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*Scientific articles*

## **Políticas educativas para reducir la brecha digital: una revisión sistemática**

***Educational Policies to Reduce the Digital Divide: A Systematic Review***

***Políticas educacionais para reduzir a exclusão digital: uma revisão sistemática***

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### **Resumen**

La desigualdad tecnológica es un desafío estructural para la equidad educativa, especialmente en zonas rurales y en comunidades con menor desarrollo económico. Esta revisión sistemática, realizada conforme a la metodología PRISMA 2020, analiza la efectividad de políticas educativas implementadas a nivel global para disminuir la brecha digital en sus tres dimensiones: acceso, uso y apropiación de las tecnologías. Se realizó una búsqueda en *Web of Science*, *Scopus*, *ERIC*, *SciELO* y *Redalyc*, en la que se identificaron 27 registros, de los cuales 24 cumplieron los criterios de inclusión (publicaciones entre 2019 y 2025 y estudios empíricos o teóricos). Debido a la heterogeneidad de los datos obtenidos, la síntesis se realizó



de forma narrativa. Los resultados muestran avances en infraestructura tecnológica en distintos contextos educativos. No obstante, persisten desigualdades socioeconómicas. Contar con acceso a recursos tecnológicos no garantiza su uso efectivo para el aprendizaje ni su apropiación pedagógica, debido a limitaciones en las competencias digitales y en el acompañamiento institucional para su implementación en el aula. Los hallazgos confirman tendencias existentes en la literatura previa y amplían el conocimiento al evidenciar la necesidad de estrategias sostenibles en territorios vulnerables. Se concluye que es necesario avanzar hacia políticas integrales que aseguren una inclusión tecnológica crítica y equitativa, así como la formación docente en competencias digitales. Asimismo, se identifica la necesidad de realizar más estudios longitudinales adaptados a contextos rurales.

**Palabras clave:** brecha digital, política educativa, educación rural, estudiantes.

## Abstract

Technological inequality remains a persistent barrier to educational equity, particularly in rural areas and economically disadvantaged communities. This systematic review, conducted following the PRISMA 2020 guidelines, examines how educational policies worldwide have addressed the digital divide across three key dimensions: access, use, and technology appropriation. A search across *Web of Science*, *Scopus*, *ERIC*, *SciELO*, and *Redalyc* identified 27 records, of which 24 met the inclusion criteria (publications from 2019 to 2025 and empirical or theoretical studies). Given the heterogeneity of the evidence, a narrative synthesis was applied. Findings reveal improvements in technological infrastructure and connectivity; however, socioeconomic disparities continue to limit meaningful technological integration. Access to devices or internet alone does not guarantee effective learning or adequate technological adoption, underscoring the need for strengthened digital pedagogy and institutional support. The results align with existing literature while contributing new insights by highlighting the importance of sustainable strategies in vulnerable contexts. Overall, the review emphasizes the need for comprehensive policies that foster critical and equitable digital inclusion, as well as the importance of conducting longitudinal studies tailored to rural environments.

**Keywords:** digital divide, educational policy, rural education, students.

## Resumo

A desigualdade tecnológica representa um desafio estrutural para a equidade educacional, especialmente em áreas rurais e comunidades menos desenvolvidas economicamente. Esta revisão sistemática, conduzida segundo a metodologia PRISMA 2020, analisa a eficácia das políticas educacionais implementadas globalmente para reduzir a exclusão digital em suas três dimensões: acesso, uso e apropriação de tecnologias. Foi realizada uma busca nas bases de dados Web of Science, Scopus, ERIC, SciELO e Redalyc, identificando 27 registros, dos quais 24 atenderam aos critérios de inclusão (publicações entre 2019 e 2025 e estudos empíricos ou teóricos). Devido à heterogeneidade dos dados obtidos, a síntese foi apresentada em formato narrativo. Os resultados demonstram avanços na infraestrutura tecnológica em diferentes contextos educacionais. Contudo, as desigualdades socioeconômicas persistem. O acesso a recursos tecnológicos não garante seu uso efetivo para a aprendizagem ou sua apropriação pedagógica, devido a limitações em habilidades digitais e apoio institucional para a implementação em sala de aula. Os achados confirmam tendências já existentes na literatura e ampliam o conhecimento ao destacar a necessidade de estratégias sustentáveis em territórios vulneráveis. Conclui-se que é necessário avançar em direção a políticas abrangentes que garantam a inclusão tecnológica crítica e equitativa, bem como a formação de professores em competências digitais. Além disso, identifica-se a necessidade de mais estudos longitudinais adaptados a contextos rurais.

**Palavras-chave:** exclusão digital, política educacional, educação rural, estudantes.

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## Introduction

In the contemporary educational context, the digital divide is conceived as a manifestation of social inequalities that affect the equity of access, use, and appropriation of Information and Communication Technologies (ICTs) (Cabero-Almenara & Ruiz-Palmero, 2018; Colom, 2020; Villao & Matamoros, 2024). While the term began to be used in the 1990s to describe the limited availability of technological devices in certain sectors of the population (Eastin et al., 2015; Scheerder et al., 2017), its scope now encompasses not only the availability of equipment but also the modes of interaction with technology and the benefits derived from its use. This conceptual expansion highlights the need for a systematic analysis of the phenomenon, as inequalities deepen among users who enter the digital environment with diverse sociodemographic conditions (Helsper, 2010).



In this context, examining this phenomenon is a social priority, given that equitable access to technologies has become a strategic element for developing digital citizenship skills. From this perspective, technological appropriation can positively impact both the improvement of socioeconomic conditions and the increase in learning opportunities and knowledge generation (Cai, 2008; Unesco, 2017; Toudert, 2019). Therefore, the differences in levels of technological participation according to social stratum are evident, underscoring the urgency of designing policies that guarantee more equitable access for the entire population (Gómez et al., 2018).

Several authors agree that the digital divide is structured in three interrelated dimensions (Gracia, 2021; Helsper, 2021; Jiménez-Mejía et al., 2024). The first dimension corresponds to access, reflected in the unequal availability of devices and connectivity. The second relates to use, associated with the skills necessary to manage technologies meaningfully. The third dimension, appropriation, refers to the ability to transform technological use into concrete benefits, such as improved academic performance or greater opportunities for social inclusion (Cabero-Almenara and Ruiz-Palmero, 2018; Chambi et al., 2024; Gómez et al., 2018).

From this perspective, Selwyn (2010, 2019) identifies three predominant approaches in the formulation of public policies in education. The first focuses on expanding access through infrastructure and equipment; the second centers on the development of digital skills in teachers and students; and the third seeks to strengthen the integration of technologies into educational processes.

Despite the global increase in connectivity and internet use, approximately 2.6 billion people remain offline—a figure representing roughly one-third of the world's population—according to the most recent reports (World Bank, 2024; International Telecommunication Union [ITU], 2024). These limitations substantially reduce educational and employment opportunities for the most vulnerable sectors, primarily composed of low-income individuals or residents of rural areas (Anaya et al., 2021; Moraga and López, 2024; Salazar, 2023).

Previous studies link the digital divide not only to the limited availability of devices or connectivity, but also to insufficient digital training, a scarcity of technological educational resources, and a lack of inclusive pedagogical strategies (Intriago et al., 2024; Cáceres and Gómez, 2023). However, this body of research reveals significant gaps that hinder a comprehensive understanding of digital inequalities, particularly in their educational, social, and territorial dimensions. In this context, educational policy—conceived as a set of

coordinated actions between the education system, society, and the State—attempts to address these challenges through strategies aimed at strengthening basic digital skills in diverse contexts (Intriago et al., 2024; Cabero-Almenara and Ruiz-Palmero, 2018; Chambi et al., 2024).

Despite institutional efforts to reduce these gaps, evidence on the effectiveness of implemented strategies remains limited and inconsistent. Furthermore, there is a persistent lack of data to assess the sustainability and relevance of these interventions in regions characterized by high levels of inequality (Mejía and Mejía, 2021; Almache et al., 2024; Intriago et al., 2024; Santa María et al., 2021).

While research on the digital divide exists, most studies have focused on specific educational levels or dimensions. Consequently, technological, pedagogical, or economic approaches predominate, which, although they contribute valuable elements, do not allow for a comprehensive understanding of the problem. This tendency has generated fragmented results that limit a global understanding (Mejía and Mejía, 2021; Almache et al., 2024; Berrío, 2023). In response, the present study broadens the analysis to include educational, social, and territorial dimensions, with the aim of moving beyond a purely instrumental perspective and incorporating a broad and contextualized understanding of the digital divide (Cabero-Almenara and Ruiz-Palmero, 2018; Chambi et al., 2024; Jiménez-Mejía et al., 2024).

Therefore, a systematic review is needed to comprehensively examine the effectiveness of educational policies aimed at reducing gaps in access, use, and appropriation of education in different socio-educational contexts. This proposal seeks to develop a comparative synthesis of interventions that have shown favorable results, as well as the contextual factors that influence their effectiveness, with the aim of guiding the design of inclusive and sustainable policies.

The analysis of the findings would allow for the formulation of practical, evidence-based recommendations aimed at strengthening public action and institutional capacities for technological integration in a scenario marked by accelerated digital transformation (Cáceres and Gómez, 2023; Intriago et al., 2024). The central focus is on evaluating the effects of these interventions on accessibility, equity, and student retention in learning environments mediated by digital technologies (Mejía and Mejía, 2021; Almache et al., 2024; Berrío, 2023).

Based on the above, the following research questions are formulated to guide the analysis:

Q1. What educational policies have shown effectiveness in reducing the access gap (first level), the usage gap (second level), and the appropriation gap (third level) in different educational environments?

P2. Under what contextual conditions — educational level, institutional type, rural or urban location, country or region — have policies significantly reduced the different levels of the digital divide?

Q3. What are the main barriers that limit the implementation and continuity of policies aimed at closing the digital divide in education?

P4. What factors facilitate the success and sustainability of policies aimed at reducing inequalities in access, use and appropriation of digital technologies?

## Methodology

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, based on the recommendations of McKenzie et al. (2021). This approach ensured transparency, traceability, and scientific rigor at each stage of the process of identifying, selecting, analyzing, and interpreting the included studies. The procedure was structured in four key stages—planning, selection, extraction, and synthesis—according to the methodological proposal of Grijalva et al. (2019). In the planning phase, a systematic search strategy was developed, supported by the use of Boolean operators (AND, OR, NOT) to combine, refine, and broaden the thematic categories of interest.

The bibliographic search was carried out in the title, abstract and keywords fields of the databases consulted. The search string used was: ("digital divide" OR "digital gap" OR "digital inequality") AND ("educational policies" OR "inclusion policies" OR "equity policies" OR "access policies") AND ("successful strategies" OR "best practices" OR "effectiveness" OR "impact" OR "outcomes" OR "case studies" OR "evidence-based") AND ("students" OR "vulnerable students" OR "marginalized students" OR "low-income students" OR "rural students" OR "first-generation students") AND ("technology access" OR "internet access" OR "digital literacy" OR "online education" OR "remote learning" OR "educational technology").

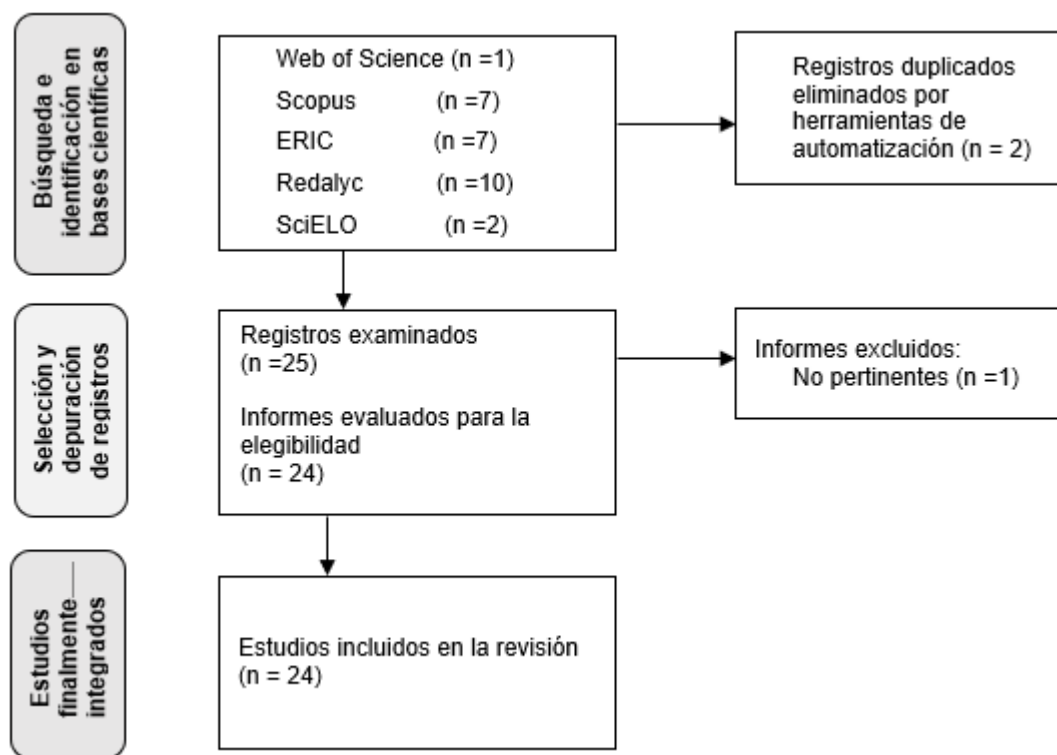
This strategy allowed for the identification of studies related to the topic using different conceptual frameworks, thus broadening the relevance of the retrieved material. The search was conducted in the *Web of Science*, *Scopus*, *ERIC*, *SciELO*, and *Redalyc databases*, covering the period between 2019 and 2025. The search terms were established based on the core dimensions of the digital divide phenomenon, in order to ensure that the construct was adequately represented in different educational contexts. In the case of *SciELO*, it was necessary to fragment the search into blocks due to the engine's limitations in combining complex operators. In contrast, the other platforms allowed the use of the complete string without modification, which facilitated a more consistent and comparable retrieval across databases.

Regarding exclusion criteria, articles “*in press*” were discarded, as well as those that did not directly address the study's purpose or did not meet the previously established inclusion criteria. All retrieved documents were centralized in a database, where a duplicate detection and removal procedure was applied. To increase the reliability of the process and reduce potential bias, Rayyan QCRI, a specialized tool for systematic reviews, was used to facilitate the formal organization of the studies and the decision-making process regarding their eligibility.

Subsequently, a preliminary review of titles and abstracts was conducted, evaluating each record individually according to the parameters defined in the planning stage. This procedure ensured methodological rigor and transparency in the final selection of included studies. Inclusion criteria included articles related to the digital divide, published between 2019 and 2025, in Spanish or English, and derived from both theoretical and empirical research. Conversely, studies linked to the private, business, or government sectors; publications prior to 2019; documents in other languages; book chapters, conference proceedings, books, and theses were excluded.

Figure 1 shows the flow diagram corresponding to this phase, which summarizes the process from the initial identification to the final selection of the analyzed studies.

**Figure 1.** Flowchart for conducting this systematic review



Source: Own elaboration, adapted from PRISMA 2020.

The initial search in *Web of Science* (n=1), *Scopus* (n=7), *ERIC* (n=7), *Redalyc* (n=10), and *SciELO* (n=2) retrieved 27 records. After removing two duplicates, 25 records were examined. One document was excluded for lack of relevance, so 24 studies were included in the review. Selection considered criteria of thematic relevance and alignment with the study objectives.

In the information cleansing and organization phase, the articles were grouped according to their thematic lines, considering that some addressed one or more dimensions of the digital divide (access, use, and appropriation). This classification allowed for the identification of recurring patterns, contrasts, and general trends among the studies, enriching the subsequent analysis. Following this preliminary organization, the relevance of each document was assessed, and the most relevant data were extracted based on the review's objectives. This stage required a meticulous and systematic reading to ensure consistency between the findings and the previously established analysis criteria.

In the final stage, a critical synthesis of the results was developed, integrating the information into analytical categories constructed with the support of ATLAS.ti software version 2025, in accordance with the purposes of the review. This procedure facilitated a

clearer organization of the contributions, gaps, and convergences identified in the literature. Based on this integration, the results, discussion, and conclusions sections were developed, presenting the main evidence derived from the analysis in a structured manner.

## Results

Although the study focuses on Latin America, research from other geographic contexts was included to strengthen the comparative analysis and enrich the discussion on the digital divide. These studies incorporated comparative case studies that allowed for contrasting trends, conceptual approaches, and intervention strategies, providing insights into the similarities and particularities of the Latin American context.

Regarding the number of annual publications, one publication was identified in 2019 (4.17%); two in 2020 (8.33%); two in 2021 (8.33%); two in 2022 (8.33%); eight in 2023 (33.33%); and nine in 2024 (37.50%). The search period included 2025, but no eligible publications were found. In total, 24 articles published between 2019 and 2024 were analyzed.

In terms of geographic distribution, Mexico, Ecuador, Spain, India, and Peru have the highest number of publications, with three each. Chile, the United States, and China have two studies each, while Uruguay, Portugal, Bangladesh, the United Kingdom, and Saudi Arabia have one study each. This distribution reveals a wide geographical spread, with a significant presence from Latin America and Asia, suggesting that the digital divide is a common challenge globally.

Regarding the methodological approach of the reviewed articles, it was observed that the majority adopted qualitative methods (45.83%,  $n = 11$ ). Quantitative studies represented 41.67% ( $n = 10$ ), and mixed-methods research reached 12.50% ( $n = 3$ ). This distribution indicates a trend toward interpretive and descriptive methods, accompanied by a considerable number of studies based on the analysis of quantifiable data and, to a lesser extent, research that integrates both approaches.

Regarding the studies classified by educational level, eight research projects focused on basic education, one on upper secondary education, and ten on higher education. Additionally, five studies were found that did not specify a particular educational level and addressed cross-cutting educational issues. These included remote education, inequalities in multigraded classrooms, the digital divide in indigenous communities, e-learning processes at different levels, and digital inclusion policies aimed at diverse audiences.

With the support of ATLAS.ti software version 2025, the main findings from the literature were identified and organized, grouping them according to the type of digital divide addressed in each study (access, use, and appropriation). This classification facilitated structuring the analysis in accordance with the research questions, which are developed in the following sections.

Q1. What educational policies have shown effectiveness in reducing the access gap (first level), the usage gap (second level), and the appropriation gap (third level) in different educational environments?

Based on the evidence analyzed, the first set of findings relates to policies aimed at reducing the access gap (see table 1).

**Table 1.** Results on the digital divide in education reported in the included studies

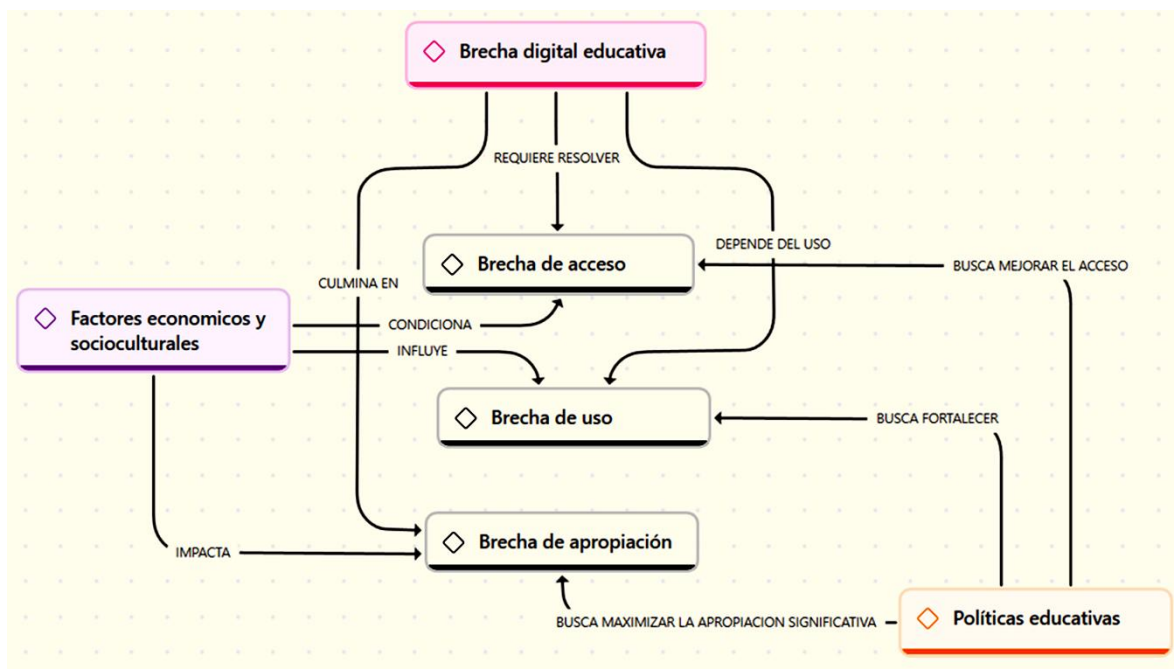
Dimension	Subcategory	Findings
Access	Infrastructure and connectivity	Despite the strengthening of public policies in digital infrastructure, structural inequalities persist that limit effective access, especially in rural contexts (Hurtado-Martín et al., 2023; Martínez and Gómez, 2024; Mescua et al., 2023; Miller and Pedersen, 2024; Ogundari, 2023; Quezada 2022; Sano and Sumiya, 2021; Stinson, 2022)
	Resource allocation	Without policies aimed at territorial equity and sustained investment, technological distribution tends to reproduce or deepen social inequalities (Aziz and Hossain, 2024; Naveed et al., 2020; Xu et al., 2024)
	Access vs. Use	Providing devices with connectivity can reduce the access gap; however, it does not guarantee sustained educational use (Sánchez and Borjas, 2021)
Use	Digital teaching skills	Access to technology does not guarantee meaningful pedagogical use; its utilization depends on teacher training in digital skills (Cisneros-Barahona et al. 2024; Miller and Pedersen, 2024; Rawal, 2024; Sano and Sumiya, 2021)
	Digital literacy	Low levels of digital literacy limit effective academic use, even when devices are available (Aziz and Hossain, 2024; Naveed et al., 2020)

Dimension	Subcategory	Findings
	Pedagogical integration	Limitations persist in the incorporation of emerging technologies and active methodologies in the university setting (Aranibar et al., 2023)
	Gender gaps	Gender inequalities affecting digital self-efficacy have been identified, particularly among women in teacher training (Ortega-Sánchez, 2023).
Appropriation	Structural and contextual factors	Technological appropriation depends on structural, family, ethical, and pedagogical factors (Gomes and Sousa, 2023; Miller and Pedersen, 2024; Ogundari, 2023; Stinson, 2022)
	Family environment	The family environment significantly influences digital educational success (Wang et al., 2024)
	Ethical and technological barriers	Emerging technologies face ethical and technical barriers that limit their adoption (Krishnan et al., 2024)
	Good practices	Experiences of pedagogical integration of interactive technologies show improvements in learning, although tensions with traditional practices and ethical challenges persist (Aranibar et al., 2023; Guaña-Moya et al., 2024; Sánchez and Borjas, 2021)

Source : Own elaboration

Based on the studies, a conceptual structure of the digital divide in education is proposed, understood as a multidimensional phenomenon that manifests itself at interrelated levels, as shown in Figure 2.

**Figure 2.** Digital divide and its relationship with structural factors and educational policies.



Source : Prepared by the author, with support from ATLAS.ti version 2025.

Reducing the gaps in access to, use of, and appropriation of ICTs represents a fundamental challenge for achieving truly inclusive and equitable digital education. To move in this direction, policies are needed that are built on solid empirical evidence, sensitive to local contexts, and that promote an ethical, reflective, and transformative use of technology in teaching (Gomes and Sousa, 2023; Martínez et al., 2024).

P2. Under what contextual conditions — for example, educational level, institutional type, rural or urban location, country or region — have policies managed to significantly reduce the different levels of the digital divide?

Regarding the access gap, several studies reveal that policies promoting the provision of devices and connectivity have had unequal benefits for different sectors. In Spain, Hurtado-Martín et al. (2023) found that students in charter schools had more advantages than students in public schools, indicating that the type of institution influences equal access to technology. In Mexico, Martínez and Gómez (2024) have documented initiatives aimed at linking education with vulnerable populations, demonstrating how regional and socioeconomic inequalities contribute to the persistence of the digital divide.

In this sense, the educational initiative implemented in Uruguay is a benchmark in reducing the digital divide, by integrating material access and meaningful educational use, and has managed to reduce inequalities in access through the distribution of devices and basic connectivity to rural areas. (Sánchez and Borjas, 2021). Its impact on the gaps in use and

appropriation was limited, since material access did not necessarily translate into meaningful educational use.

On the other hand, experiences in countries like the United States and Ecuador demonstrate recurring obstacles in the implementation of digital education policies in rural contexts. Miller and Pedersen (2024) point out that rural U.S. school districts faced difficulties implementing one-to-one access programs due to a lack of stable networks and local resources, which particularly affected students in remote areas. Similarly, in Ecuador, Stinson (2022) found that distance education policies during the pandemic failed to guarantee effective participation in rural areas due to infrastructure deficiencies. Taken together, these findings demonstrate that, in the absence of robust infrastructure and sustained support, the digital divide continues to limit educational opportunities, particularly in contexts with less technological development.

In the second dimension of the digital divide, focused on technology use, various studies agree that teacher training remains a determining factor. In India, Rawal (2024) observed that the lack of adequate training among rural teachers limited the effectiveness of digital literacy policies, even when sufficient technology was available.

A similar trend was identified in Ecuador . Cisneros-Barahona et al. (2024) documented that urban teachers possess higher levels of digital competence than rural teachers, indicating that training programs do not fully close the skills gap. However, despite institutional efforts to expand access to and promote the use of ICTs, achieving meaningful adoption remains a persistent challenge.

In Mexico, Brazil, and Uruguay, the study by Gomes and Sousa (2023) indicates that distance learning strategies implemented during the pandemic exacerbated inequalities related to connectivity and digital skills. This situation not only disrupted the continuity of educational processes but also revealed the growing dependence of school systems on technological infrastructure.

On the other hand, in the United Kingdom, Sano and Sumiya (2021) highlighted that the lack of digital support in homes disproportionately impacted vulnerable students, reducing the reach of inclusive policies implemented during school closures. In Chile, Quezada (2022) identified that students in private and subsidized schools achieved greater proficiency in using digital tools than those in public institutions, due to significant differences in infrastructure and family support.

In the university setting, Aranibar et al. (2023) emphasize that, although access to emerging technologies is recognized as an essential element of higher education, cultural and structural barriers persist that hinder their pedagogical adoption and critical appropriation. Additionally, several studies agree that the effectiveness of technology policies varies according to the educational level.

In basic education, differences in infrastructure and equipment between public and private schools continue to determine actual access to digital resources (Hurtado-Martín et al., 2023; Quezada, 2022). The same cannot be said for higher education. Although many universities have sufficient devices and connectivity, cultural and pedagogical barriers persist that hinder truly reflective use of technology (Aranibar et al., 2023; Gomes and Sousa, 2023). This diversity of scenarios confirms the need for differentiated policies at each educational level.

Policies to reduce the digital divide tend to be more effective in urban contexts, in institutions with greater resources, and among populations with family support and prior digital skills. In contrast, in rural areas, vulnerable sectors, and marginalized communities, their impact is limited if not accompanied by complementary structural measures that comprehensively address the socio-educational conditions that perpetuate inequality.

Q3. What are the main barriers that limit the implementation and continuity of policies aimed at closing the digital divide in education?

A set of recurring barriers limiting the effectiveness and sustainability of digital inclusion policies in diverse educational contexts have been identified. These barriers extend beyond technological provision to encompass structural, pedagogical, cultural, and community dimensions that affect access to, use of, and appropriation of technologies. Table 2 presents a summary of the most relevant findings, grouped according to the nature of the identified barrier.

**Table 2.** Barriers to closing the educational digital divide

Barrier identified	Notable finding
Insufficient infrastructure	The lack of basic infrastructure hindered the promotion of distance education in the high Andean territories (Mescua et al., 2023). Similarly, geographical, cultural, and economic conditions prevented the expansion of connectivity programs in Indigenous communities (Martínez and Gómez, 2024). Likewise, minimal broadband coverage and a scarcity of resources discouraged one-to-one programs and the use of access points (Miller and Pedersen, 2024). However, these factors persisted, perpetuating socioeconomic disparities among schools (Hurtado-Martín et al., 2023).
Cultural and ethical barriers	In the context of cultural and ethical barriers, rural adolescents tend to perceive ICTs primarily as communication tools, rather than as learning resources (Sánchez & Borjas, 2021). Furthermore, cultural resistance and a lack of ethical guidance have hindered both the adoption and critical appropriation of emerging technologies (Aranibar et al., 2023).
Teacher skills gap	Rural teachers had a low level of digital skills, which impacted the pedagogical integration of ICTs (Cisneros-Barahona et al., 2024). The lack of training led to limited use of current technological resources (Rawal, 2024).
Technical support	The lack of technical support and specific programs widened the digital skills gap (Gomes and Sousa, 2023).
Family and community support	Limited family support and limited self-management learning capabilities limited the impact of access policies in low-income rural households (Miller and Pedersen, 2024; Sano and Sumiya, 2021).
Integration between components	Without articulation between infrastructure, training and content, the appropriation of ICTs remains limited (Gomes and Sousa, 2023).
Intergovernmental coordination	Weak institutional coordination and the absence of adapted policies affected the sustainability of the program (Stinson, 2022)

Source : Own elaboration

The above confirms that digital inclusion goes beyond mere access to devices: it requires training processes, institutional support, and community participation. Addressing these barriers in a coordinated manner is necessary to move towards a more equitable, meaningful, and transformative digital education.

P4. What factors facilitate the success and sustainability of policies aimed at reducing inequalities in access, use and appropriation of digital technologies?

were identified that have contributed to the success and sustainability of digital inclusion policies in different educational contexts. These facilitators are related not only to infrastructure but also to pedagogical, institutional, and community aspects that strengthen access to, meaningful use of, and critical appropriation of technologies. Table 3 presents a summary of these factors, organized according to the type of intervention highlighted and their respective empirical findings.

**Table 3.** Factors that promote digital inclusion in education

Facilitating factor	Notable finding
Technological integration with local support	The combination of device provision, community <i>hotspot networks</i> and collaboration with local authorities improved connectivity in rural areas (Miller and Pedersen, 2024).
Strengthening urban infrastructure	Strengthening technological infrastructure and distributing devices reduced access gaps in urban basic education (Quezada, 2022).
Contextualized teacher training	Practical and contextualized continuing education programs strengthened the pedagogical use of ICTs (Cisneros-Barahona et al., 2024). Networking among teachers and collaborative digital communities fostered the sustainability of technology policies in rural and semi-urban areas (Lagos et al., 2019).
Personalized technical support	The inclusion of individualized tutoring and technical assistance substantially improved the digital skills of teachers and students (Rawal, 2024).
Family and community support	Family and community support networks contributed to the significant use of ICTs in vulnerable populations in the United Kingdom (Sano and Sumiya, 2021).
Innovative pedagogical culture	At the university level, fostering a culture of research, pedagogical innovation and critical thinking facilitated the critical appropriation of emerging technologies (Aranibar et al., 2023).
Clear curriculum objectives	The integration of digital learning goals into the formal curriculum strengthened the educational use of ICT in school contexts (Miller and Pedersen, 2024).
Multisectoral approach	Collaboration between governments, schools, technology companies and communities increased the effectiveness of inclusive policies in Latin America and Europe (Gomes and Sousa, 2023).

Source: Own elaboration

As can be seen, digital inclusion policies are more effective when they integrate multiple dimensions: sustainable technological infrastructure, adapted ongoing teacher

training, technical support, family and community support, curriculum clarity, pedagogical innovation, and multisectoral collaboration. These elements act in a complementary way, creating favorable conditions not only for bridging the digital divide but also for consolidating more equitable, contextualized, and transformative educational processes.

## Discussion

Based on the findings, it can be inferred that most studies do not delve deeply into the pedagogical, social, or territorial uses of ICTs. Likewise, the dimensions of sustainability, governance, and gender equity remain underexplored, especially in rural Latin American contexts where the digital divide is intertwined with structural inequalities (Martínez and Gómez, 2024; Ortega-Sánchez, 2023). In this sense, the results allow us to understand that the digital divide persists as a manifestation of inequalities that transcend the mere availability of technological resources (Villao and Matamoros, 2024).

While progress has been made in providing devices and infrastructure—particularly in rural and marginalized areas—Colom's (2020) warning is also confirmed: these efforts do not necessarily translate into substantive digital inclusion processes. Consequently, the digital divide cannot be overcome solely through connectivity, but rather through initiatives that combine educational support, community assistance, and the development of a critical digital culture (Mejía and Mejía, 2021; Almache et al., 2024). Even with these considerations, fragmented or disjointed policies tend to reproduce pre-existing inequalities (Stinson, 2022; Miller and Pedersen, 2024; Martínez and Gómez, 2024).

Unlike previous reviews focused exclusively on technological provision or digital literacy processes (Cabero-Almenara and Ruiz-Palmero, 2018; Gómez et al., 2018), this study broadens the perspective to include the interactions between educational, social, and territorial factors, demonstrating that digital equity depends on sustainable and context-sensitive policies (Intriago et al., 2024; Guaña-Moya et al., 2024). In this vein, the results partially confirm the theory of unequal access (Warschauer, 2003) and the notion of “multiple gaps” (Helsper, 2021), but also qualify them by showing that the availability of resources, while necessary, is insufficient if it is not accompanied by pedagogical, cultural, and territorial conditions that enable their meaningful appropriation. Thus, the digital divide must be understood as a relational phenomenon, in which material access only acquires value when it translates into formative experiences that strengthen educational and social participation.

It was found that access and usage gaps have garnered the most available evidence, in contrast to the appropriation gap, which has been less explored in the literature. This imbalance highlights the need for further analysis of technological appropriation, particularly given its potential to translate into concrete benefits for citizens, such as access to open educational resources, free training platforms, digital libraries, and online certification courses, which expand learning opportunities without requiring additional investment (Cai, 2008; Unesco, 2017; Toudert, 2019). Furthermore, several studies suggest that technological appropriation can facilitate labor market integration, as proficiency in digital tools—both basic and specialized—facilitates access to remote jobs and virtual professional internships, especially in contexts far removed from training centers.

However, in many vulnerable contexts, technology use tends to be concentrated on recreational and entertainment purposes, rather than academic or educational activities (Rawal, 2024; Miller and Pedersen, 2024). This is not due to a lack of interest in learning, but rather to the absence of pedagogical guidance, models for academic use, and institutional support that demonstrate how to transform digital devices into learning tools. Added to this are factors such as fatigue from long workdays, economic pressure, emotional stress, and the need for escapism, which lead to digital platforms functioning as spaces for rest and socialization.

Unfortunately, in many cases, students fail to identify a direct link between the academic use of technology and improved job prospects. Educational platforms are often perceived as disconnected from their immediate reality when there are no close examples demonstrating that these tools can translate into more stable or better-paying jobs (Cabero-Almenara & Ruiz-Palmero, 2018; Chambi et al., 2024; Gómez et al., 2018). This disconnect is reinforced where career paths are characterized by informality or subsistence work, making it difficult to visualize the long-term value of digital training. In this sense, the appropriation gap is not only technological but also symbolic—understood as the difficulty in attributing meaning, value, and future potential to technology—due to a failure to recognize it as a means to transform their professional future.

In this sense, the appropriation gap not only expresses inequalities in skills, but also in the ability to turn technology into a resource to improve living conditions, which highlights that digital inclusion requires strategies that strengthen the critical and productive use of technologies.

Based on the above, in the Mexican case, it becomes essential to design regionalized policies that address socioeconomic, cultural, and geographic conditions, with a special emphasis on institutions located in rural and community contexts. This implies moving beyond the technocratic approach that has predominated in digital inclusion programs—focused primarily on providing infrastructure and connectivity—and advancing toward comprehensive digital inclusion models that combine technological investment, contextualized teacher training, institutional support, and community participation.

Under this approach, digital equity should be considered a cross-cutting state policy, articulated between the federal, state, and municipal levels and promoted through the coordination of the educational, social, and technological sectors (Cáceres and Gómez, 2023; Intriago et al., 2024). A multi-level co-responsibility model would allow us to move beyond fragmented policies and advance toward sustainable strategies that promote the critical appropriation of technology and the development of digital skills with social and territorial relevance (Gomes and Sousa, 2023).

It is also necessary to move towards a multi-level governance model adapted to the structure of the Mexican education system. At the macro (federal) level, the Ministry of Public Education and the Ministry of Infrastructure, Communications and Transportation are responsible for coordinating the planning, financing, and regulation of educational connectivity policies. At the meso (state and municipal) level, state education ministries and municipalities must strengthen local capacities through digital support units, community centers, and teacher collaboration networks. Finally, at the micro (institutional and community) level, schools, families, and communities must be actively involved in digital literacy and appropriation processes (Sano and Sumiya, 2021; Lagos et al., 2019).

Additionally, comparative evidence shows that the most effective programs are those that integrate technological investment, pedagogical support, and territorial equity policies. Patterns of partial success are also identified: countries or regions that combine technological resources, ongoing teacher training, and local support tend to achieve better results, while isolated interventions—focused solely on equipment or connectivity—often fail or lose impact over time (Stinson, 2022; Hurtado-Martín et al., 2023). This suggests a trend toward collaborative intervention models, in which the participation of local stakeholders and contextual adaptation strengthen the sustainability of the actions (Gomes and Sousa, 2023; Singh et al., 2023).

In the area of teacher training, the findings indicate that the technology gap persists primarily due to a lack of support and ongoing training. The review reveals disparities in contextualized and practice-oriented training, which is one of the main obstacles to the meaningful pedagogical use of technology (Rawal, 2024; Cisneros-Barahona et al., 2024). Furthermore, digital literacy policies continue to be implemented in a fragmented manner and, in most cases, disconnected from regional needs and realities.

Furthermore, several studies emphasize that the critical appropriation of technology depends on both family and community resources and the pedagogical conditions of the environment (Wang et al., 2024; Krishnan et al., 2024). This implies that digital appropriation should not be conceived as an individual process, but rather as a social and cultural construct that requires ongoing institutional support. In other words, the relationship between technology and learning is based on support networks, collaborative practices, and meaningful educational environments.

Finally, it is observed that the most effective policies share three elements: a) they are based on territorial and sociocultural assessments; b) they integrate infrastructure, training, and ongoing support; and c) they strengthen community networks and links between schools, families, and local stakeholders. In this context, it is essential to reflect on social and gender equity, particularly regarding the training of female teachers, since various studies have identified lower levels of digital self-efficacy and less access to technological resources (Ortega-Sánchez, 2023). These gender gaps are not incidental, but structural, and must be considered a priority in the design of digital literacy policies. Incorporating this perspective implies recognizing the real differences in opportunities and moving toward policies that promote greater social justice.

## Conclusions

The effectiveness of digital policies depends not on the volume of investment or simply expanding infrastructure, but on their systemic coherence and their ability to adapt to the contexts in which they are implemented. Reducing the digital divide requires a comprehensive, multi-sectoral approach that integrates technology, pedagogical training, institutional support, and equity policies. In this sense, digital literacy strategies must consider the sociocultural, gender, and economic conditions of educational communities and promote sustainable and inclusive processes that are sensitive to diversity.



In parallel, this study offers a critical analysis of digital policies from an educational and social perspective, based on recent evidence from various educational levels, with an emphasis on Latin America (2019–2025). In this regard, it highlights the need to design policies that integrate infrastructure, pedagogy, and social justice to support digital inclusion processes by integrating them with educational, institutional, and community dynamics.

However, the inherent limitations of this study are acknowledged, stemming from its reliance on sources published in Spanish and English and the exclusion of grey literature, which restricts the diversity of perspectives considered. Furthermore, there is a possibility of publication bias, as studies with positive results tend to be more visible in academic journals indexed in major databases, which were the ones consulted in this case.

Furthermore, the descriptive nature of the analysis limits the longitudinal understanding of the impact of digital policies; however, these limitations do not invalidate the findings and should be considered when interpreting the results. Therefore, it is recommended that comparative, longitudinal, and situated research be developed to examine the evolution of digital equity at different educational levels and in different territories, with particular attention to rural, indigenous, and historically marginalized communities.

### **Future lines of research**

Based on the results obtained, future research directions are emerging, focusing on educational innovation, equity, and digital governance. These include evaluating the sustainability of digital policies; analyzing strategies for the cultural and ethical appropriation of technologies in Indigenous contexts; studying the institutional role in consolidating digital equity; and exploring the intersection of gender and territorial gaps in the development of digital skills. These lines respond to gaps identified in the review, particularly the scarcity of studies on appropriation, the absence of longitudinal analyses and the limited exploration of gender and territorial inequalities.

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