Digital Learning Environments in Special and Inclusive Education: A Literature Review

PANAGIOTIS TOUMPOS[1], ALEXANDROS GAZIS[2], THEODOROS VAVOURAS[3], CHRISTOS DOUVLOS[1], STYLIANOS PAPPAS[4], KLEANTHI SANTAMOURI[5], AGGELIKI DELI[6]

[1]Ministry of Education, Religious Affairs and Sports,
Directorate of Primary Education of Athens A,
Chios 16–18, 10438 Athens,
GREECE

[2]Heriot-Watt University,
Edinburgh EH14 4AS,
UNITED KINGDOM

[3]Department of Humanities, School of Humanities,
Hellenic Open University,
26335 Patras,
GREECE

[4]Department of Electrical Engineering and Computer Science,
Hellenic Naval Academy,
Terma Chatzikyriakou,
18539 Piraeus,
GREECE

[5]Salvezza Energy Systems Ltd,
Sirakouson 4,
Paphos 8016,
CYPRUS

[6]School of Higher Vocational Training,
2 Karagianni & Antigonou Street,
34133 Chalkida,
GREECE

Abstract: - This critical literature review examines the use of digital learning environments in special and inclusive education, focusing on assistive technologies, adaptive platforms, artificial intelligence, online learning, smart learning environments, and teacher competence. The review addresses three main questions: what benefits these environments offer students with special educational needs and disabilities, what knowledge and competencies teachers need to use them effectively, and what barriers limit their inclusive value. The findings show that digital tools can improve access, communication, engagement, self-paced learning, and social participation when they offer flexible, multimodal ways to learn. However, technology alone does not create inclusion; its success depends on teacher guidance, institutional support, reliable infrastructure, accessibility by design, and careful ethical governance. The review also highlights risks such as cognitive overload, weak accessibility, unequal access, privacy concerns, and biased or opaque AI systems. Overall, digital learning environments can support more equitable education, but only when guided by learner needs, teacher judgement, and clear lines of responsibility.

Key-Words: - digital learning environments, inclusive education, special educational needs and disabilities, assistive technology, artificial intelligence, smart learning environments, teacher competence, accessibility, educational equity.

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1 Introduction

The learning environments in which we study and practice have become a regular feature of present-day schools, universities and professional development, [1]. However, they are of poor educational worth. Specifically, this means that criticism of accessibility is not restricted to complexities on the part of a user as many examples show that the real-time technology platform may be inaccessible and the assistive technology may be too much of a cognitive burden for the learner, [2], [3], [4], [5]. These distinctions are not secondary in special and inclusive education, [6], [7]. This is important for understanding whether digitalization widens participation or simply changes the medium through which exclusion is experienced, [8].

This review argues that digital learning environments have value only when they respond to learner diversity and form part of a broader pedagogical arrangement. As such, the synthesized literature suggests that assistive technologies, [9], adaptive platforms, [10], mobile applications, [11], virtual and augmented reality, [12], text-to-speech and speech-to-text tools, [13], communication systems, [14], digital organizers, [15], and cloud-based learning platforms, [16], can reduce barriers for learners with sensory, motor, cognitive, emotional, behavioral, or communication-related needs, [3], [17]. Nevertheless, this very literature also cautions against equating technology with inclusion based solely on the presence of technology. Whether a tool is meaningful in a classroom depends on its design, access, teacher competence, institutional readiness, and the nitty-gritty work of making it meaningful for a particular learner in a particular setting, [18].

During the review process, evidence across four research domains has been reinforced by recent publications in leading venues such as IEEE, MDPI, Springer Nature, and Taylor & Francis. To begin with, systematic reviews and conference studies of artificial intelligence highlight that there is a potential gap in infrastructure, teacher training, transparency, privacy, and equal access for tools that provide adaptive feedback, [19], automated transcription and image description, [20], language assistance, [21], and intelligent tutoring. Efforts underway focus on smart learning environments regarding inclusion. Smart learning environments refer to the ecology of design affordances, learner support, teacher practice and institutional conditions rather than a device-level problem, [22]. Studies of who adopts assistive technology and who does not show that it is often teacher experience, classroom organization, disability category, training, ease of use, and paraprofessional support that shapes whether a tool is adopted and sustained, [23], [24], [25]. Finally, more recent research on disabled students' online education and technology-inclusive transitions in a higher education context reminds us that digital access is also a matter of continuity, belonging, reasonable accommodation and psychosocial experience, [26], [27].

The review begins with a deliberately cautious premise: Digital learning environments cannot, on their own, be considered either a solution or a threat to education. They are conditional resources. Learning environments can enhance accessibility and flexibility, but they may also increase cognitive fatigue, inequality, and surveillance when poorly designed or unsupported.

2 Technical Novelty & Research Questions

This review aims to provide a thematically organised critical synthesis of how digital learning environments are conceptualised and implemented in special and inclusive education. The synthesis is guided by three research questions, so the analysis does not become too diffuse or collapse into a mere catalogue of technologies.

The research questions (RQ) are the following:

- RQ1: What are the educational advantages of digital learning environments for students with special educational needs and disabilities?
- RQ2: What competences enable a teacher to implement digital inclusive education effectively?
- RQ3: Which technical, pedagogical, and ethical barriers limit the inclusive potential of digital learning environments?

3 Methodology

The review was planned as an updated critical literature review. The source manuscript on which the corpus is built examined peer-reviewed publications on digital learning environments, assistive technologies, adaptive learning, online learning, special education, inclusive education, disability, teacher competence, and barriers to implementation. As these references had already been verified, they were retained, providing a coherent foundation for the argument.

A second, targeted update then incorporated recent work from four publication venues: IEEE, MDPI, Springer Nature, and Taylor & Francis. This update was not intended to replace the sources, but to sharpen the discussion in areas that have grown rapidly, namely artificial intelligence, smart learning environments, the classification and adoption of assistive technologies, online higher education, and policy or institutional barriers. The selected materials were chosen for their relevance to the three research questions and for providing systematic evidence or clear implications for inclusive educational practice, [28].

The analysis followed a thematic synthesis approach, with evidence organised into four interpretive categories: educational benefits; teacher practices and competences; barriers and ethical risks; and cross-cutting implementation conditions.

4 Problem Formulation

This section presents the findings of the literature review in relation to the research questions. The results of the analysis are organised into four themes synthesising educational benefits, teacher practices, barriers, and cross-cutting insights on the use of digital learning environments for students with special educational needs and disabilities.

4.1 Learning Advantages. Involvement, Accessibility and Learning

The first key finding is that digital learning environments can enhance access to learning when they provide multiple routes to content, communication, and assessment. The studies reviewed, as well as the more recent publications, support this point. Digital technology creates better conditions of inclusion when it allows learners to read, hear, manipulate, repeat, annotate, slow down, enlarge, translate, dictate and/or transform educational material. In this sense, accessibility isn't something you tack on to a finished lesson. It forms part of the framework of the lesson.

In the broad mappings, [17], [29], [30], the same point is made: inclusive digital education is best achieved by combining the use of assistive technologies, multimodal learning resources, mobile or cloud-based access, collaborative platforms, and pedagogical flexibility. Learners with visual, hearing, motor, communication, cognitive, language or attention-related difficulties may benefit from such environments. Educational institutions may also assist students from socioeconomic or geographical exclusion, but the evidence around these areas is less developed than the evidence on disability-related accessibility.

Adaptive systems that rely on AI provide an additional advantage. Studies in [4], [31], and others highlight that AI-based solutions enhance accessibility through automatic captioning, speech recognition, image description generation, translation, and intelligent tutoring.

AI systems also enable adaptive sequencing and personalised feedback. These functions are important because many learners with disabilities do not just need extra time. They need alternative ways of getting information and showing understanding, and they need support to stay focused. Adaptive systems can help teachers identify difficulties sooner, vary the level of support, and help participants receive feedback without delaying the learner's next response.

However, the literature suggests that educational success should not be measured solely by academic improvement. Digital learning and self-regulation are powerful tools. They are helpful in improving motivation, writing, emotional regulation, resilience, engagement and persistence. Benefits accrue from digital learning when accompanied by explicit instruction and structured feedback. Research conducted on the tools being employed in mathematics and science education, [32], has shown that simulations, manipulatives, audio-enhanced systems, educational games, robotics, and e-texts can render abstract content more comprehensible, provided they are pedagogically aligned with the curriculum, [33].

The social element is just as important. According to [26], [27], [34], digital inclusion includes communication, identity, social presence, and participation in a community of learning in various ways. For students with complex disabilities or communication needs, digital access may depend on AAC, multimodal access and sustained human support. Inclusion of disabled students in online higher education is not just about getting the uploaded material. It requires experiences of belonging and interaction, accessible assessment, reliable services and effective procedures.

Table 1 (Appendix) summarises the main digital learning technologies discussed in this review, showing their inclusive function, likely educational benefit, and main caution.

4.2 Teacher Practices and Professional Competences

Teachers play a key role in addressing the lack of digital inclusion in schools, which is the second key finding. While it may seem familiar, this conclusion is one of the most robust elements of the evidence. Digital tools do not teach on their own, nor do accessibility features interpret the learner's situation on their own. The teacher is still responsible for selection, timing, scaffolding, explanation, feedback, adaptation and evaluation. We should focus less on whether teachers should use more technology and more on whether they are able to do so effectively.

According to [35], it is important to find inclusive hardware, choose specialized software, select appropriate platforms, use communication services, and develop visual or educational materials for children with special educational needs. This is not a narrow technical agenda. Teachers need to connect their technological knowledge to psychology, pedagogy, curriculum and disability knowledge.

The quality of implementation is a decisive factor, [32]. The findings on digital learning and self-regulation indicate that these benefits depend on explicit instruction, fidelity, feedback and teacher scaffolding. According to [36], personalized learning technologies ought to require teacher mediation to identify difficulties related to vision, hearing, motor coordination, communication and attention. A platform may offer individualized pathways, but the teacher must still determine when the learner requires independence, when the learner requires assistance, and when the tool is becoming a hindrance.

Recent adoption studies sharpen this point. According to [23], professional development, length of service, education level, and age will determine the extent of special education at a distance learning teacher level EdTech adoption. Advanced technologies such as mixed reality are likely to remain underused. This is consistent with recent findings highlighting the structural limitations of distance education, including infrastructural constraints and organisational challenges.

The adoption of assistive technology is further shown to be associated with teacher experience, classroom type, student disability category, ease of use, and paraprofessional support, [24].

These findings are important because they remove the discussion from the abstract. Teacher competence not only refers to disposition, but is also produced or weakened by training systems, organizing schools, available support staff and the everyday practicality of the tool.

In this sense, teacher competence is a layered professional mastery. It should incorporate technical fluency, inclusive pedagogical design, disability-specific knowledge, collaborative practice, data literacy, ethical sensitivity, and assessing when a tool is not in the service of the learner. It is worth emphasising. A mature inclusive practice does not celebrate technology per se; it asks whether this particular arrangement of technology is good for this learner, in this task, at this time, under these institutional conditions.

Table 2 (Appendix) presents the main teacher-level practices and institutional conditions that support the effective use of digital tools in inclusive education.

4.3 Barriers, Challenges and Ethical Risks

The third significant conclusion is that barriers are spread across multiple layers. They comprise technical, pedagogical, and ethical aspects, but not just any one of these. The most outstanding literary works, in every form, work against the idea of separation between the levels. A student might possess a device such as a PC, laptop, tablet, or phone, but not a trained teacher; a school might purchase a platform, but not have the bandwidth; a system may provide adaptive feedback, but store sensitive data while lacking transparency; a resource may be accessible in principle, but practically impossible to find because metadata are weak or absent.

Technical unreliability continues to be an issue. Efforts to provide real-time captioning in lessons often fail, as do speech recognition, screen-reader functions, automatic transcription, adaptive interfaces, and AI-supported assistance. The authors in [21], [37], [38], indicate that advanced functionalities should not automatically be seen as an indicator of inclusive design. Expect accessibility to be stable, tested, and contextual.

The second barrier is cognitive load. More layers of interaction can overwhelm some learners, despite the obvious appeal of adaptive, immersive or similar tools. The study, [39], reminds us that adaptive learning technologies may create mental demands that undermine performance. This is particularly relevant in special education, where the learner might already be dealing with attentional, executive, language, sensory or emotional demands. Thus, inclusive design must ask not only whether a tool offers access but also how much effort producing access costs.

The way information is organized is a third obstacle. The work of [40], reveals that it is less visible than tools such as screen readers or AI tutors, yet it plays a fundamental role in system usability and accessibility. The existence of accessible tools will not practically help if a learner or a teacher cannot identify which ones match a particular need. The infrastructure of inclusion consists of metadata, retrieval systems and interoperability.

Institutional unfairness is a fourth barrier. The studies by [22], [23], [26], [27], [41], all demonstrate that digital inclusion is contingent upon infrastructure, training, continuity, reasonable accommodation, and administrative responsiveness. Differences in equipment, broadband, specialist staff and professional development mean that the same technology may produce very different outcomes in schools or universities. The literature thus supports a simple yet often forgotten conclusion: inclusive technology policy must include implementation capacity.

The ethical dimension is particularly significant in cases of AI-based personalisation. The performance, pace, errors, preferences, and interaction patterns of users, and occasionally their emotions, may be monitored by AI systems. Such data might encourage earlier teacher intervention, but they might also create risks of surveillance and biased categorisation, over-profiling and diminished agency of learners, [4], [19], [20]. For students with disabilities, who may already be overclassified, this ethical risk is significant. It necessitates consent, transparency, minimal data collection, auditability, and human control.

Table 3 (Appendix) brings together the main barriers identified in the literature and links each barrier to a practical safeguard for inclusive implementation.

4.4 Synthesis that Cuts Across Sectors

The review finds no evidence supporting either technological enthusiasm or technological pessimism. The authors propose a more rigorous position: when designed and governed as educational ecosystems, digital learning environments can serve inclusive education. The same tool can thus be inclusive or exclusionary, depending on its design, fit with learner needs, quality of teacher mediation, available support structures, and ethical regime under which it operates.

Four conditions are useful for understanding meaningful digital inclusion. The first principle is accessibility by design. Access must be built into platforms, materials, assessment, communications, and data systems from the outset. Teachers should be ready to choose, modify, coach, and assess learners' tools. Schools and universities must provide infrastructure, training, and support personnel, and maintain continuity of services. The fourth ethical principle stressed the need for data-driven systems to be explainable, proportionate and subject to human intervention. If one of these conditions is missing, inclusion becomes fragile; if several are missing, digitalization may reproduce exclusion.

Table 4 (Appendix) provides a concise synthesis of the answers to the three research questions and connects each answer to its main evidence base and practical implication.

5 Discussion

According to the review's results, digital learning environments are increasingly integrated into special and inclusive education; however, their value should not merely be evaluated based on technology availability, as this risks undermining their educational purpose. The studies found in the literature reviewed revealed that digital tools may contribute to students' accessibility, personalised learning, engagement, progression, communication, self-regulation, and social participation. Nonetheless, these results manifest themselves only when technology is embedded within thoughtfully conceived pedagogical, institutional, and ethical arrangements. In other words, the potential of digital learning environments is inclusive, but only under specific conditions. The effectiveness of a design depends not only on its quality but also on implementation appropriateness, teacher preparedness, infrastructure accessibility, and whether learners with disabilities are treated as active participants rather than passive recipients of technological support. The review makes one of the main points that accessibility cannot simply be understood in technical usability terms. As long as a platform has captions, larger fonts, alternative formats, or assistive technology compatibility features, it is not enough. While these aspects are necessary, they are not sufficient to guarantee inclusion. Accessibility will be educationally meaningful only when it allows people to take part in tasks, communicate with others, show what they understand and act with agency. Recent work in [30], confirms that the same educational technology can function as a solution or a new barrier depending on whether it is pedagogically designed and intended to respond to real learner diversity. This difference is important. A digital tool may be available at the user interface level, yet still exclude specific groups because of its learning design, cognitive demand, linguistic assumptions, or use in the classroom.

Evidence also underlines the significance of personalisation, especially in adaptive and AI-supported environments. Adaptive systems offer tailored feedback, varied learning routes, modified challenge levels, and quicker reactions to student activities. Students with special educational needs benefit especially from characteristics that offer flexible pacing and multiple opportunities to engage with content. However, personalization should not be confused with automation. Although AI-driven systems may enhance inclusion, they cannot replace teachers' pedagogic judgement. According to [19], AI can help students with disabilities or language barriers, but ethical and inclusive frameworks will also be needed. The point here is not whether AI can personalise learning, but whether that personalisation is transparent, accountable, pedagogically justified, and open to teacher interpretation.

This means that teachers continue to be the most important mediators of digital inclusion. Research indicates that the value of a digital learning environment is greatest when teachers know how to select, adapt, scaffold and evaluate it. Expertise of teachers in this area cannot be reduced to functional digital skills. This requires professional judgement that combines technological knowledge, inclusive pedagogy, assessment literacy, ethical awareness, and sensitivity to learner diversity. The teacher should be capable of asking not simply "Does this tool work?", but also "Who does it work for, under what conditions, with what support and at what educational cost?"

This question can also be reframed more critically as: "Who does it work for, under what conditions, with what support and at what educational cost?" In this regard, a reflective practitioner is one who is able to evaluate the process and identify the educational impact of technology use by themselves and others. The role of institutional culture is equally important. Digital integration shouldn't be reliant on individual teachers' goodwill or technical curiosity. Sustainable institutional arrangements are required: open procurement policies, capacity support, professional development, assistive technology services, data governance procedures and a channel for student and family engagement in decisions. Recent research on techno-inclusivity in higher education shows that inclusive use of technology is dependent upon shared ownership, staff knowledge development, institutional commitment and student partnership, [27]. Although this study relates to higher education, it can also refer to special and inclusive education. Educational institutions should be taking a whole-system approach to digital inclusion instead of piecemeal accommodation.

Another issue concerns the use of assistive technology. Professional literature often depicts assistive tools and technologies as an unqualified good. However, a teacher's adoption decision is influenced by the teacher's experience, the nature of the classroom, the composition of the students, and optimally available resources.

The study conducted by [24], demonstrates that there is a lack of uniformity in the usage of assistive technologies across special education settings. Patterns of adoption vary according to teacher, classroom and student factors. The most important thing to take away from the aforementioned statement is that assistive technology is not "introduced" in the classroom, but is rather socially and pedagogically adopted. The successful application of the tool greatly depends on the extent to which teachers feel sufficiently competent to use it, whether the environment in the classroom permits its use, whether the students are willing to accept it and whether it can be integrated into the day-to-day learning of students.

We must increasingly focus on a greater emphasis on ethics. AI-supported and data-driven systems often collect private information on students regarding their performance, behaviours, learning pace, attention, and sometimes, emotions. For disabled students, this poses particular issues because they may have been already diagnostic labelled, institutionally categorised, and subject to inequitable expectations. When data is used in non-transparent ways or algorithms reproduce biased assumptions about individuals' capacity to learn, digital systems may exacerbate these processes. In a recent article on AI governance in education, which draws on the social model of disability, the authors argue that governance should not just look at how disability is an individual limitation, but that it should look at how educational technologies may produce barriers or remove them, [42], [43], [44], [45].

This viewpoint is particularly pertinent to the present review. To enable everyone to simply click and share what's on their mind, we need to pay more than lip service to concerns around power, representation, bias, dependency, and data protection. Over and above these, learners must not be reduced to the data profiles generated about them; they must remain more than this ensemble of performance data.

The results also indicate that Universal Design for Learning remains an appropriate framework but is applied with more methodological accuracy. Discussions of digital inclusion often invoke UDL, yet without associated design decisions, it risks becoming an empty slogan. The recent work on inclusive and digital science education calls for closer connections between lesson planning, digital enrichment and inclusive design frameworks, [46]. It is important to ensure that inclusive digital learning is not an afterthought and is planned from the outset of the design process. The techniques of active teaching of teachers can develop within teachers' methods through their experience with colleagues and students.

Ultimately, the review indicates a balanced reading of the field. Digital learning environments must accept neither idealisation nor rejection. Assistive technologies hold great promise for children with special educational needs and disabilities, especially when they enhance access, lessen reliance, assist with communication and provide opportunities to show what they can achieve in other ways. Simultaneously, poorly designed, overly cognitively demanding, under-supported, commercially driven, or ethically ambiguous AI systems can reproduce inequality, [47]. The discussion's main conclusion, therefore, is that inclusive digital education is not a technology problem. The use of technology, as well as its significance, is not as important as what it promotes or adds value to in these terms; that is, participation, dignity, equity and education, [48], [49], [50].

6 Conclusion

The review demonstrated that digital learning environments may contribute to special/inclusive education, but only under specific pedagogical/institutional conditions. The research shows that technology is not destiny. It cannot automatically enhance inclusion. But it can assist it if it is accessible, adaptive, carefully mediated, ethically governed and responsive to genuine learning needs. Digital settings allow better access to content, communication modes, Engagement, self-paced Learning, and Participation, for students with special educational needs and disabilities. Nonetheless, technology does not in and of itself create these benefits. The interaction between digital design, teacher knowledge, learner agency, institutional support, and ethical responsibility informs their educational impact.

According to the first research question, the review found that the educational gains of digital learning environments appear most evident in five areas: accessibility, personalisation, academic support, motivation and social participation. Students can use assistive technologies, adaptive platforms, multimodal resources, speech-to-text and text-to-speech systems, immersive tools, and AI-supported applications to overcome the limitations of traditional learning spaces. Yet, these benefits are more likely to happen when digital tools are used to enhance learners' participation rather than merely deliver content. The digital inclusivity that matters most is the kind that enables learners to connect, cooperate, make choices, govern their learning, and engage with dignity in the classroom's life.

The findings in relation to the second research question show that the teacher plays an important role in the implementation of digital inclusive education. Human mediation is not secondary to technology. On the contrary, teachers' professional judgement, rather than technical properties, determines the pedagogic mean. It is up to teachers to monitor learner needs, select tools, adapt materials and scaffold learning processes, manage cognitive load, protect students' agency and evaluate whether a particular digital intervention actually promotes inclusion. Professional development initiatives should extend beyond the basics of digital literacy to focus on areas such as inclusive design, assistive technologies, Universal Design for Learning, ethical use of AI and evidence-informed decision-making.

A teacher who uses technology inclusively is more than just technologically competent; they are also pedagogically reflective, ethically alert and responsive to learner diversity.

The review highlighted several barriers that have proven persistent in relation to the third research question. The barriers include lack of devices and connectivity, lack of teacher readiness, weak institutional support, non-standard accessibility, cognitive load, poor interoperability, limited adoption of assistive technology, privacy risks and discriminatory outcomes. Digital exclusion also reflects system design, rather than only disability of the individual. This is produced by systems, policies, infrastructures, design decisions and assumptions about what the "normal" learner can do. Consequently, future endeavors in digital inclusive education must take a systemic viewpoint. The evaluation of technology should go beyond its availability. It should also include how it is governed, cited, taught, maintained and evaluated.

Digital inclusion should therefore be understood as an educational issue rather than merely a technological one. Ultimately, what we are saying is that through the lens of diversity and inclusion, one ought to plan to digitally champion inclusion as well as digital excellence. Schools and educational institutions should resist jumping onto the bandwagon of the latest, smartest, and most marketable tool. As such, some serious questions should be answered before undertaking an action. Does the tool break down barriers? Does the tool enhance students' accessibility? Does the tool uphold students' dignity? Does the tool enhance student learning outcomes? These are some of the most critical questions educational institutions must ask themselves. As a result, this holds particular significance in the present time, where the educational context is subject to a rapid invasion of all kinds of systems based on AI. While such systems have the potential to create new opportunities for delivering personalized support, they also call for attention regarding transparency, bias, data protection and dependency on automated judgement.

Future research should investigate long-term outcomes, the implementation in classrooms, under-represented disability groups, teacher professional learning and the experiences of students and families. It is the need of the hour to conduct more comparative studies that examine digital inclusion across educational systems, socio-economic contexts, ages, and disabilities. Also, the voices of the students themselves need to get more focus from researchers. If we only conceptualize students with disabilities as objects who need to be 'intervened' with (fixed) and not as a person who interprets (give meaning to) the incident/situation, then we cannot fully understand inclusive education.

To sum up, digital learning environments can offer a more equitable education but only if their development is guided by equity rather than efficiency alone. We don't want to create a false impression that it is the tech that drives the inclusion; it is only a part of the system. When crafted with accessibility, pedagogical aim, ethical accountability and learner variability, digital environments can foster more flexible and participatory forms of education. When introduced without such guarantees, they risk reproducing older forms of exclusion in newer digital forms. The challenge is thus to humanise the digital education experience.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

During the preparation of this work the authors used Grammarly for language editing. After using this service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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APPENDIX

Table 1. Comparison of digital learning technologies and inclusive functions

Technology or environment	Main inclusive function	Likely educational benefit	Main caution
Assistive technologies, including screen readers, speech-to-text, text-to-speech, AAC, captioning, and alternative input	Remove or reduce sensory, communication, motor, and print-access barriers	Access to content, communication, autonomy, and participation, [9], [25]	Benefit depends on availability, compatibility, training, and ease of use
Adaptive and AI-supported platforms	Adjust sequence, feedback, difficulty, or representation to learner data	Personalized learning, timely feedback, engagement, and performance support, [19], [20], [31]	Risk of opaque profiling, privacy concerns, weak infrastructure, and excessive automation
Smart learning environments	Integrate data, interaction, accessibility, analytics, and adaptive support	Holistic support across design, pedagogy, and institutional conditions, [22]	May remain inaccessible if universal design and systemic supports are absent
Immersive technologies, including AR, VR, XR, and simulations	Offer multisensory, contextualized, and experiential learning	Engagement, conceptual understanding, safe practice, and social participation, [48], [49]	Can create sensory load, cost barriers, and disability-specific design gaps
Collaborative online and blended environments	Support interaction, peer learning, flexible participation, and continuity	Social belonging, communication, and shared learning, [26], [32]	Risk of isolation if accessibility, moderation, and learner support are weak

Source: created by the authors.

Table 2. Comparison of teacher and institutional responsibilities in digital inclusive education

Responsibility domain	Teacher-level practice	Institutional condition	Evidence-based implication
Assessment of learner needs	Identify sensory, cognitive, communication, emotional, and motor barriers	Access to diagnostic information and specialist support	Tool selection should begin from learner need, not from technology availability
Pedagogical integration	Connect digital tools with curriculum aims, task design, feedback, and assessment	Time for planning and access to inclusive instructional resources	Digital tools need structured instructional purpose, [32]
Assistive technology adoption	Support use, model routines, adjust tasks, and monitor effectiveness	Procurement, maintenance, technical support, paraprofessionals	Adoption increases when ease of use and classroom support are present, [24]
Professional learning	Develop digital, inclusive, and ethical competence	Differentiated training rather than generic workshops	Professional development is a predictor of EdTech adoption, [23]
Ethical and data-aware practice	Explain data use, avoid unnecessary profiling, protect learner dignity	Clear data governance, privacy policies, and accountability procedures	AI personalization requires transparency and restraint, [4], [20]
Collaboration	Work with families, support staff, therapists, and students themselves	School-level coordination and reasonable accommodation procedures	Inclusion is sustained through collective capacity, not individual goodwill alone

Source: created by the authors.

Table 3. Comparison of barriers and possible safeguards

Barrier domain	Typical manifestation	Risk for inclusion	Necessary safeguard
Technical reliability	Inaccurate captioning, weak speech recognition, platform incompatibility	Access becomes unstable and learner trust is reduced	Accessibility testing, maintenance, procurement standards, and user feedback loops
Cognitive accessibility	Overloaded interfaces, too many prompts, complex navigation, sensory strain	The tool increases effort rather than reducing barriers	Cognitive load review, simplified pathways, learner-controlled pacing, and teacher scaffolding
Metadata and discoverability	Resources exist but cannot be matched to accessibility needs	Teachers and learners cannot locate appropriate materials	Accessibility metadata, interoperability, and searchable resource repositories, [40]
Teacher preparation	Generic digital training without inclusive design or disability-specific application	Tools are underused, misused, or abandoned	Professional development linked to real classroom cases and learner profiles
Infrastructure and cost	Limited devices, connectivity, support staff, or platform licenses	Unequal implementation across schools and regions	Policy funding, technical support, and sustainable institutional planning
Ethics and data governance	Opaque learner profiling, privacy risks, algorithmic bias	Personalization becomes surveillance or misclassification	Consent, transparency, data minimization, bias audits, and human oversight

Source: created by the authors.

Table 4. Results table: answers to the research questions

Research question	Concise answer from the synthesis	Principal evidence base	Implication for practice
RQ1. What educational benefits do digital learning environments offer to students with special educational needs and disabilities?	They can improve accessibility, personalization, engagement, self-regulation, academic participation, communication, and social belonging when they provide multimodal, adaptive, and learner-responsive pathways.	[9], [17], [20], [22], [29], [31], [33], [49]	Design digital environments around learner variability, not around a single assumed user.
RQ2. Which teacher practices and professional competences support effective implementation?	Effective implementation depends on teacher judgement: selecting appropriate tools, adapting tasks, providing explicit instruction, scaffolding self-regulation, collaborating with support personnel, and evaluating whether the tool actually serves the learner.	[23], [24], [32], [35], [36], [50]	Professional development should combine digital competence with inclusive pedagogy, disability-specific adaptation, and ethical data awareness.
RQ3. What barriers limit the inclusive value of digital learning environments?	The main barriers are unreliable accessibility features, cognitive overload, weak metadata, insufficient teacher preparation, poor infrastructure, cost, privacy risks, algorithmic bias, and uneven institutional support.	[4], [19], [26], [27], [37], [38], [39], [40]	Inclusive technology policy must include safeguards, support structures, and accountability, not only procurement.

Source: created by the authors.