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Analyzing barriers to the effective implementation of technological tools in inclusive education: a scoping review

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Introduction: Digital accessibility and inclusive pedagogy are central to achieving equitable education systems worldwide. Yet, the integration of technological tools for students with disabilities remains inconsistent, often limited to fragmented initiatives without long-term institutional or policy support. Understanding the structural barriers that constrain digital inclusion is crucial for transforming technology into an enabler of educational equity rather than a source of further exclusion.
Methods: This study conducted a scoping review following PRISMA-ScR guidelines to identify and analyze barriers affecting the implementation of educational technologies in inclusive education. A systematic search across six databases (ERIC, Scopus, ACM Digital Library, EBSCOhost, Wiley Online Library, and Web of Science) yielded nine primary studies published between 2015 and 2025. Data were thematically synthesized through inductive–deductive coding to identify recurring structural, pedagogical, and policy patterns.
Results: The findings reveal persistent deficits in teacher training and digital competence, technological and infrastructural limitations, economic constraints, and weak enforcement of inclusion policies. Additionally, attitudinal barriers, including low expectations toward students with disabilities and limited institutional accountability, hinder sustainable progress. Positive factors, such as teacher initiative, institutional commitment, and universal design-based practices, partially mitigate these challenges, demonstrating the potential of inclusive technologies when supported by coherent policy and training structures.
Conclusion: Ensuring genuine digital inclusion requires embedding accessibility and universal design as structural components of education systems. Sustainable progress depends on coordinated governance, investment, and professional development that bridge the gap between policy and classroom practice.
Registration: This review was registered in Open Science Framework: 10.17605/OSF.IO/T5K7Y.

KEYWORDS

inclusive education, digital accessibility, educational technology, universal design for learning, assistive technologies

1 Introduction

Inclusive education is based on the principle of educational equity, recognizing that all people have an equal right to education regardless of their personal circumstances (Almqvist and Granlund, 2005; Navas-Bonilla et al., 2025). According to the United Nations Educational, Scientific, and Cultural Organization (UNESCO), inclusive education is a process that allows for the diversity of special needs of children, youth, and adults to be considered during the educational process (Skär, 2002; UNESCO, 2021). In other words, it could involve reformulating mainstream education systems to find and remove limitations that have historically excluded students with diverse needs. From the perspective of various international organizations, inclusive education requires a change in mindset based on human rights and the social model of disability, respecting and recognizing all people's needs (Budnyk and Kotyk, 2020; Campos Soto et al., 2020; Teräs, 2022).

The functional diversity of the population with disabilities is wide. It encompasses sensory, motor, cognitive, intellectual, and psychosocial disabilities, among others, which interact with the environment to create barriers to learning. According to international estimates, 16% of the global population experiences some form of disability (World Health Organization, 2023; UNESCO, 2024). These figures illustrate the size of the challenge ahead. There should be educational systems capable of meeting the different functional needs of this vast group (Koskenniemi, 2020; Tromp and Datzberger, 2021).

In this context, information and communication technologies (ICT) are essential tools for students with disabilities, as they enable access to learning materials in adaptable formats, support personalized learning experiences, and promote greater participation in educational environments. Their impact lies in reducing barriers related to communication, physical accessibility, and information access that traditionally hinder inclusion (Basantes et al., 2018; Cruz-Aldrete, 2021; Ekin et al., 2023; Pérez Valles et al., 2023). However, the integration of accessible technologies in inclusive education cannot be approached solely from an instrumental perspective (Chantry and Dunford, 2010; Gallegos Navas, 2018; Pinilla-Roncancio, 2018; Calderón-Almendros et al., 2020). Their use involves structural decisions that directly influence the equity of the educational process (Garcia Rivas, 2024). In this study, structural barriers are understood as the set of institutional, regulatory, and organizational conditions that limit the fair integration of educational technologies for people with disabilities. These include deficiencies in policy frameworks, insufficient teacher training systems, a lack of accessibility standards, and funding mechanisms that perpetuate exclusion within educational institutions. Conversely, positive aspects (facilitators) are defined as conditions, resources, or practices that enable or support the effective and inclusive integration of these technologies.

Currently, digitization is an irreversible process, and comprehensively understanding how technological tools can act as facilitators of inclusion represents not only a technical challenge but also a priority with substantial ethical implications (Herrera-Seda et al., 2016; Arteaga-Tuba, 2024; Vaca et al., 2024). The digital divide is not only a technological problem but also a barrier to human development (Lei and Zhao, 2007; Delgado-Ramirez et al., 2021).

In this context, the present study seeks to provide an overview of the main obstacles that hinder the integration of educational technologies within formal inclusive education systems. Through a scoping review of recent literature, it aims to synthesize existing evidence and identify the gaps that persist regarding the structural, pedagogical, and policy conditions influencing such integration. Rather than offering definitive answers, the purpose is to outline an initial map that can guide future research and institutional decision-making toward more effective and sustainable digital inclusion.

2 Materials and methods

2.1 Methodological approach

This research was conducted as a scoping review guided by the PRISMA-ScR guidelines. This methodological framework is widely recognized in academia for ensuring transparency, rigor, and reproducibility in the identification, selection, and analysis of relevant studies. The main aim was to find the structural barriers that prevent the effective implementation of educational technologies in inclusive contexts for people with disabilities, synthesizing the available evidence with special attention to its limitations and challenges. The review was registered in the Open Science Framework (OSF) under the registration number 10.17605/OSF. IO/T5K7Y.

The guiding question is: What barriers influence the integration of educational technologies for people with disabilities in formal education systems? Population (P): students with disabilities enrolled in formal education systems. Intervention (I): integration and implementation of educational technologies, including digital accessibility, Universal Design for Learning (UDL), and inclusive educational technologies. Comparison (C): not applicable, as the scoping review synthesizes findings across diverse educational contexts without a specific control group. Outcome (O): identification of structural, regulatory, and organizational conditions that function as barriers or facilitators for fair integration of educational technologies.

2.2 Search strategy and databases

The literature search was conducted following the PRISMA-ScR guidelines in six high-impact academic databases: ERIC, Scopus, ACM Digital Library, EBSCOhost, Wiley Online Library, and Web of Science. The same search strategy was applied across all sources to ensure methodological consistency and comparability of results. Searches included combinations of terms such as inclusive education, inclusive learning, educational inclusion, ICT, digital technologies, technological tools, disability, students with disabilities, and people with disabilities. Table 1 presents the databases consulted, the dates of the searches, the search terms, the filters applied, and the number of records retrieved from each source.

Filters by year (2015–2025), language (English and Spanish), and document type (peer-reviewed journal articles) were applied to all databases. This period was selected to reflect the most recent developments in the implementation of UDL and digital accessibility. Although the conceptual foundations of UDL were set up in earlier decades, the last 10 years have seen significant advances in technology, educational policy, and regulatory frameworks. This period enables the review to capture emerging innovations; find current structural barriers in teacher training, funding, infrastructure, and legislation;

TABLE 1 Identification of records in electronic databases.

Database	Search date	Query	Filters applied	Exported results
ERIC	12/05/2025	("inclusive education" OR "inclusive learning" OR "educational inclusion") AND ("ICT" OR "digital technologies" OR "technological tools") AND ("disability" OR "students with disabilities" OR "people with disabilities")	Years: 2015–2025; Peer-reviewed; Language: English, Spanish; Document type: Article	7
Scopus	12/05/2025			37
ACM Digital Library	12/05/2025			59
EBSCOhost	12/5/2025			4
Wiley Online Library	12/05/2025			51
Web of Science	19/05/2025			39

and provide a synthesis relevant to contemporary educational contexts while acknowledging the historical evolution of the concepts.

2.3 Inclusion and exclusion criteria

The inclusion criteria applied allowed for the selection of articles that were (i) published in English or Spanish; (ii) focused on the digital divide, technological accessibility, higher education, or the use of technological tools in inclusion contexts; (iii) prioritized empirical evidence, including studies with experimental and quasi-experimental designs and case studies. In contrast, the following were excluded: (i) non-peer-reviewed articles; (ii) studies targeting non-target populations such as older adults or vulnerable groups unrelated to disability; (iii) secondary systematic reviews, books, and book chapters; (iv) duplicate documents.

2.4 Study selection process

The selection process was conducted in three stages. First, duplicates were removed using a spreadsheet. Next, titles and abstracts were reviewed to exclude studies that did not meet the review goal. Finally, the selected texts were thoroughly analyzed, rigorously applying the previously established inclusion and exclusion criteria. This process was documented using the PRISMA flow diagram, which enabled detailed traceability of each phase and reinforced the validity of the results obtained.

Additionally, the Mendeley reference manager was used to store, classify, and thematically organize the selected documents. Its integration with word processors eased automatic citation and standardized bibliography generation, while folder categorization supported systematic analysis and reduced interpretation time.

2.5 Data extraction

Data from the studies included were extracted using a standardized template to ensure consistency and help with thematic synthesis. For each article, the following elements were recorded: Author and year of publication, country of implementation, methodological design, educational level addressed, main technology or technological tools evaluated, identified barriers, and facilitators. This structure allowed for a systematic comparison across studies, highlighting contextual differences and similarities in the implementation of inclusive educational technologies. Extraction was conducted manually by the research team with cross-checking to reduce errors and ensure completeness of the dataset.

To find recurring themes, an inductive–deductive coding process was applied. Data organization and thematic grouping were supported by spreadsheet software Excel, building upon the first filtering stages. Initial codes were generated directly from the data and then organized according to pre-established categories aligned with the research goals. Two researchers independently performed coding, and discrepancies were resolved through discussion to ensure reliability and reduce subjective bias. The resulting codes were synthesized through a narrative approach, providing an integrated thematic analysis aligned with the research question.

3 Results

A total of 197 records were retrieved from academic databases. After removing duplicates and applying the eligibility criteria, nine studies were included for analysis (Figure 1). Most exclusions were due to non-relevant populations, non-peer-reviewed sources, or insufficient data for extraction. The characteristics of the included studies are summarized in Table 2, detailing their geographical context, methodological design, educational level, technologies evaluated, and reported barriers and facilitators. This synthesis serves as the basis for the thematic categorization presented in the following sections.

3.1 Typical characteristics of the included studies

3.1.1 Geographic distribution of studies

The majority of the studies were conducted in European contexts, particularly in Spain (Acedo and Osuna, 2016; Barros del Río et al., 2021; Sanchez-Diaz and Morgado, 2023; Fernández-Cerero et al., 2024; Sanchez Diaz et al., 2024). Other research came from the United Kingdom (UK) (Cranmer, 2020) and Sweden (Holmgren, 2024). In Latin America, only two studies were found, one in Peru (Huamán-Romaní et al., 2022) and another in Ecuador (Fierro et al., 2019). This regional distribution was not the result of predefined inclusion or exclusion criteria since the search strategy applied global parameters in both English and Spanish,

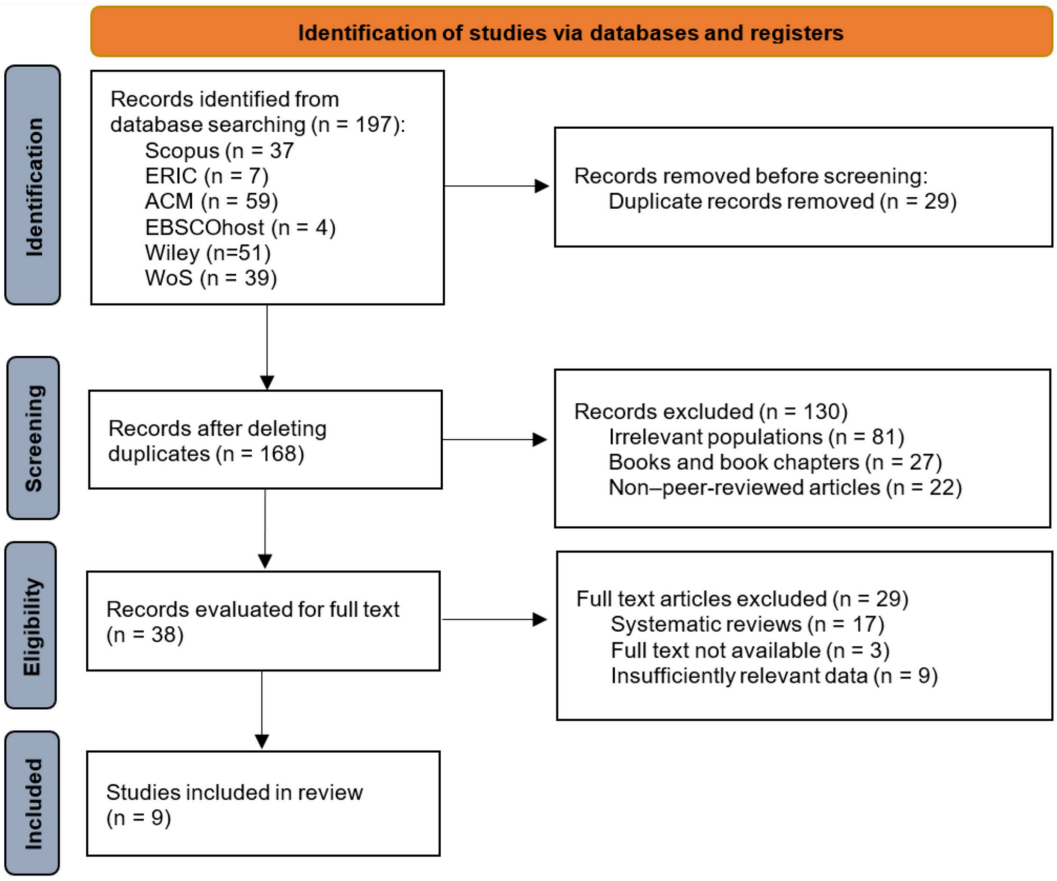

FIGURE 1
Flow diagram of the study.

but rather a natural outcome of the screening process. The predominance of European studies reflects a more established academic engagement with digital inclusion policies, while the smaller Latin American presence illustrates an emerging research field still in development.

3.1.2 Methodological approaches

Qualitative designs predominated ($n = 5$) (Acedo and Osuna, 2016; Cranmer, 2020; Sanchez-Diaz and Morgado, 2023; Fernández-Cerero et al., 2024; Sanchez Diaz et al., 2024), reflecting an emphasis on understanding teacher beliefs, inclusive practices, and lived experiences. Mixed methods were employed in three studies (Fierro et al., 2019; Barros del Río et al., 2021; Holmgren, 2024), allowing for triangulation of subjective and quantitative data. Only one study used a quantitative design (Huamán-Romaní et al., 2022), highlighting a gap in large-scale empirical measurement of digital inclusion outcomes.

3.1.3 Educational levels covered

Higher education stood for the dominant focus ($n = 6$) (Acedo and Osuna, 2016; Fierro et al., 2019; Barros del Río et al., 2021; Sanchez-Diaz and Morgado, 2023; Fernández-Cerero et al., 2024; Sanchez Diaz et al., 2024). Other educational levels included secondary education (Cranmer, 2020), primary and secondary jointly (Holmgren, 2024), and initial to postgraduate education (Huamán-Romaní et al., 2022). One study addressed adult education (Barros del Río et al., 2021). The predominance of higher education suggests greater institutional and technological capacity in universities, but limits a comprehensive understanding of digital inclusion across the educational continuum.

3.2 Structural barriers

As summarized in Table 3, the most recurrent structural barriers reported across studies include lack of teacher training, technological limitations, economic constraints, policy limitations, and attitudinal challenges.

3.2.1 Insufficient teacher training and limited digital competence

A recurrent limitation across studies was the lack of teacher training in digital inclusion and accessibility. This was reported in Spain, the UK, Sweden, Ecuador, and Peru (Acedo and Osuna, 2016; Cranmer, 2020; Fierro et al., 2019; Huamán-Romaní et al., 2022; Fernández-Cerero et al., 2024; Holmgren, 2024; Sanchez Diaz et al., 2024; Sanchez-Diaz and Morgado, 2023). Barriers included limited teacher knowledge of assistive technologies, insufficient training on disability-related issues, resistance to new tools, and a lack of pedagogical adaptation. These gaps restricted the inclusive potential of educational technologies.

TABLE 2 Methodological and contextual characteristics and findings of the studies included.

Reference	Country	Design	Educational level	Main technology	Barriers	Facilitators
Acedo and Osuna (2016)	Spain	Qualitative	Higher	Massive open online courses (sMOOC), accessible video player, subtitles, and transcripts	Platform-related issues, insufficient digital habits, partial accessibility perception, and need for ongoing platform improvement.	Universal design, inclusive model, multilingual, and networked communication environment.
Fernández-Cerero et al. (2024)	Spain	Qualitative	Higher	Electronic devices and accessible software	Cost of technology, lack of compatibility, limited teacher training and knowledge related to disability, budget constraints, and limited resources.	Greater participation, development of digital skills, and digital materials.
Cranmer (2020)	United Kingdom	Qualitative	Secondary	Tablets, laptops, and assistive technologies	Non-inclusive teaching practices, technical problems, lack of teacher training, limited digital skills, and incomplete implementation of inclusive policies.	Technical support, assistive technology, inclusive practices, and digital devices.
Holmgren (2024)	Sweden	Mixed	Primary and secondary	Digital tools for inclusion.	Lack of teacher knowledge of digital tools, organizational disagreement about inclusion, dependence on digitization without sufficient support, and variability in student experience and preferences.	Teacher supervision and training, constant use of digital tools, and flexible inclusion focused on the student.
Huamán-Romaní et al. (2022)	Peru	Quantitative	Initial to postgraduate	Apps, resources, and software for specific disabilities	Insufficient specialized training in inclusive education, institutional and policy constraints, economic and motivational shortcomings, and deficiencies in communication and dissemination.	Use of digital tools, high level of knowledge of resources for hearing impairment, and accessible digital resources.
Fierro et al. (2019)	Ecuador	Mixed	Higher	Web platforms, assistive technologies	Lack of knowledge and implementation of inclusive policies, limited physical accessibility, insufficient teacher training on diversity, limited technological accessibility, lack of curricular and methodological adaptations, deficits in coexistence and participation, and limitations in the student welfare department.	Existence of institutional policies and legal framework, use of digital materials, awareness-raising and incipient training, and partial institutional commitment.
Sanchez-Diaz and Morgado (2023)	Spain	Qualitative	Higher	Moodle, PowerPoint, Prezi, Google Drive, apps (Kahoot, Socrative, Remind)	Predominance of conventional technologies, teachers use platforms as repositories and for one-way communication, not all materials are accessible, lack of teacher training, resistance to the use of modern technologies, weak internet connections, and lack of academic adaptation.	Materials in accessible formats, advance delivery of content, and some teachers achieve inclusive teaching using conventional tools.
Sanchez Diaz et al. (2024)	Spain	Qualitative	Higher	Learning Management Systems, technological media, technological resources, and mobile devices	Limited use of technologies by teachers, focus on accessibility rather than participation, lack of knowledge or limited application of universal design for learning, lack of teacher training, and lack of institutional commitment.	Use of technologies as means of accessibility, initiative-taking teachers who are aware of diversity, promotion of communication and close relationships with students, and inclusive methodologies.

(Continued)

TABLE 2 (Continued)

Reference	Country	Design	Educational level	Main technology	Barriers	Facilitators
Barros del Río et al. (2021)	Spain	Mixed	Adults	En-Abilities platform, multimedia exercises	Dependence on assistive technologies, need for continuous development of accessible materials, and dependence on external standards to ensure accessibility.	Inclusive and adaptive design, technological and multimodal support, flexible and self-regulated learning, non-segregated vision, accessibility, and lifelong opportunity.

3.2.2 Technological and infrastructural limitations

Several studies emphasized technical and infrastructural barriers, such as device costs, poor connectivity, and incompatibility of platforms or software (Fierro et al., 2019; Cranmer, 2020; Fernández-Cerero et al., 2024; Holmgren, 2024; Huamán-Romaní et al., 2022). Other challenges included incomplete accessibility in sMOOCs (Acedo and Osuna, 2016), dependence on assistive technologies (Barros del Río et al., 2021), and insufficient digital resources in schools and universities. These structural constraints directly affect both teachers' and students' capacity for digital inclusion.

3.2.3 Economic barriers and resource constraints

Economic limitations were a persistent barrier (Fierro et al., 2019; Huamán-Romaní et al., 2022; Fernández-Cerero et al., 2024). Costs associated with getting digital devices, software, and training were often mentioned. Budget constraints restrict institutional capacity to ensure inclusive technologies, especially in contexts with limited public funding.

3.2.4 Policy and organizational deficiencies

Institutional and policy-related weaknesses were shown in several studies (Fierro et al., 2019; Huamán-Romaní et al., 2022; Holmgren, 2024). These included the absence of clear inclusion frameworks, inconsistent implementation of inclusive policies, limited institutional commitment, and organizational disagreement about inclusion. Such systemic issues perpetuate fragmented and short-term inclusion efforts.

3.2.5 Attitudinal and pedagogical challenges

Even in resource-rich contexts, non-inclusive teaching practices and attitudinal resistance limited progress (Cranmer, 2020; Sanchez-Diaz and Morgado, 2023; Holmgren, 2024). The predominance of conventional, non-interactive technologies, used as repositories rather than inclusive learning environments, further restricted active participation and accessibility.

3.3 Positive aspects

Correspondingly, Table 4 highlights the facilitators, including inclusive technologies, teacher supervision, initiative-taking (proactive) teaching attitudes, policies, and digital participation opportunities.

3.3.1 Universal design and inclusive technological practices

Multiple studies emphasized the relevance of universal design principles and inclusive technological ecosystems. Examples include the sMOOC model (Acedo and Osuna, 2016), the En-Abilities platform (Barros del Río et al., 2021), and the development of accessible and multimodal materials (Sanchez-Diaz and Morgado, 2023). These approaches helped networked communication, adaptive learning, and multilingual engagement, strengthening pedagogical inclusivity.

3.3.2 Teacher motivation and initiative-taking engagement

Three studies found teacher motivation and proactivity as central facilitators of inclusion (Huamán-Romaní et al., 2022; Sanchez Diaz et al., 2024; Holmgren, 2024). Continuous supervision, self-initiated training, and relational closeness with students promoted inclusive methodologies and sustained participation-focused teaching, even within resource constraints.

3.3.3 Pedagogical innovation and flexibility

Inclusive pedagogical strategies were also promoted through constant use of digital tools, flexible inclusion centered on students, and multimodal learning approaches (Holmgren, 2024; Barros del Río et al., 2021). Such practices align with participatory and student-centered paradigms, reinforcing the pedagogical value of technology for accessibility and autonomy.

3.3.4 Institutional and policy support

All the countries shown in the reviewed papers have institutional and policy frameworks that address digital inclusion, although at distinct levels of maturity. In Spain, such frameworks are merged and reflected in accessible platforms and inclusive teaching models (Acedo and Osuna, 2016; Barros del Río et al., 2021; Sanchez-Diaz and Morgado, 2023; Fernández-Cerero et al., 2024; Sanchez Diaz et al., 2024). The UK and Sweden show well-developed policies and organizational structures that promote inclusive digital practices, though implementation challenges persist at the institutional level (Cranmer, 2020; Holmgren, 2024).

In Latin America, Peru and Ecuador also present formal policies supporting digital inclusion; however, their application is still partial and uneven, often constrained by economic and infrastructural limitations (Fierro et al., 2019; Huamán-Romaní et al., 2022). Despite these disparities, the presence of regulatory frameworks across contexts serves as a structural facilitator, providing the foundation for sustainable and systematized digital inclusion strategies.

TABLE 3 Factors identified as barriers.

Barrier	Operational definition	Studies reporting it	*n* (%)	Representative examples
Lack of teacher training and knowledge	Insufficient teacher training or limited knowledge related to disability, inclusive pedagogy, or use of digital tools.	Fernández-Cerero et al. (2024), Cranmer (2020), Holmgren (2024), Huamán-Romaní et al. (2022), Fierro et al. (2019), Sanchez-Diaz and Morgado (2023), and Sanchez Diaz et al. (2024)	7 (77.8%)	Limited teacher training and knowledge related to disability.
Platform and technological limitations	Difficulties with functionality, compatibility, accessibility, or usability of technological platforms and resources.	Acedo and Osuna (2016), Fernández-Cerero et al. (2024), Cranmer (2020), Fierro et al. (2019), Sanchez-Diaz and Morgado (2023), Sanchez Diaz et al. (2024), and Barros del Río et al. (2021)	7 (77.8%)	Platform-related issues; lack of compatibility; and limited technological accessibility.
Economic and resource constraints	Limitations derived from the cost of technologies, budget restrictions, or a lack of institutional resources.	Fernández-Cerero et al. (2024) and Huamán-Romaní et al. (2022)	2 (22.2%)	Cost of technologies, budget constraints, and limited resources.
Institutional and policy limitations	Weak or incomplete implementation of inclusive or accessibility policies in educational institutions.	Cranmer (2020), Huamán-Romaní et al. (2022), Fierro et al. (2019), and Sanchez Diaz et al. (2024)	4 (44.4%)	Incomplete implementation of inclusive policies; lack of institutional commitment.
Attitudinal barriers and resistance to innovation	Resistance to the use of modern technologies or persistence of non-inclusive teaching practices.	Cranmer (2020) and Sanchez-Diaz and Morgado (2023)	2 (22.2%)	Non-inclusive teaching practices; resistance to the use of modern technologies.
Physical and infrastructural limitations	Barriers related to physical accessibility or implementation of digital inclusion environments.	Fierro et al. (2019)	1 (11.1%)	Limitations in physical implementations and limited physical accessibility.

4 Discussion

4.1 Structural and pedagogical determinants

The review found a persistent deficit in teacher training and knowledge about digital accessibility, inclusive pedagogy, and UDL. According to de Souza Godinho et al. (2021), these barriers limit the effective integration of inclusive technologies in the classroom and perpetuate inequalities in access to knowledge. In Latin America, this shortfall is further compounded by structural constraints, such as insufficient funding for professional development, reliance on teacher self-financing, work overload, lack of incentives, and, in some cases, resistance to change (Batanero et al., 2018; Meléndez and Rojas, 2021).

About the use of technology, basic tools continue to predominate, while the implementation of emerging technologies remains scarce (Jadán-Guerrero et al., 2023). When web accessibility guidelines and UDL principles are applied, positive outcomes are seen in the autonomy and participation of students with disabilities; however, such practices are still isolated and non-systematic (Sosa-Díaz and Fernández-Sánchez, 2020). Massive open online courses have shown potential due to their flexibility and alignment with UDL principles, yet their regional expansion is constrained by the lack of sustainable funding models (Marta-Lazo et al., 2019).

Although national and institutional policies and regulatory frameworks for educational inclusion are in place, adherence is still inconsistent. The core issue lies not in the inadequacy of these policies but in the limited effectiveness of monitoring, enforcement, and accountability mechanisms (Khoiriyah et al., 2024). Even where comprehensive regulations are formally set up, they often lack the operational capacity, institutional support, or financial resources needed for full implementation. This partial compliance not only impedes progress toward meaningful educational inclusion but also reveals deeper structural challenges, such as insufficient investment in accessible infrastructure and the absence of phased implementation plans and robust evaluation mechanisms (Zakiah et al., 2021).

In Europe, inclusive education policies are supported by stable public investment, clearer institutional accountability, and sustained teacher training systems that integrate digital accessibility into pedagogical standards. However, these systems still face challenges in the consistent translation of regulatory mandates into practice. In contrast, Latin American contexts are characterized by fragmented policy implementation, financial instability, and high dependence on individual teacher initiative, which limits scalability and sustainability (Meléndez and Rojas, 2021). Differences in digital infrastructure and connectivity further widen this gap, positioning Europe within a context of resource consolidation, while Latin America remains an emergent system of

digital inclusion, struggling with inequitable access and governance asymmetries. This comparative lens highlights the structural imbalance in how both regions approach the integration of inclusive technologies and the operationalization of UDL frameworks.

Beyond this regional contrast, the persistence of digital inequity also raises critical and ethical concerns about structural inequality and the right to inclusive education. Digital inclusion cannot be reduced to technological access alone; it must be understood as a dimension of social justice that demands redistributive and participatory policies. In contexts of chronic underfunding, inequitable governance, and unequal digital infrastructure, technological adoption risks reproducing existing hierarchies of privilege rather than dismantling them. Therefore, addressing digital exclusion implies confronting broader ethical questions about who designs, funds, and benefits from technological innovation in education.

In summary, while inclusion policies are often well-articulated in official documents, their implementation is still uneven and fragmented, varying across institutional contexts and depending heavily on the commitment of local leadership (de Souza, 2018). This persistent gap between policy and practice underscores that achieving educational inclusion requires more than policy enactment; it demands a comprehensive approach integrating targeted investment, strategic planning, systematic monitoring, and the definition of clear and measurable indicators (Yi and Shin, 2018). Only through such coordinated efforts can the goals of equity and accessibility translate into tangible outcomes for students with disabilities (Gilor and Shavit, 2015).

At the institutional and policy levels, the absence of clear, inclusive frameworks and stable funding for adaptive technologies leaves implementation dependent on the initiative of individual teachers or local actors (Elmubark et al., 2017), perpetuating a systemic pattern of exclusion. Even in European contexts, where regulatory frameworks and resources are more robust, technological availability alone does not guarantee effective pedagogical integration. Persistent barriers include the lack of implementation plans, limited continuous professional training, and insufficient specialized skills in special education (Donath et al., 2023). These gaps underscore that digital inclusion is not only a technical or administrative challenge but also a reflection of governance and ethical responsibility.

Beyond structural dimensions, an attitudinal and symbolic layer also appears. The normalization of stigma and the persistence of low expectations toward students with disabilities reinforce structural neglect, restrict investment in accessible tools, and limit the full participation of these students in the construction of knowledge (Gurney, 2018; James et al., 2020; Cinquegrani, 2021). Addressing digital equity, therefore, requires transforming both the organizational structures and the ethical imaginaries that shape inclusion, ensuring that accessibility becomes a shared institutional value rather than an individual effort.

TABLE 4 Factors identified as facilitators.

Facilitator	Operational definition	Studies reporting it	*n* (%)	Representative examples
Teacher supervision and continuous training	Institutional or pedagogical support for teacher professionalization in inclusion and ICT use.	Holmgren (2024)	1 (11.1%)	Teacher supervision and training, constant use of digital tools.
Inclusive and adaptive technologies	Design or use of digital tools and environments that promote accessibility, multimodality, and inclusion.	Acedo and Osuna (2016), Cranmer (2020), Huamán-Romaní et al. (2022), Sanchez-Diaz and Morgado (2023), Sanchez Diaz et al. (2024), and Barros del Río et al. (2021)	6 (66.7%)	Inclusive and adaptive design, accessible digital resources, universal design.
Initiative-taking and inclusive teaching attitudes	Teachers show awareness of diversity, adopting inclusive and participatory teaching approaches.	Cranmer (2020) and Sanchez Diaz et al. (2024)	2 (22.2%)	Initiative-taking teachers are aware of diversity; inclusive practices.
Digital participation and skill development	Opportunities for improved participation and acquisition of digital competences through technology use.	Fernández-Cerero et al. (2024)	1 (11.1%)	Greater participation, development of digital skills.
Institutional and policy support	Presence of institutional and policy frameworks that promote digital inclusion and provide a foundation for sustainable, systematized strategies.	Acedo and Osuna (2016), Barros del Río et al. (2021), Sanchez-Diaz and Morgado (2023), Fernández-Cerero et al. (2024), Sanchez Diaz et al. (2024) Cranmer (2020), Holmgren (2024), Fierro et al. (2019), and Huamán-Romaní et al. (2022)	9 (100%)	Institutional and policy frameworks exist to support digital inclusion, though implementation varies by context.

4.2 Comparative analysis with earlier research

The patterns observed in this review are consistent with previous research. de Souza Godinho et al. (2021) underscore the centrality of teacher digital literacy for overcoming barriers in producing adapted materials, while Batanero et al. (2018) and Meléndez and Rojas (2021) relate the lack of financial resources to the need for teacher self-financing in professional development. Lidström and Hemmingsson (2014) caution that technologies are often employed as superficial adaptations rather than as transformative pedagogical tools, an observation that aligns with the limited integration of UDL guidelines found here.

The literature also corroborates the potential of MOOCs in inclusive education (Gil-Quintana et al., 2017), the constraints imposed by payment models, and the absence of structural funding (de Moura et al., 2018). Internationally, Elmubark et al. (2017) and Meléndez and Rojas (2021) associate the failure of inclusive projects with resource scarcity and insufficiently trained personnel. In European contexts, Brodin (2010) and Donath et al. (2023) affirm that regulatory frameworks without pedagogical integration and specialized training do not guarantee inclusion. Gurney (2018), James et al. (2020), and Cinquegrani (2021) support the view that stigma and low expectations foster segregating practices and affect the agency and subjectivity of people with disabilities.

4.3 Implications for practice

The evidence points to the need to strengthen specific teacher training, not only to improve the quality of materials and the pedagogical integration of technologies but also to foster attitudinal and ethical changes that contribute to an inclusive school culture (Guachamin et al., 2023). This process requires educational institutions to address work overload and create incentives that enable professional development without transferring costs to teachers (Aithal and Aithal, 2023).

Technology selection and implementation must transcend the use of platforms as mere repositories, incorporating accessibility guidelines and UDL principles that enhance autonomy and participation for students with disabilities (Floyd et al., 2024). Massive open online courses and other open resources can serve as valuable tools, provided their design prioritizes inclusion and accounts for the limitations of contexts with reduced funding and connectivity. Additionally, reducing teacher resistance requires training programs that integrate attitudinal and ethical components related to educational expectations to counteract exclusionary practices (Buele and Llerena-Aguirre, 2025).

The persistence of economic constraints and fragmented policy implementation continues to hinder sustainable progress. The reliance on teacher self-financing and the lack of institutional investment worsen structural inequalities, particularly in educational contexts characterized by limited budgets and technological dependency (Huang, 2023). Therefore, inclusive digital education demands coordinated and sustainable institutional strategies that integrate financial support mechanisms, continuous professional development, and the systematic creation of accessible learning materials. These efforts must be reinforced through explicit policies that guarantee accessibility and fair participation across all educational levels (Muzafarova, 2019).

Similarly, financing plans could be developed for public institutions based on low, fixed interest rates, accompanied by sustainable payment schemes that do not compromise the institutions' operations. However, the effectiveness of these measures will depend on rigorous planning (Han, 2023), with realistic timelines and monitoring mechanisms to ensure the effective use of resources. A truly transformative digital inclusion policy, therefore, requires the convergence of institutional will, strategic financial planning, and sustained political commitment (Seng, 2019).

This study provides a valuable contribution to the field of inclusive education by systematically showing structural barriers that limit the effective integration of digital technologies, inclusive pedagogy, and UDL in higher education. The findings highlight persistent gaps in teacher training, institutional support, and policy enforcement, which are particularly pronounced in Latin American contexts compared to Europe. While some positive practices were reported in the results, the emphasis on barriers offers actionable insights for institutions and policymakers to address gaps in teacher training, accessibility, and institutional support. By highlighting these factors, the findings offer evidence-based guidance for designing targeted interventions, professional development programs, and policies aimed at fostering fair and sustainable educational inclusion.

4.4 Policy implications

At the public policy level, sustained structural financing and robust implementation models are essential to prevent innovations from remaining isolated efforts (Zancajo et al., 2022). The State must take an active role in developing inclusive regulatory frameworks, providing resources, infrastructure, and relevant training, thereby bridging the gap between policy design and effective implementation (Nechaev, 2018).

Regulations should also be updated and adapted to regional realities, recognizing that people with disabilities often experience multidimensional poverty and reduced access to education and employment. Coordinated actions that integrate educational measures with broader social policies can help ensure that technology adoption reduces rather than widens inequality (Fierro et al., 2019).

Public policies should be structured to ensure institutional commitment and the effective implementation of action plans. It is essential that existing regulatory frameworks and policies be strengthened and coordinated to enable their progressive implementation, prioritizing the improvement of educational conditions and accessibility for people with disabilities. Policies should also be aligned with international standards to guarantee accessibility and inclusivity across contexts (Hodgson, 2012). Similarly, policy formulation should transcend declarative approaches and move toward clear governance mechanisms, with defined responsibilities, continuous monitoring, and accountability (Shumba and Moodley, 2018). Only through comprehensive planning that considers local contexts, financial sustainability, and the participation of all actors, the State, educational institutions, and civil society, will it be possible to ensure that digital and educational inclusion translate into real and sustainable transformations (Naami, 2015). Ultimately, advancing inclusive digital education is not only a technical or policy challenge but also a matter of ethical responsibility, upholding principles of justice, equity, and dignity for all learners.

4.5 Limitations and future research

The scope of this review was constrained by the limited number of studies that met the inclusion criteria. This restriction may reflect not only the emerging nature of the topic but also methodological decisions that could have unintentionally narrowed the sample. The inclusion and exclusion criteria, while designed to ensure rigor and thematic coherence, may have been overly restrictive, excluding relevant evidence from broader types of research such as reviews, surveys, or policy evaluations. Likewise, the decision to limit the search to a specific set of databases may have reduced coverage, particularly in the case of regional or non-indexed studies in Latin America.

Future reviews could adopt a more flexible search strategy to capture a wider range of empirical and theoretical contributions. Despite these constraints, the conclusions drawn here remain grounded in the evidence analyzed and should therefore be interpreted as generalizable only to a limited extent, given the characteristics and representativeness of the included sample.

This review is also limited by its inclusion of studies published only in English and Spanish, which may exclude relevant literature in other languages, as indicated in González-Sordé and Matamala (2024). The sample is heavily skewed toward European contexts, with fewer studies from Latin America, limiting the generalizability of findings to diverse educational systems. Additionally, the majority of included studies employed qualitative or mixed designs, which, while rich in contextual detail, restrict the availability of comparable quantitative indicators for large-scale evaluation.

Future studies should address the scarcity of quantitative and longitudinal evidence on the impact of inclusive technologies (Okoye et al., 2023). There is also a need for comparative analyses that evaluate the scalability of innovations and the transferability of successful models from high-resource to low-resource settings. Moreover, research agendas should incorporate the voices of students with disabilities to better align technological interventions with their needs and lived experiences (Biegun et al., 2020).

Additionally, future research could explore mixed methods designs that integrate quantitative outcomes with qualitative insights, providing a more holistic understanding of both effectiveness and user experience. Longitudinal studies tracking the sustainability of inclusive practices over time in low-resource educational systems would help find structural and contextual factors that support or hinder success. Investigations comparing the impact of different technological modalities across diverse educational levels and disability types could further inform targeted implementation strategies.

Moreover, studies should examine institutional and policy-level interventions, including teacher training programs, resource allocation models, and governance mechanisms, to assess how systemic support interacts with classroom-level innovations. To enhance accountability and measurement, internal and external audits could be incorporated as evaluative tools, providing objective parameters to check policy compliance, resource use, and adherence to accessibility standards. This approach would allow researchers to generate actionable insights for both policymakers and practitioners, ensuring that inclusive technologies lead to meaningful, fair, and scalable improvements in educational access and participation.

5 Conclusion

The goal of this scoping review was to systematically find and analyze the barriers that influence the integration of educational technologies for people with disabilities in formal education systems. Across the nine included studies, several interrelated patterns appeared. Insufficient teacher training and limited digital competence consistently restricted the adoption of inclusive technologies, reflecting gaps in professional development, pedagogical adaptation, and the integration of Universal Design for Learning principles. Technological and infrastructural limitations further hindered fair participation. Economic constraints and fragmented policy implementation compounded these challenges, while attitudinal barriers, including resistance to innovative practices and low expectations toward students with disabilities, underscored the role of organizational culture and ethical commitment in shaping inclusion. Crucially, the absence of effective State oversight and monitoring was repeatedly highlighted; regulatory frameworks often lacked enforcement mechanisms, accountability structures, and dedicated resources, leaving the operationalization of inclusion heavily reliant on individual initiative and institutional goodwill. When present, initiative-taking teacher engagement, institutional support, and inclusive technological practices showed the capacity to partially offset these structural and governance deficiencies, illustrating that sustainable inclusion requires the coordinated interaction of pedagogical agency, institutional strategy, and State regulation.

These findings directly address the research question by revealing that the integration of educational technologies for people with disabilities is constrained by a complex interplay of structural, pedagogical, economic, policy, and governance factors, with marked regional disparities between high-resource European contexts and emergent Latin American systems. Two critical gaps were found: the limited availability of quantitative and longitudinal evidence assessing the sustained effectiveness, scalability, and contextual adaptability of inclusive technologies; and the scarce incorporation of students with disabilities' lived experiences in guiding technological interventions. Future research should therefore prioritize longitudinal, mixed-method designs that integrate outcome measurement, user-centered perspectives, and evaluations of State-level regulatory oversight and institutional accountability. By explicitly examining how governance, policy enforcement, and institutional practices interact with classroom-level implementation, such studies would provide actionable evidence to inform policy development, resource allocation, and professional training, ensuring that digital inclusion is not contingent on isolated efforts but emerges as a sustainable, ethically grounded, and equitable component of formal education systems.

Author contributions

HM-J: Conceptualization, Investigation, Writing – review & editing, Writing – original draft, Data curation, Visualization, Formal analysis, Methodology. MC-A: Writing – original draft, Formal analysis, Methodology, Investigation. JB: Supervision, Writing – review & editing, Conceptualization, Data curation, Writing – original draft, Methodology. FY: Funding acquisition, Validation, Project administration, Supervision, Writing – review & editing, Data curation.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that Gen AI was used in the creation of this manuscript. Generative AI was used solely to revise English grammar and syntax.

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