seldom support each other and few contributions tell us why the same digital resources create varying opportunities for learning in different contexts. An integrated approach that focuses on the humanities and social sciences is necessary since the issue is not just a technical issue, but one of the institutions, meaning, and power.

Five questions are answered in this review. It addresses the following research questions: What factors at the structural, socioeconomic, demographic and institutional levels are associated with digital inequality (RQ1); how does digital inequality in terms of access, skills, usage and support influence educational participation and opportunity (RQ2); and how is digital inequality intertwined with exclusion by income, gender, geographical location, disability and others (RQ3). It then examines the evidence available for interventions that address the educational opportunities and social inclusion of targeted groups through digital inequality, and considers the constraints of such interventions (RQ4), and suggests an integrated framework of digital inequality, social inclusion and educational opportunity (RQ5).

The research question is that of the conditions that make digital resources unequal and become, or not, educational capabilities and inclusive outcomes, or, in short, the question of conversion, as in post-structuralism. This review has three contributions: the thematic separation of stronger and weaker evidence, the theoretical integration of four well-known perspectives, and a testable conceptual framework based on the literature. The review is not a study that produces new empirical data.

2. Literature Review and Conceptual Foundations

2.1 Conceptualizing Digital Inequality

This means that digital inequality is seen as a multi-layered phenomenon. Initial discussion focused on computer ownership or Internet access. Later research focused on material access, including the quantity and quality of devices, connection speed and stability and paying for devices (van Deursen & van Dijk, 2019). Skills make up a second layer and encompass operational, informational and strategic skills, which are all independent of access (Hargittai, 2002). A third aspect is related to patterns of use as well as tangible consequences of their use, like learning gains or labour-market returns (Scheerder et al., 2017). These inequalities are important because of their interaction with offline resources and life chances, according to Robinson et al. (2015). Gonzales (2016) further explained that low income users may have access to a device but then lose it or have access to it intermittently, meaning access is considered a condition that is maintained, rather than acquired. Pangrazio et al. (2020) revealed that there is a wide variety of definitions of digital literacy, from functional skills to critical and creative skills, making it challenging to measure. This multidimensionality is confirmed by the reviews of the wider field (Lythreatis et al., 2022). Warschauer and Matuchniak (2010) had already grouped educational evidence by access, use and outcomes, an organization that continues to be analytically useful.

2.2 Social Inclusion and Educational Opportunity

Social inclusion will be interpreted here as the ability to be involved in the resource, relationship and civic dimensions of social life without discrimination and without being disadvantaged. Educational opportunity means the actual conditions under which educational inputs enable a learner to gain access to education, to participate in it and to benefit from it in ways of which the learner has good reason to believe. While the two concepts are not the same, there is a relationship between the two as education shares out networks, credentials, and skills. Opportunity can be without inclusion when participation is stigmatised or when participation is merely nominal and inclusion can be through work, community or civic structures. Zheng and Walsham (2008) considered social exclusion in the digital society as a lack of capability, and it helps to maintain resources, opportunities and inclusion analytically separate.

2.3 Relevant Theoretical Perspectives

Digital inequality theory is an explanation for the layers of access, skills, use, and outcomes, and provides less insight into why the same resource results in different outcomes. This is what the capability approach fills in. It makes the difference between what people have (resources) and what people can do (capabilities), and emphasizes conditions affecting what individuals can do with resources, such as personal, social and environmental conditions (Robeyns, 2005). The problem is that conversion factors are not easily implemented in empirical research in education. Social and cultural capital perspectives determine the origins of conditions for conversion. Family and community relations generate resources for learning (Coleman, 1988) and digital capital applies this concept to digital competences and assets, which can be transferred between areas (Ragnedda, 2018; Ragnedda et al., 2020). The views can be deterministic if institutional actions are overlooked. Intersectionality argues that interlayered systems of disadvantage have experiences that are not easily broken down into the sum of the separate categories (Crenshaw, 1989). It cautions against examining these components separately – few digital education studies model interactions formally, but this is what it suggests to do – income, gender, geography and disability. The viewpoints are supplementary. The layers are provided by digital inequality theory, the capability conversion logic by the capability approach, the distribution of capability to convert by capital perspectives and the identification of those least capable of conversion by

intersectionality.

2.4 Research Gap and Analytical Position
Four gaps follow. First, the digital inequalities do not necessarily translate into a conversion mechanism for educational opportunity. Second, evidence is mostly from high income locations, thus restricting contextual comparisons. Third, there are conflicting conclusions from observational studies and randomised or quasi-experimental studies regarding the educational benefits of access and the reasons for these differences are not fully explained. Fourthly, there is still a lack of thorough assessment of connectivity subsidies, skills programmes and accessibility measures. This review takes a relational approach: digital resources are educationally significant in conjunction with skills, supports, and institutional conditions.

3. Review Methodology
3.1 Review Design
A critical, integrative review was chosen due to the literature being multidisciplinary, involving many different designs, and having various levels of analysis that precludes the pooling of literature in a statistical way. This design allows the use of theoretical, empirical and review sources, and explicitly demands comparison of the various sources.

3.2 Literature Identification and Eligibility
Iterative keyword searches were conducted in a general-purpose web search engine that returns scholarly records using the Boolean combinations ["digital inequality" OR "digital divide" OR "digital exclusion"] AND [education OR "educational opportunity" OR "online learning"], [digital literacy" OR "digital skills"] AND "social inclusion", "digital divide" AND [rural OR disability OR gender] and [educational technology" OR "home computer"] AND [randomized OR experimental]. Wherever possible, bibliographic information has been verified against the page of the publisher, repository or indexing page. Theory and empirical studies that support the base papers were identified via backward citation and the reviewers' own knowledge of the field. Scopus, Web of Science, ERIC, OpenAlex, Crossref and Google Scholar were not systematically searched.
The publication window was focused on 2020-2026, with some seminal publications from 2016-2019 and a small number of earlier works. Peer reviewed journal articles in English that explicitly examined digital inequality, digital skills, educational inclusion and/or technology-related education outcomes were included as long as the methods were described adequately and the venue was credible. Excluded were commercial material, grey literature, duplicate records and sources for which the bibliographic identity of the source could not be established. The fit with the review questions, transparency of design, and venue standing were used to determine how relevant and credible each work was.

3.3 Evidence Organization and Thematic Synthesis
Selected sources were organized into six themes that correspond to the questions for the review: structural drivers; skills and meaningful use; intersecting disadvantages; educational participation and outcomes; institutional and policy responses; and conceptual integration. Informal recording was done for context, design, population, principal finding and limitation at each source. Similarities and differences were examined, along with contextual variation, and the strength of design (experimental, quasi-experimental, longitudinal, cross-sectional or review). The synthesis was essentially interpretive, performed by one reviewer only and there was no independent second coding or quantitative quality scoring.

3.4 Methodological Limitations

The search is not exhaustive and publication bias cannot be excluded as null and negative results may be less likely to be published. The restrictions on English language sources and search tools employed likely bias the results towards research from Europe and North America. 2024-26 publications in some cases are covered to a limited extent. There is a lack of direct comparison between studies due to differences in ways of measuring access, skills and outcomes. Single reviewer judgement creates some subjective element. Most cited studies are observational and the review cannot make strong causal inferences and the conceptual framework proposed in Section 4.6 is for testing.

4. Thematic Findings and Discussion

4.1 Structural and Multidimensional Drivers of Digital Inequality

Literature is unanimous in saying that digital inequality mirrors the social stratification and is shifting with the increased level of access. Van Deursen and van Dijk (2019) suggested that in the affluent nations, inequality is not just about having these devices, but about their quality and connection quality, as well as the number of devices. Helsper and Reisdorf (2017) found that in Great Britain and Sweden the motivations for digital exclusion shifted from lack of access to lack of skills and interest and that the groups of those who were digitally excluded intersected with those who were socially disadvantaged. Gonzales (2016) reported that the access to these devices and services is unstable for low income users, in that they might have devices and services, but have intermittent access to them. There's another dimension added with geography. A systematic review of rural areas found unequal availability, adoption and use of ICT as a result of infrastructure constraints and the socio-demographic characteristics of people living in rural areas (Salemink et al., 2017). The dimensions and their educational implications are summarised in table 1.

Table 1. Dimensions of Digital Inequality and Their Educational Implications

Dimension	Defining characteristics	Principal barriers	Implications for educational opportunity	Supporting literature
Material access (devices)	Ownership, number, and suitability of devices	Cost; shared or outdated devices	Constrains task completion and sustained study	van Deursen & van Dijk (2019)
Connectivity	Availability, speed, and stability of connection	Rural infrastructure gaps; unstable service	Limits participation in synchronous and media-rich instruction	Salemink et al. (2017)
Affordability and maintenance	Ability to sustain devices and service over time	Low income; interrupted service	Produces discontinuous access to coursework	Gonzales (2016)

Dimension	Defining characteristics	Principal barriers	Implications for educational opportunity	Supporting literature
Digital skills	Operational, informational, and strategic competences	Limited prior exposure; weak support	Shapes ability to find, evaluate, and use learning resources	Hargittai (2002); Scheerder et al. (2017)
Meaningful use	Purposeful, educationally productive activity	Entertainment-dominated use; absent guidance	Determines whether access yields learning benefit	Camerini et al. (2018)
Accessibility	Usability for people with disabilities	Inaccessible design and content	Excludes learners from instruction and resources	Dobransky & Hargittai (2006)
Opportunity conversion	Capacity to turn resources into valued educational functionings	Unequal conversion factors; weak institutional support	Explains uneven benefit from equal access	Robeyns (2005); Zheng & Walsham (2008)

Note. Developed for this review from the cited literature. Dimensions are analytically distinct but empirically overlapping.

The meaning of a text depends upon its context. Much of the evidence retrieved relates to the higher income settings and the issues are quality, maintenance and skills. Based on Latin American household survey data, Hilbert (2011) suggested that in developing contexts the association between income, education and employment level and basic access is still strong. There was less evidence from lower-resource settings in this review and patterns from affluent countries cannot be assumed to apply. Beaunoyer et al. (2020) also posited that digital inequalities and the pandemic were mutually influential, implying that the extent to which institutions in schools and universities provide would partly shape how household disadvantage is experienced as educational disadvantage. The structural drivers (RQ1) are thus a combination of household resources, infrastructure, geography and institutional provision.

4.2 Digital Literacy, Agency, and Meaningful Participation

Skills evidence all come together around a common theme: nominal access is not equational with productive use. Studies that measure only operational skills may underestimate barriers to education because Hargittai (2002) found differences in skill levels among those with equal access and Pangrazio et al. (2020) found conceptions of digital literacy range from functional competence to critical and creative engagement. A systematic evidence review on the research of 12-17 year olds involving 34 cross-sectional studies showed positive associations between digital skills and online opportunities and information benefits; technical skills were associated with mixed results while information skills were associated with information benefits (Livingstone et al., 2023). These studies have been conducted on a cross-sectional design and causal interpretation is not possible, and there was a lack of studies addressing communication and creative skills.

An Italian-speaking Swiss longitudinal study provides an alternative view. Based on two-wave survey data from 843 students and their parents, as well as school grades, Camerini et al. (2018) found that lower family income was correlated with greater use of entertainment and communication, and that such was correlated with lower grades, which the authors termed as a second-order divide. Both the results are consistent. Skills and information that is used purposefully are linked to educational gain; information used for entertainment may not be used for study. It is the use, not the technology that is different. Both bodies of evidence are first-hand and context specific, and therefore spot potential mechanisms, but not known ones.

Accessibility and autonomy finishes the overall look. However, Dobransky and Hargittai (2006) found that individuals with disabilities were less likely to use the Internet and explained this somewhat in terms of access barriers and socioeconomic conditions, suggesting that with inaccessible design, skill measures are inadequate. Agency in the capability perspective relies on factors of conversion, including confidence, time, supportive adults and usable interfaces (Robeyns, 2005). Functional and critical literacy, supportive environments and accessible design, and not just connection, are thus required for meaningful participation (RQ2).

4.3 Intersectional Disadvantages and Social Exclusion

Digital disadvantage is not often just one thing, as warned by intersectional analysis (Crenshaw, 1989). Much of the evidence base, however, focuses on individual aspects and formal interaction analysis is rare. With respect to gender, Hilbert (2011) found that the gender difference in the use of the Internet is significantly correlated with the difference in education, employment and income in Latin America based on household surveys. This indicates that gender impacts are sometimes indirect, dependent on broader socio-economic status, but it is a regional effect and not generalisable across societies as norms and policy contexts vary. When it comes to disability, the evidence suggests that these disparities remain constant and are related to inaccessibility in design and limited resources (Dobransky & Hargittai, 2006). In terms of Geography, rural disadvantage is related to both the infrastructure and the population (Salemink et al., 2017).

The capability perspective provides some answers as to how these disadvantages accumulate. Zheng and Walsham (2008) theorised about exclusion in the digital society as deprivation of capabilities, that is, where several conversion barriers overlap, such as low income, poor local infrastructure and inflexible interfaces. A learner who is involved in that kind of combination may, having a device, still not have been able to participate in learning. Helsper and Reisdorf (2017) also concluded that digital exclusion was related to broader social disadvantage. Digital inequality is understood to be both a mirror and a facilitator of exclusion (RQ3), although the interaction effect and its nature (additive or multiplicative) are less well explored.

4.4 Educational Participation, Learning Opportunities, and Unequal Outcomes

The literature distinguishes between two questions that are frequently asked together; whether digital inequality is a constraint on the potentially equalising experience of education and whether digital inequality reduction enhances educational outcomes. There is uniformity in trend in the evidence for the first question in the pandemic period. In a high connectivity country like the Netherlands, with relatively short school closures, Engzell et al. (2021) found learning loss before and after school closures is more substantial than the loss of less educated students. This means that connectivity doesn't eradicate disadvantage in the event of a variation in home support. In a commentary, Van Lancker and Parolin (2020) explained that closures had the potential to negatively affect disadvantaged children due to unequal home learning environments, while a systematic review of higher education in developing countries revealed that the digital divide negatively affected marginalised learners (Assefa & Gebremeskel, 2024).

The second question has conflicting evidence. Vigdor et al. (2014) found negative (albeit modest)

impacts of home computer and broadband introduction on test scores in North Carolina using within-student variation. A randomized trial conducted in California showed no impact on grades, test scores, or attendance when free home computers were made available to students (Fairlie & Robinson, 2013) and a regression discontinuity of low-income Romanian households found that while computer skills were improved, the school grades of those with free computers were reduced (Malamud & Pop-Eleches, 2011). These and similar studies are compared in Table 2.

Table 2. Comparative Synthesis of Empirical Evidence on Digital Inequality and Educational Inclusion

Study	Context	Research design	Principal relevant finding	Interpretation or limitation
Vigdor et al. (2014)	North Carolina, United States	Administrative data; within-student and timing-based variation	Home computer and broadband introduction associated with modest negative effects on test scores	Single state; suggests universal provision alone may widen gaps
Fairlie & Robinson (2013)	California, United States	Randomised trial of free home computers	No effect on grades, test scores, or attendance	Short-term school outcomes; opportunity measures not assessed
Malamud & Pop-Eleches (2011)	Romania	Regression discontinuity (low-income voucher)	Higher computer skills; lower school grades	Possible displacement of study time; mechanism inferred
Camerini et al. (2018)	Italian-speaking Switzerland	Two-wave longitudinal survey; multilevel structural equation modelling	Lower income associated with more entertainment use, linked to poorer grades	Regional sample; reliance on self-reported use
Engzell et al. (2021)	Netherlands	Pre/post comparison of national assessments	Learning loss larger among students from less educated households	Closure context; high connectivity setting
Helsper & Reisdorf (2017)	Great Britain and Sweden	Analysis of national survey data	Reasons for exclusion shifted from access toward skills and	Cross-sectional comparisons; limited educational

Study	Context	Research design	Principal relevant finding	Interpretation or limitation
			interest	outcomes
Hilbert (2011)	Latin America	Household survey analysis	Gender gaps largely associated with education, employment, and income	Regional pattern; not causal
Dobransky & Hargittai (2006)	United States	National survey analysis	Lower internet use among people with disabilities	Older data; accessibility conditions have changed
Livingstone et al. (2023)	Multiple countries	Systematic evidence review of 34 cross-sectional studies	Skills associated with opportunities and information benefits; technical skills mixed	Cross-sectional base; adolescents only

Note. Studies were selected as representative of design and context, not as an exhaustive set. Findings are summarised without effect sizes. The final row is a review and is included for comparison of design strength.

The main conflict in this literature is the difference between descriptive gaps and null or negative causal estimates. Some plausible explanations are: what happens when the device becomes a distraction from study, lack of guidance, and device quality—these are interpretations and not verified mechanisms. In methodological terms, the experimental and quasi-experimental studies have more potential for causal inferences, but they primarily measure grade levels and test scores, and opportunity indicators like access to instruction, participation, and resources are not always measured. Outcome disparities should not, therefore, be interpreted as opportunity disparities, and the lack of test-score improvement should not be interpreted as lack of relevance to learning.

4.5 Institutional and Policy Responses

The assessment of policy responses (RQ4) is done in the form of a distinction between demonstrated interventions and plausible ones, as reflected in the organisation of Table 3. There is the most direct rationale for device and connectivity provision, but the least evidence of the educational gain when delivered by itself. An analysis of both RCTs and RDs in developed countries yielded mixed results for access to technology, mixed to positive results for computer-assisted learning, especially in mathematics, but less encouraging results for online courses as compared to in-person learning (Escueta et al., 2020). In addition to the null and negative estimates

in Section 4.4, this means that some provision is required for some types of participation, but not for benefit. While skills education has a clear conceptual justification due to the extent of digital literacy (Pangrazio et al., 2020), there is limited supporting evidence mostly of an associational nature (Livingstone et al., 2023). Teachers' beliefs and attitudes towards technology influence the way technology is used in classes (Tondeur et al., 2017) which is a connection between the technology infrastructure and how it's used. Coordinated mitigation strategies were proposed by Beaunoyer et al. (2020); however, these are based on a conceptual review, rather than on evaluation. Not a single rigorous evaluation for accessibility was retrieved, and so recommendations are based on barriers documented (Dobransky & Hargittai, 2006).

Table 3. Educational and Policy Interventions for Reducing Digital Inequality

Intervention category	Targeted inequality	Proposed or documented mechanism	Supporting evidence or limitation	Practical evaluation indicator
Device provision	Material access; affordability	Removes cost barrier to participation	Documented increase in ownership and use in trial settings; educational gains mixed or null (Fairlie & Robinson, 2013; Malamud & Pop-Eleches, 2011; Escueta et al., 2020)	Device functionality and replacement rates; completion of required tasks
Affordable connectivity and infrastructure	Connectivity; rural and low-income gaps	Enables participation in online instruction	Proposed; limited evaluation of educational effects, and broadband associated with modest negative scores in one study (Vigdor et al., 2014; Salemink et al., 2017)	Share of learners with stable connection; learning time lost to outages
Digital skills education	Skills; meaningful use	Builds functional and critical literacy	Proposed; associational support only (Pangrazio et al., 2020; Livingstone et al., 2023)	Skill assessment across functional and critical domains; rate of purposeful

Intervention category	Targeted inequality	Proposed or documented mechanism	Supporting evidence or limitation	Practical evaluation indicator
				use
Teacher preparation and pedagogical integration	Meaningful use; institutional support	Aligns technology with instructional practice	Partly supported; qualitative evidence on beliefs and use, and promising experiments on computer-assisted learning (Tondeur et al., 2017; Escueta et al., 2020)	Observed teaching practice; proportion of lessons with purposeful technology use
Accessible and inclusive design	Accessibility; disability exclusion	Removes interface and content barriers	Proposed; barriers documented but no retrieved evaluation (Dobransky & Hargittai, 2006)	Accessibility compliance; participation of learners with disabilities
Community access and multilevel coordination	Geography; household resource gaps	Provides alternative access and support	Proposed; conceptual support only (Beaunoyer et al., 2020; Salemink et al., 2017)	Learner use of community facilities; availability of support

There are significant barriers and tradeoffs to implementation. There is a high cost of universal provision and the possibility that the gaps could be increased if disadvantaged families do not use the devices as effectively as privileged families (Vigdor et al., 2014), while targeted provision would potentially be stigmatizing and administrative. Devices need maintenance, replacement and support, as Gonzales (2016) mentioned that devices are unstable. There is very little evidence from low-resource contexts and results from high-resource contexts may not be transferable. Figure 1 depicts a multi-level coordination mechanism to coordinate responses between levels.

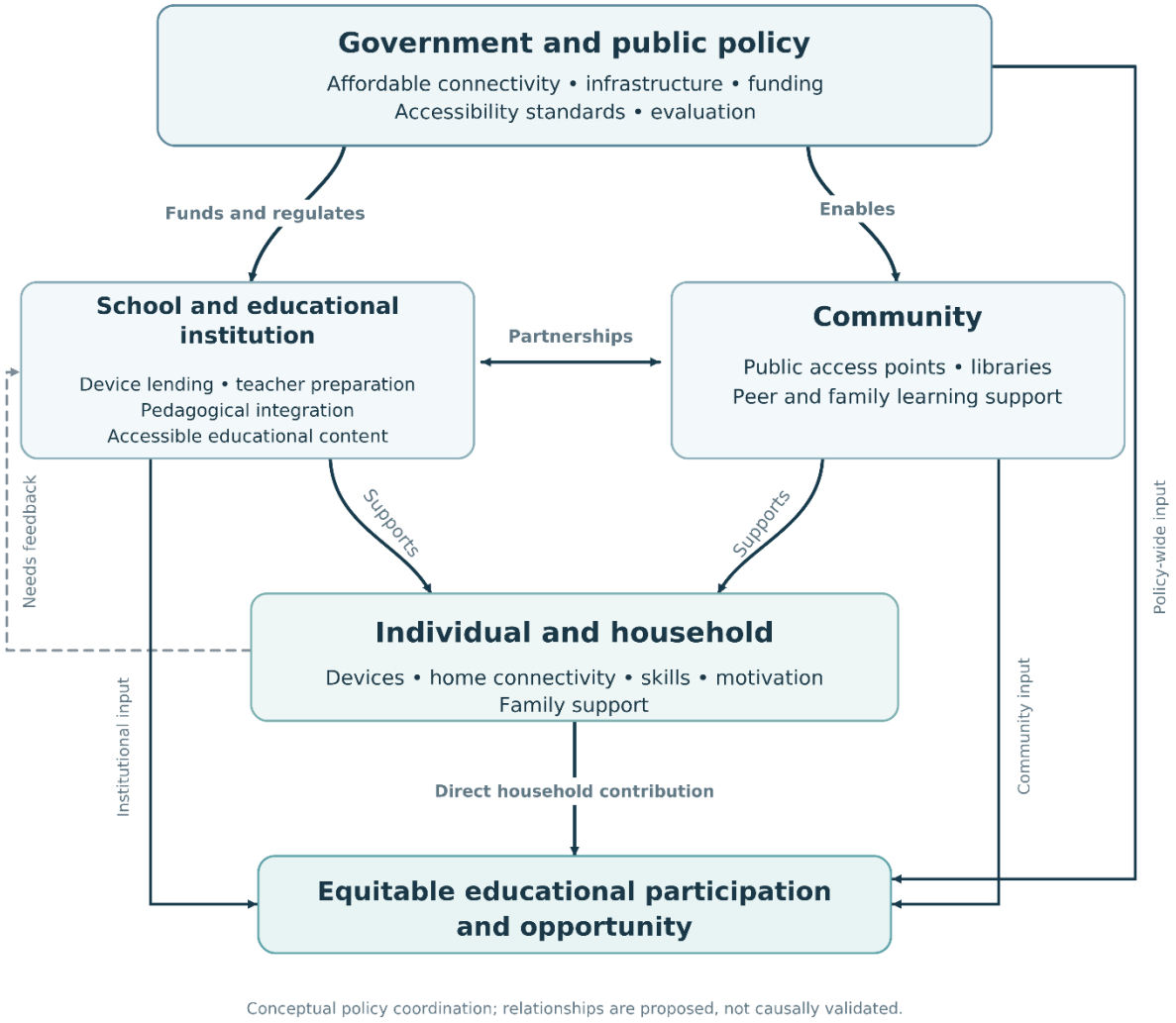


Figure 1. Multilevel framework for inclusive digital education policy. Conceptual synthesis developed for this review from the cited literature. It is not an empirically validated causal model.

4.6 Integrated Conceptual Framework and Research Implications

Based on the evidence a framework for an integrated conversion was proposed (RQ5) which is depicted in Figure 2. Research shows a link between structural and socioeconomic factors and material digital access (Helsper & Reisdorf, 2017; van Deursen & van Dijk, 2019). While access to materials is a prerequisite for participation, on the basis of available evidence, it is a poor determinant of education gains alone (Fairlie & Robinson, 2013; Vigdor et al., 2014). The framework suggests that there is a shift between access and educational participation, with skills and meaningful use providing the bridge between these two dimensions, based on the associational evidence on skills (Livingstone et al., 2023) and differences in use (Camerini et al., 2018). Institutional support or accessibility can be seen as conversion factors in the capability sense (Robeyns, 2005), since the potential educational return from a resource is determined by the institutional support, in this case teachers, inclusive design and community provision. Educational participation and opportunity then help to insure social inclusion, as education is a means of distributing credentials, networks and recognition. All steps are influenced by contextual factors – intersecting disadvantage and the policy environment (Crenshaw, 1989; Zheng & Walsham, 2008).

Two feedback mechanisms are suggested, namely that participation fosters development of skills and confidence that will help them to use the facilities later, and that inclusion will increase household and social capital that will boost access (Coleman, 1988; Ragnedda, 2018).

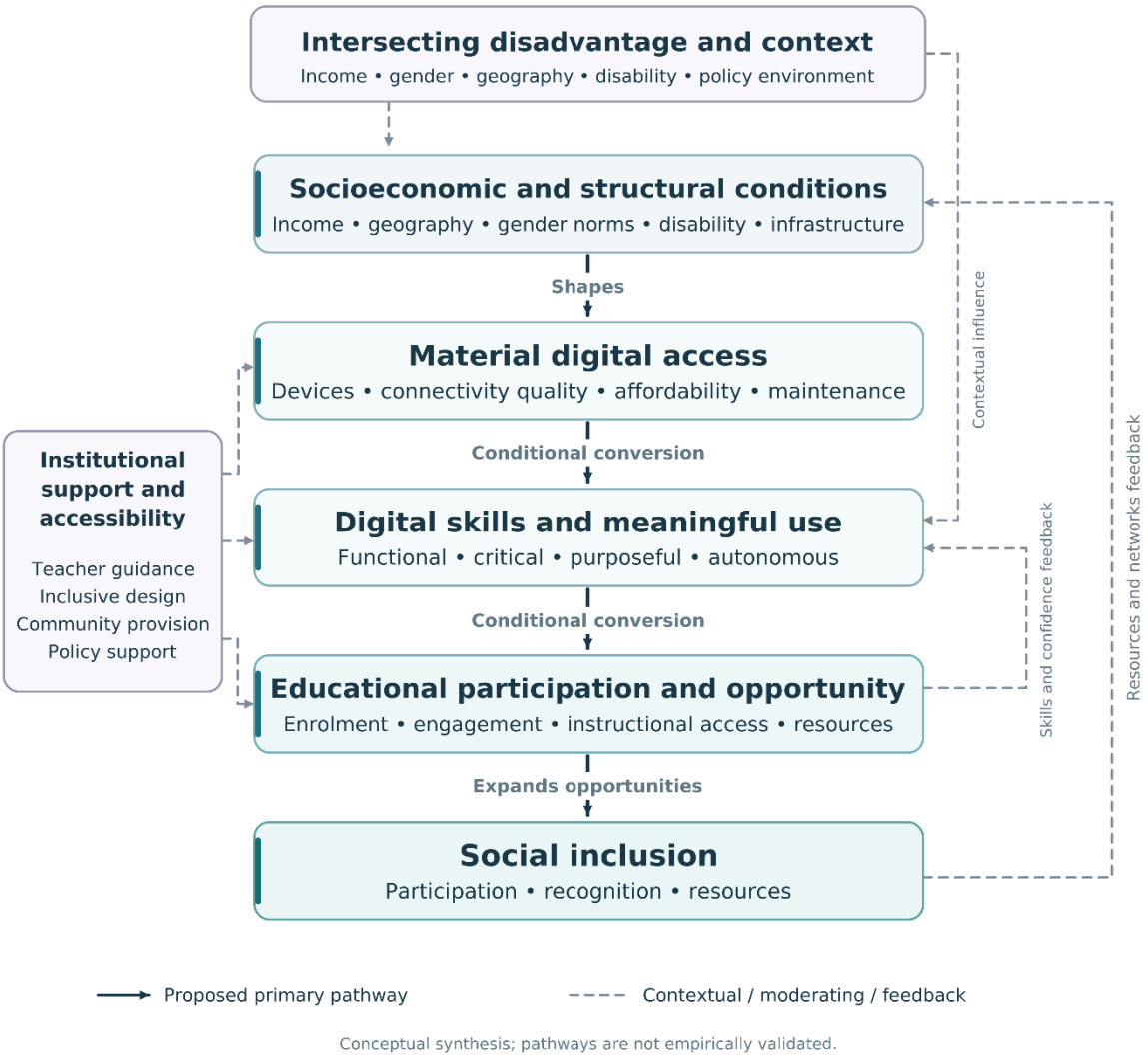


Figure 2. Conceptual pathways linking digital inequality, social inclusion, and educational opportunities. Solid arrows denote proposed primary pathways, dashed arrows denote moderating, contextual, or feedback influences. Conceptual synthesis developed for this review. It is not an empirically validated causal model.

The framework delineates between supported relationships and proposed pathways. The reviewed evidence supports the relationship between structural conditions and unequal access, the limited and inconsistent impact of access alone on educational outcomes and the relationship between skills and type of use and educational benefit (largely based on observation). The moderating role of institutional support, the feedback loops and the connection between educational opportunity and social inclusion are proposed and have been indirectly retrieved. There are five propositions that follow for empirical testing: First, the impact of device provision on educational participation is greater in settings in which learners are provided with teacher guidance and household support. Second, the correlation between access and outcomes is less strong in environments where access is limited to unguided entertainment. Third, the provision of accessibility features increases participation of students with disabilities beyond just the provision of devices. Fourth, multiple

disadvantages compound resulting in greater conversion losses than would be expected based on the individual disadvantage effects. Fifth, opportunity-based indicators capture effects of interventions that test score indicators do not. Examples of suitable designs are multi-arm trials of varying provision and support, longitudinal multilevel models, formal interaction analysis, and comparative studies across higher and lower income and lower provision/support contexts.

5. Conclusion

This review discussed the possible connection between digital inequality and social inclusion and educational opportunity and concluded that the connection is not automatic. The most strongly supported results are that gaps in device access, connectivity quality, and skills are related to socioeconomic, geographic, gender, and disability status, and that the impact of access alone has yielded mixed and limited results in the experimental and quasi-experimental studies analyzed. Evidence on skills and types of use, as well as on intersecting disadvantages, is mostly observational and can only be interpreted as plausible mechanisms.

The theoretical contribution is a conversion framework, which combines the digital inequality theory, the capability approach, capital perspectives, and intersectionality. Changes the conversation to 'who is connected', and maintains analytically separate considerations of opportunity, outcome, and inclusion.

To achieve educational equity and social inclusion, the distribution of devices and connectivity must be considered a precondition and must be accompanied by learning skills, teacher training, accessible design and community support. The priorities are proportional to the proof, with affordable and stable connectivity, maintained devices, pedagogical integration and accessibility being key, and judged by participation and opportunity as well as test scores. Stigma and the difference in higher income and low resource settings should be addressed in targeting.

The evidence base is constrained by some cross-sectional designs, use of a variety of measures, geographical focus on a limited number of locations and by the non-exhaustive retrieval of this review. Future research needs to evaluate the proposed moderating role of institutional support, formally model intersecting disadvantages, and expand to lower-resource contexts and more recent technological contexts.

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