

Revisiting Constructivism Theory for Inclusive Digital Learning Materials in Primary Special Education: A Critical Narrative Review

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Abstract

The increasing integration of digital technologies into primary special education has transformed the design of digital learning materials for students with special educational needs (SEN). However, existing studies remain fragmented, emphasising technological effectiveness over the pedagogical principles underpinning meaningful learning. This critical narrative review revisits Constructivism Theory as a framework for developing inclusive digital learning materials in primary special education. Empirical studies, systematic reviews, conceptual papers, and policy documents published between 2020 and 2025 were synthesised to examine the relationship between constructivist principles, digital learning materials, and inclusive educational practices. The review found that digital learning materials enhance learner engagement, accessibility, collaboration, autonomy, and achievement when supported by pedagogically meaningful environments. Nevertheless, current research remains characterised by fragmented applications of constructivist principles, technology-centred perspectives, and limited theoretical integration, particularly within primary special education. In response, this review proposes the Integrated Constructivist Framework for Inclusive Digital Learning Materials (ICF-IDLM), positioning Constructivism Theory as the pedagogical foundation for integrating artificial intelligence, assistive technologies, adaptive learning systems, and Universal Design for Learning (UDL). By reconceptualising technology as a pedagogical mediator rather than an instructional objective, this review contributes to theory development, instructional design, and future research strengthening inclusive digital learning for SEN students.

Keywords: Constructivism Theory, Digital Learning Materials, Special Education, Inclusive Education, Universal Design for Learning

Introduction

The rapid advancement of digital technologies has fundamentally reshaped educational systems worldwide, transforming how teaching, learning, and assessment are designed and implemented across diverse educational contexts. In particular, digital learning materials have evolved beyond conventional electronic resources into sophisticated learning environments integrating multimedia applications, artificial intelligence (AI), adaptive

learning systems, immersive technologies, cloud-based collaboration, and assistive technologies that enable more personalised and accessible learning experiences (UNESCO, 2023; OECD, 2023). These developments have significantly influenced inclusive education, where digital technologies are increasingly recognised as important mechanisms for reducing barriers to learning, promoting equitable participation, and accommodating learner diversity. Nevertheless, contemporary educational research increasingly argues that technological advancement alone cannot guarantee meaningful educational improvement. Rather, the educational value of digital learning materials depends fundamentally on the pedagogical principles that guide their design and implementation (Bray et al., 2024; Navas-Bonilla et al., 2025).

Recent systematic reviews consistently demonstrate that digital learning materials have contributed positively to learner engagement, academic achievement, communication, and self-regulated learning among students with special educational needs (SEN). For instance, D'Elia et al. (2025) reported that technology-enhanced, differentiated learning interventions produce positive educational outcomes across diverse special education settings. Similarly, Navas-Bonilla et al. (2025) concluded that digital technologies improved educational participation when integrated with inclusive pedagogical practices, while Voultsiou and Moussiades (2025) highlighted the growing contribution of artificial intelligence, virtual reality, and adaptive learning systems in supporting personalised instruction for learners with disabilities. Despite these encouraging findings, the literature simultaneously reveals considerable variation in educational effectiveness across different interventions. Such inconsistencies suggest that successful digital learning cannot be explained solely by technological sophistication but requires greater attention to the pedagogical processes through which learners actively construct knowledge.

A critical examination of the literature reveals that much contemporary research remains dominated by technology-centred perspectives, where digital innovation is frequently evaluated according to technological performance, usability, accessibility, or learner satisfaction rather than educational processes. While these indicators provide valuable evidence regarding system effectiveness, they offer comparatively limited explanation of how digital learning environments facilitate conceptual understanding, higher-order thinking, learner autonomy, and collaborative knowledge construction. Bray et al. (2024) observed that technology implementation frequently prioritises accessibility while giving insufficient attention to learner agency and self-regulation. Relatedly, although ICT interventions often incorporate collaborative learning, scaffolding, and inquiry-based activities, many studies fail to explain how these instructional strategies collectively contribute to meaningful knowledge construction. This imbalance has resulted in a substantial body of empirical evidence describing technological effectiveness but comparatively limited theoretical understanding of the pedagogical mechanisms underpinning successful digital learning.

Despite the growing body of literature on digital learning, several important theoretical and pedagogical gaps remain unresolved. Existing reviews have predominantly examined educational technologies, artificial intelligence (AI), assistive technologies, Universal Design for Learning (UDL), or digital inclusion as separate domains, with limited attention given to how these innovations collectively support meaningful learning through a coherent pedagogical framework (Bray et al., 2024; Navas-Bonilla et al., 2025; Voultsiou & Moussiades,

2025). Consequently, much of the current evidence remains technology-oriented, emphasising system functionality, accessibility, usability, or learner satisfaction, while providing comparatively limited explanation of the learning processes through which students with special educational needs actively construct knowledge in digital environments. Furthermore, although Constructivism Theory is frequently cited to justify learner-centred instructional practices, relatively few studies have critically examined its contemporary relevance in guiding the design of inclusive digital learning materials for primary special education. Most empirical investigations operationalise isolated constructivist elements, such as collaboration, scaffolding, or inquiry-based learning, without integrating these principles into a comprehensive pedagogical framework capable of explaining how digital technologies facilitate meaningful learning. This fragmented application has limited theoretical advancement and reduced opportunities to establish stronger connections between learning theory and educational technology.

In response to these limitations, the present critical narrative review revisits Constructivism Theory as an integrative pedagogical framework for understanding and designing inclusive digital learning materials in primary special education. Rather than evaluating individual technologies, this review critically synthesises contemporary evidence to explain how constructivist principles underpin effective digital learning environments and proposes an integrated theoretical framework that connects constructivist pedagogy with emerging technologies, including AI, adaptive learning systems, assistive technologies, and UDL. By doing so, this review seeks to strengthen theoretical understanding, inform instructional design, and provide clearer directions for future research and educational practice.

Methodology

This study employed a critical narrative review to synthesise and critically interpret contemporary literature concerning the application of Constructivism Theory in the development of inclusive digital learning materials for primary special education. Unlike systematic reviews that primarily emphasise exhaustive evidence identification through predefined inclusion procedures, a critical narrative review enables the integration of theoretical perspectives, empirical findings, conceptual developments, and policy documents to construct a comprehensive understanding of an emerging research field (Grant & Booth, 2009; Ferrari, 2015). This approach was considered appropriate because the present study aimed not only to summarise previous findings but also to reinterpret Constructivism Theory within the context of rapidly evolving digital learning environments.

Table 1

Eligibility Criteria for Literature Selection

Criteria	Inclusion	Exclusion
Publication year	2020–2025	Before 2020
Language	English	Languages other than English
Document type	Peer-reviewed journal articles, systematic reviews, conceptual papers, policy reports	Conference proceedings, book chapters, dissertations, editorials
Educational context	Primary special education, inclusive education, digital learning	Higher education without special education context
Research focus	Constructivism, digital learning materials, AI, assistive technology, UDL	Studies unrelated to pedagogy or digital learning
Publication source	Scopus, Web of Science, ERIC, Google Scholar	Non-indexed or unpublished documents

The inclusion and exclusion criteria were developed to ensure that the reviewed literature remained directly relevant to the objectives of the present review while maintaining methodological consistency. Priority was given to recent peer-reviewed publications that explicitly examined the pedagogical application of digital learning materials within inclusive and special education contexts. This selection strategy enabled the review to synthesise contemporary evidence while maintaining a clear theoretical focus on Constructivism Theory. The literature search was conducted between January and June 2026 using four internationally recognised electronic databases: Scopus, Web of Science (WoS), ERIC, and Google Scholar. These databases were selected because they provide comprehensive coverage of educational research, educational technology, inclusive education, and special education. To ensure the review reflected current developments in digital learning, only publications between 2020 and 2025 were considered. The search strategy combined Boolean operators with keywords including "Constructivism Theory" OR "Constructivist Learning" AND "Digital Learning Materials" OR "Educational Technology" OR "Digital Learning" AND "Special Education" OR "Inclusive Education" OR "Students with Special Educational Needs". Additional keywords such as Artificial Intelligence, Assistive Technology, Universal Design for Learning, Adaptive Learning, and Primary Education were incorporated to capture recent developments in digital learning.

The initial database search yielded a substantial number of publications. Following title and abstract screening, duplicate removal, and full-text evaluation, approximately 80 publications were retained for detailed analysis. The selected sources consisted of empirical studies, systematic reviews, conceptual papers, theoretical articles, and international policy reports published in peer-reviewed journals or by internationally recognised organisations. Preference was given to articles indexed in Scopus and Web of Science, particularly those published in high-impact journals such as *British Journal of Educational Technology*, *Education and Information Technologies*, *Computers & Education*, *Interactive Learning Environments*, *Technology, Knowledge and Learning*, *Journal of Special Education Technology*, and *Frontiers in Education*. International policy documents produced by UNESCO and the Organisation for Economic Co-operation and Development (OECD) were also included because they provide important contextual evidence concerning inclusive digital education.

The analysis adopted a thematic synthesis approach. The thematic synthesis followed an iterative and interpretative process adapted from contemporary qualitative synthesis approaches. Each selected publication was first examined to identify its theoretical orientation, research objectives, methodological design, participant characteristics, educational setting, and principal findings. Recurring concepts and pedagogical patterns were then coded and continuously compared across studies to identify conceptual similarities, differences, contradictions, and emerging theoretical relationships. Rather than reporting individual studies separately, the analysis focused on generating higher-order interpretations capable of explaining how constructivist principles collectively underpin inclusive digital learning materials. This analytical process ultimately produced six interconnected themes that form the structure of the present review.

To enhance analytical rigour, the review adopted a constant comparative approach throughout the synthesis process. Emerging interpretations were continuously compared across empirical studies, systematic reviews, conceptual articles, and international policy documents to minimise isolated interpretation and strengthen theoretical consistency. This iterative comparison enabled the identification of recurring pedagogical patterns as well as inconsistencies within the contemporary literature, thereby supporting a more critical synthesis rather than a descriptive summary of previous studies.

The trustworthiness of the review was strengthened through several strategies. First, only recent peer-reviewed publications and internationally recognised policy documents were included to ensure the relevance and credibility of the evidence. Second, findings from multiple studies were compared and synthesised rather than interpreted individually, thereby reducing reliance on isolated evidence. Third, theoretical interpretations were continuously cross-referenced with classical constructivist scholarship, including the works of Piaget (1972), Vygotsky (1978), Bruner (1966), and Jonassen (1999), to maintain conceptual consistency while incorporating contemporary developments in educational technology. This combination of systematic literature identification, thematic synthesis, and critical interpretation enabled the present review to provide a comprehensive and theoretically grounded understanding of Constructivism Theory within the context of inclusive digital learning materials for primary special education. Collectively, these procedures enhanced the credibility, dependability, confirmability, and theoretical coherence of the review, ensuring that the interpretations presented were grounded in a transparent and systematic synthesis of contemporary literature.

Literature Review and Discussion

Revisiting Constructivism Theory in the Digital Era

Constructivism Theory has long been recognised as one of the most influential pedagogical theories for explaining how learners actively construct knowledge through experience, interaction, and reflection rather than passively receiving information from teachers (Piaget, 1972; Vygotsky, 1978; Bruner, 1966). Although these foundational perspectives were established before the widespread adoption of digital technologies, contemporary educational research demonstrates that constructivist principles remain highly relevant in technology-enhanced learning environments. Rather than diminishing the significance of constructivism, the rapid evolution of educational technologies has reinforced its importance

because digital learning environments increasingly require learners to engage in inquiry, collaboration, self-regulation, and authentic problem-solving (Jonassen, 1999).

However, a closer examination of the contemporary literature reveals a more complex conceptual evolution than is commonly acknowledged. While previous studies consistently recognise Constructivism Theory as a learner-centred approach, they differ substantially in explaining its role within technology-enhanced learning environments. Dahl and Mørch (2025) argued that constructivist principles should fundamentally shape the design of digital learning objects rather than merely inform instructional activities. This perspective suggests that constructivism is no longer confined to classroom pedagogy but has evolved into an overarching framework for designing meaningful digital learning environments. Consequently, the educational value of digital technologies depends less on their technical sophistication than on the extent to which they facilitate active knowledge construction, learner agency, and authentic educational interaction.

Despite this conceptual evolution, important inconsistencies remain across the existing literature. Although many researchers explicitly claim to adopt constructivist pedagogy, the theory is frequently operationalised through isolated instructional strategies rather than implemented as a coherent pedagogical framework. For example, collaborative learning, inquiry-based instruction, scaffolding, and learner autonomy are often investigated independently, with limited explanation of how these principles interact to facilitate knowledge construction. As a result, the literature demonstrates strong empirical support for learner-centred practices but comparatively weak theoretical integration. This fragmentation restricts cumulative theoretical development and makes it difficult to explain why similar digital technologies produce substantially different educational outcomes across diverse learning contexts.

The reviewed literature also demonstrates increasing convergence between Constructivism Theory and contemporary perspectives on inclusive education. International policy documents consistently emphasise that inclusive education should extend beyond ensuring physical or technological access towards creating meaningful opportunities for participation and learning (UNESCO, 2023; OECD, 2023). Constructivism complements this perspective by explaining that meaningful participation requires learners to actively construct knowledge through interaction with teachers, peers, learning materials, and authentic contexts. Consequently, the educational value of digital learning materials cannot be evaluated solely according to technological accessibility but must also be assessed according to their capacity to facilitate learner agency, collaboration, reflection, and conceptual understanding. This interpretation broadens the theoretical scope of constructivism by positioning it as a central framework for understanding inclusive digital learning rather than simply a theory of classroom instruction.

The emergence of artificial intelligence further illustrates the growing tension between technological innovation and pedagogical theory. While contemporary studies consistently acknowledge AI's capacity to personalise instruction, automate feedback, and support adaptive learning, considerable disagreement remains regarding its educational role. Voultsiou and Moussiades (2025) both emphasised AI as a powerful mechanism for instructional adaptation and cautioned that excessive dependence on AI may unintentionally

weaken learner autonomy, inquiry, and reflective thinking if pedagogical interaction becomes secondary to algorithmic decision-making. Taken together, these observations reinforce a central constructivist proposition: technology enhances learning only when it supports the cognitive, social, and reflective processes through which learners actively construct knowledge.

From a critical perspective, the review suggests that the principal contribution of Constructivism Theory in the digital era lies not in explaining the existence of digital technologies but in explaining the educational conditions under which those technologies become meaningful. Technologies differ in design, complexity, and functionality, yet successful digital learning environments consistently share common pedagogical characteristics, including active learner participation, collaborative knowledge construction, structured scaffolding, authentic learning experiences, and reflective practice. These characteristics are fundamental principles of Constructivism Theory rather than inherent properties of technology itself. Consequently, this review argues that future research should shift from comparing individual technologies towards examining how constructivist principles can systematically guide the development of inclusive digital learning materials capable of supporting diverse learners within primary special education.

Constructivist Principles Supporting Inclusive Digital Learning Materials

The synthesis of contemporary literature indicates that the success of digital learning materials is closely associated with the extent to which their instructional design reflects core constructivist principles. Across the reviewed studies, six pedagogical principles emerged consistently as fundamental characteristics of effective digital learning environments: active knowledge construction, scaffolding, collaborative learning, authentic learning, learner autonomy, and reflective practice. Although these principles have traditionally been discussed independently, the reviewed evidence demonstrates that they function interdependently to create meaningful learning experiences for students with special educational needs.

Collectively, these studies indicate that active knowledge construction should not be interpreted simply as learner interaction with digital content. Rather, meaningful learning occurs when learners are cognitively challenged to interpret information, negotiate meaning, justify decisions, and apply prior knowledge to authentic contexts. This observation explains why technologically sophisticated learning materials do not necessarily produce superior educational outcomes, as cognitive engagement depends primarily on pedagogical design rather than technological functionality.

The principle of active knowledge construction remains central to contemporary digital learning. Constructivist scholars argue that learning occurs when individuals actively interpret, reorganise, and apply new information in relation to prior knowledge rather than memorising isolated facts (Piaget, 1972). D'Elia et al. (2025) found that problem/project-based learning approaches were generally effective in promoting inclusive digital education for students with special educational needs, particularly when students were required to investigate authentic problems, evaluate information, and generate solutions rather than passively receive content, although differentiated implementation was needed to maximise inclusivity. In contrast, studies focusing primarily on multimedia presentation reported more

modest improvements, suggesting that interactivity alone is insufficient unless learners are cognitively engaged in constructing understanding (Mayer, 2021). These findings collectively indicate that the effectiveness of digital learning materials depends on their capacity to stimulate active thinking rather than simply presenting information through attractive technological interfaces.

A second principle consistently highlighted across the literature is scaffolding, which refers to structured instructional support enabling learners to perform tasks beyond their current level of independent competence (Vygotsky, 1978). Contemporary digital technologies have expanded opportunities for scaffolding through adaptive feedback, intelligent tutoring systems, guided multimedia instruction, and AI-assisted learning; Zhao et al. (2025) similarly found that sustained AI-supported interventions strengthen conceptual understanding when they provide continuous, structured guidance throughout the learning process. However, Voultsiou and Moussiades (2025) cautioned that AI-generated scaffolding cannot replace pedagogical judgement because effective scaffolding requires continuous interpretation of learners' cognitive, emotional, and social responses. This comparison suggests that technology can enhance scaffolding but remains dependent on teacher expertise to ensure meaningful learning progression. Taken together, these findings suggest that digital scaffolding is most effective when technological guidance complements rather than replaces teachers' pedagogical judgement. Consequently, scaffolding should be conceptualised as a dynamic interaction between teacher expertise, learner needs, and technological support rather than as an automated instructional function.

Beyond active knowledge construction and scaffolding, collaborative learning emerged as another dominant constructivist principle underpinning successful digital learning environments. According to Vygotsky (1978), knowledge develops through social interaction in which learners negotiate meaning, challenge existing understandings, and co-construct new knowledge with peers and teachers. This theoretical perspective has become increasingly relevant in digital education because contemporary learning technologies facilitate communication through online discussion forums, collaborative workspaces, cloud-based platforms, and synchronous learning environments.

D'Elia et al. (2025) similarly reported that cooperative and project-based digital learning approaches increased engagement among students with special educational needs by encouraging collaborative problem-solving, shared decision-making, and structured peer interaction. However, Bray et al. (2024) observed that many digital learning environments remain predominantly individualistic despite incorporating advanced technologies, as instructional activities frequently prioritise content delivery rather than collaborative inquiry. Likewise, Navas-Bonilla et al. (2025) argued that access to digital technology alone does not automatically create inclusive learning because meaningful inclusion depends on learners actively participating in knowledge construction with others. Taken together, these findings suggest that collaboration should be regarded as a pedagogical process intentionally embedded within digital learning environments rather than an incidental consequence of technological connectivity. This synthesis further indicates that collaboration functions not merely as a social activity but as a cognitive mechanism through which learners refine understanding, negotiate multiple perspectives, and co-construct knowledge. Therefore,

collaborative learning represents one of the defining characteristics distinguishing constructivist digital learning environments from technology-centred instructional models.

Closely related to collaborative learning is the constructivist principle of authentic learning, which emphasises engaging learners in realistic tasks that resemble the complexity of real-world situations. Rather than learning through isolated exercises or repetitive practice, constructivist pedagogy argues that conceptual understanding develops more effectively when learners investigate meaningful problems requiring analysis, interpretation, and decision-making (Bruner, 1966; Jonassen, 1999). Problem-based and authentic digital learning tasks are widely argued to help students with special educational needs connect classroom knowledge with real-world experiences, thereby strengthening motivation and conceptual understanding when learners are required to solve contextualised rather than decontextualised problems. This pattern indicates that authentic learning is determined not by technological sophistication but by the pedagogical authenticity of learning experiences designed within digital environments. Importantly, authentic learning should not be equated with technological realism alone. Instead, authenticity derives from the intellectual complexity of learning tasks that encourage learners to investigate meaningful problems, integrate multiple sources of information, and generate contextually relevant solutions.

The reviewed literature further identifies learner autonomy as an increasingly important outcome of constructivist digital learning. Autonomy extends beyond independent technology use and refers to learners' capacity to regulate their learning, monitor their progress, make informed decisions, and assume responsibility for knowledge construction. Digital technologies have substantially expanded opportunities for personalised learning by enabling learners to control learning pace, select learning pathways, and receive adaptive feedback according to individual needs.

Khasawneh and Khasawneh (2024) found that adaptive digital learning technologies affect students with disabilities differently depending on the specific tool used, with cognitive load and engagement varying according to individual learning profiles, academic performance, and demographic factors. Similarly, Mallory and Hampshire (2025) found that technology-supported interventions promoted learner independence among students with autism by encouraging self-monitoring and self-management. Nevertheless, Voultsiou and Moussiades (2025) cautioned that personalised learning systems should not be equated with learner autonomy because algorithmic adaptation may unintentionally reduce opportunities for critical thinking if learners become overly dependent on automated recommendations. This observation extends constructivist scholarship by suggesting that genuine learner autonomy requires not only instructional personalisation but also opportunities for reflection, decision-making, and independent problem-solving. This distinction is theoretically significant because personalised instruction and learner autonomy are not synonymous. While adaptive technologies may individualise learning pathways, genuine autonomy emerges only when learners actively regulate, evaluate, and justify their own learning decisions.

Another recurring constructivist principle identified throughout the reviewed literature is reflection and metacognition. Constructivist scholars have consistently argued that meaningful learning requires learners to evaluate their understanding, monitor cognitive processes, and reorganise knowledge through reflective thinking (Jonassen, 1999). Despite

the increasing availability of digital technologies capable of providing automated feedback, learning analytics, and adaptive assessment, reflective learning remains comparatively underrepresented within contemporary educational technology research. Zhao et al. (2025), synthesising 29 experimental and quasi-experimental studies, found that generative AI exerts a moderate positive effect on learners' higher-order thinking—including self-questioning and reflective dialogue rather than merely generating instructional content—with the strongest gains observed in problem-solving and critical thinking when learners were encouraged to justify decisions and evaluate their own learning processes. However, several intervention studies continued to evaluate educational effectiveness primarily through academic achievement or learner satisfaction, providing limited evidence regarding the development of metacognitive competence. Consequently, reflection should be recognised as a fundamental component of constructivist digital learning rather than an optional extension of instructional activities. Accordingly, reflective practice should be recognised as the pedagogical process through which digital learning experiences are transformed into durable conceptual understanding, thereby extending the explanatory power of Constructivism Theory within contemporary digital education.

A critical synthesis of these six constructivist principles reveals that they should not be interpreted as independent instructional strategies. Instead, they represent an integrated pedagogical system through which meaningful digital learning is achieved. Active knowledge construction provides the cognitive foundation for learning, scaffolding supports progressive conceptual development, collaborative learning facilitates social negotiation of meaning, authentic learning contextualises knowledge, learner autonomy promotes self-regulation, and reflective practice consolidates conceptual understanding. Although individual studies frequently emphasise one or two principles, the reviewed evidence demonstrates that successful digital learning environments consistently integrate multiple constructivist processes simultaneously. This observation represents an important theoretical contribution because it challenges reductionist interpretations of constructivism that equate the theory with isolated instructional techniques. Rather, Constructivism Theory should be understood as a holistic pedagogical framework capable of guiding the design of inclusive digital learning materials that respond to the diverse educational needs of primary school students with special educational needs.

The synthesis also highlights an important conceptual implication for future instructional design. Much of the existing literature evaluates digital learning materials according to technological features such as multimedia quality, artificial intelligence, gamification, or adaptive functionality. However, the evidence reviewed in this study suggests that these technological characteristics are secondary to the pedagogical principles underpinning learner engagement. A technologically advanced digital learning resource may remain educationally ineffective if it fails to encourage inquiry, collaboration, reflection, and learner agency. Conversely, relatively simple digital resources may produce substantial educational benefits when deliberately designed around constructivist learning principles. Therefore, future research and instructional design should prioritise pedagogical coherence over technological complexity, ensuring that digital innovation remains firmly grounded in theories of learning rather than driven primarily by technological capability.

Digital Learning Materials in Primary Special Education: A Constructivist Perspective

A recurring finding across the reviewed literature is that digital learning materials significantly improve learner engagement among students with special educational needs. Nevertheless, a closer examination reveals that engagement is not an automatic consequence of technology use. Technology-enhanced learning interventions are generally reported to increase learner motivation and participation, although considerable variation in educational outcomes persists across different instructional contexts. For example, Lee et al. (2025) demonstrated that computer-assisted instructional programmes improved conceptual understanding among learners with autism spectrum disorder, yet these improvements were strongly influenced by teacher guidance and structured learning activities rather than the technological applications themselves. Navas-Bonilla et al. (2025) likewise argued that learner engagement increases when digital technologies reduce participation barriers and support differentiated instruction; however, they cautioned that engagement declines when technology functions merely as a medium for presenting instructional content. Collectively, these findings indicate that learner engagement is fundamentally a pedagogical outcome rather than a technological feature. From a constructivist perspective, engagement emerges because learners actively interact with meaningful learning experiences rather than because digital devices are inherently motivating.

The reviewed studies also demonstrate that digital learning materials play an increasingly important role in supporting differentiated learning among primary school students with diverse educational needs. Contemporary inclusive classrooms comprise learners with substantial variation in cognitive development, communication abilities, sensory functioning, behavioural characteristics, and learning preferences. Consequently, instructional materials designed according to uniform teaching approaches frequently fail to accommodate such diversity.

Bray et al. (2024) argued that Universal Design for Learning (UDL) provides an important framework for addressing learner variability through multiple means of engagement, representation, and action. Adaptive digital learning environments are similarly reported to enable teachers to personalise instructional activities according to individual learner characteristics (Khasawneh & Khasawneh, 2024), thereby strengthening learner participation and reducing instructional barriers. Nevertheless, Abdelwahab et al. (2025) found that although assistive technology substantially improves accessibility and engagement for students with disabilities, its effective use is frequently constrained by inadequate teacher training and limited awareness of available tools, leaving comparatively limited opportunities for collaborative inquiry or higher-order thinking. This comparison suggests that effective differentiation extends beyond adapting instructional content to individual learner characteristics. Instead, meaningful differentiation requires pedagogical flexibility that enables all learners to participate actively in knowledge construction regardless of their cognitive, behavioural, or communication differences. Such an interpretation aligns closely with the constructivist view that learning environments should accommodate learner diversity while maintaining common opportunities for inquiry, collaboration, and reflection. An equally significant finding concerns the growing integration of assistive technologies within digital learning materials. Contemporary assistive technologies—including text-to-speech software, speech-generating devices, visual communication systems, adaptive interfaces, and intelligent communication supports—have substantially improved access to

curriculum content for learners with disabilities. Abdelwahab et al. (2025) reported that teachers who receive adequate training in assistive technologies demonstrate greater confidence and competence in supporting inclusive learning than teachers without such training. Voultsiou and Moussiades (2025) further concluded that artificial intelligence enhanced accessibility through adaptive communication supports and personalised instructional feedback, while emphasising that technological accessibility alone does not guarantee educational inclusion. Learners benefit most when assistive technologies facilitate meaningful interaction with teachers, peers, and learning activities rather than functioning merely as compensatory devices. This interpretation aligns closely with Vygotsky's (1978) conception of learning as a socially mediated process, suggesting that assistive technologies should strengthen participation in collaborative knowledge construction rather than simply increasing functional independence. Therefore, assistive technologies should not be viewed merely as compensatory tools but as pedagogical resources that enable learners to participate more meaningfully in collaborative learning and authentic educational experiences. This distinction strengthens the conceptual relationship between accessibility and constructivist learning.

The rapid emergence of artificial intelligence (AI) has introduced further opportunities for improving inclusive digital learning materials. AI-supported educational systems increasingly provide adaptive assessment, personalised feedback, predictive learning analytics, intelligent tutoring, and automated content generation. These capabilities have generated considerable optimism regarding the potential of AI to address learner diversity within inclusive education. While Voultsiou and Moussiades (2025) argued that AI substantially improves instructional personalisation for learners with disabilities, they simultaneously warned that excessive reliance on algorithmic decision-making may reduce opportunities for learner inquiry, reflection, and collaborative problem-solving if AI replaces rather than supports pedagogical interaction. Similarly, Dahl and Mørch (2025) contended that digital learning resources should be designed around constructivist learning processes instead of technological automation. These contrasting perspectives indicate that AI should not be evaluated solely according to its adaptive capabilities but according to its contribution to active knowledge construction, learner agency, and meaningful educational interaction. Consequently, the constructivist value of AI lies not in replacing teachers but in expanding opportunities for personalised scaffolding, formative feedback, and reflective learning.

A critical issue emerging from the literature concerns the continuing tendency to evaluate digital learning materials using predominantly quantitative indicators such as academic achievement, usability, learner satisfaction, or technology acceptance. Although these indicators provide valuable evidence regarding intervention effectiveness, they offer comparatively limited understanding of the cognitive, social, and pedagogical processes responsible for conceptual learning. The majority of intervention studies in this area report statistically significant improvements in educational outcomes yet provide limited explanation of how learning occurred during instructional implementation. Collaborative learning and inquiry-based instruction, for instance, are consistently reported to enhance learning outcomes, yet many studies lack explicit theoretical explanations linking these instructional practices to Constructivism Theory. This methodological pattern reveals an important limitation within current research. By concentrating primarily on measurable outcomes, contemporary studies frequently overlook the pedagogical interactions through

which learners construct meaning, negotiate understanding, and develop higher-order thinking skills. Future investigations should therefore integrate qualitative analyses, classroom observations, learner discourse, and design-based research to complement traditional outcome measures and provide a more comprehensive understanding of constructivist digital learning.

The synthesis presented in this review further demonstrates that digital learning materials should not be conceptualised as isolated technological innovations but as components of broader pedagogical ecosystems. Effective inclusive digital learning emerges through the interaction of multiple interconnected factors, including learner characteristics, teacher expertise, instructional design, technological affordances, classroom culture, and educational policy. While individual technologies such as AI, gamification, multimedia applications, and assistive technologies each contribute unique educational affordances, none independently determines learning success. Instead, the reviewed evidence consistently indicates that educational outcomes depend upon the extent to which these technologies collectively support active knowledge construction, collaboration, scaffolding, learner autonomy, and reflective practice. This interpretation extends Constructivism Theory beyond its traditional classroom orientation by positioning digital learning environments as dynamic systems in which learning is co-constructed through continuous interaction among learners, teachers, technologies, and authentic educational experiences.

Critical Challenges and Research Gaps

Although the reviewed literature consistently reports positive educational outcomes associated with digital learning materials, a critical synthesis reveals that important conceptual and methodological limitations continue to constrain theoretical advancement. Much of the existing evidence remains dominated by technology-oriented perspectives that evaluate educational success primarily through indicators such as academic achievement, usability, accessibility, learner satisfaction, or technology acceptance. While these outcomes provide valuable evidence regarding intervention effectiveness, they offer comparatively limited explanation of the pedagogical mechanisms responsible for meaningful knowledge construction. Consequently, the current literature provides stronger evidence regarding what digital technologies achieve than why they achieve these educational outcomes.

One of the most significant challenges identified throughout the reviewed studies is the continued dominance of technology-driven research paradigms, evaluating digital learning materials primarily through measurable outcomes such as academic achievement, learner satisfaction, technology acceptance, usability, or accessibility, while contributing comparatively little to explaining the learning processes responsible for educational improvement.

The reviewed studies illustrate this imbalance concretely. Navas-Bonilla et al. (2025) demonstrated that digital technologies strengthened inclusive education only when accompanied by learner-centred pedagogical practices, whereas Bray et al. (2024) found that many technology initiatives remained disproportionately focused on improving accessibility while providing limited opportunities for collaborative inquiry, learner autonomy, and metacognitive development. These contrasting findings indicate that technological innovation alone cannot adequately explain successful learning; educational outcomes are

instead mediated by pedagogical processes that remain insufficiently examined within current research, limiting theoretical accumulation because similar technologies are frequently evaluated across diverse educational contexts without sufficient explanation of the instructional processes mediating learner outcomes.

A second challenge concerns the fragmented application of Constructivism Theory across contemporary educational technology studies. Although constructivist terminology is frequently employed to justify learner-centred instructional practices, relatively few investigations explicitly operationalise constructivist principles throughout the design, implementation, and evaluation of digital learning materials. Scaffolding, collaborative learning, and inquiry-based activities are consistently reported to enhance learning outcomes in ICT-supported instruction; however, these pedagogical elements are commonly discussed as independent instructional strategies rather than interconnected components of Constructivism Theory. A similar pattern is evident in studies of problem-based, cooperative, and service learning, where these approaches are reported to strengthen learner participation even though the theoretical relationships among them remain largely implicit. Such fragmentation weakens cumulative theoretical development because individual instructional strategies are evaluated separately without contributing to a unified understanding of how constructivist learning occurs within digital environments. Consequently, the present review argues that Constructivism Theory should be interpreted as an integrated pedagogical framework rather than a collection of isolated instructional techniques.

Another critical issue emerging from the reviewed literature relates to the rapid expansion of artificial intelligence (AI) within education. AI has introduced substantial opportunities for personalising instruction, automating feedback, and supporting adaptive learning pathways, particularly for learners with diverse educational needs. Nevertheless, current evidence suggests that enthusiasm surrounding AI has often outpaced pedagogical understanding. While Voultsiou and Moussiades (2025) emphasised AI's potential to improve accessibility and differentiated instruction, they simultaneously identified concerns regarding teacher preparedness, algorithmic bias, ethical governance, and learner dependency. Consistent with this, Zhao et al. (2025) found that generative AI applications hold the most educational value when they complement higher-order thinking, inquiry, and collaborative learning rather than replacing human interaction or instructional judgement. Conversely, several technology-focused studies continue to evaluate AI primarily through indicators of system efficiency, accuracy, or adaptive functionality, providing limited consideration of learner agency or conceptual understanding. These divergent perspectives illustrate an important theoretical tension within contemporary educational technology research. Rather than treating AI as an autonomous educational innovation, future scholarship should investigate how AI can be integrated within constructivist learning environments that preserve authentic dialogue, reflective thinking, and collaborative knowledge construction.

The review further identifies persistent methodological limitations that constrain the generalisability of existing evidence. Much of the contemporary literature is characterised by short-term intervention studies, relatively small sample sizes, and single-site investigations, limiting understanding of how digital learning materials influence long-term conceptual development, learner autonomy, and educational participation. Moreover, quantitative

outcome measures continue to dominate the field, whereas qualitative analyses examining learner interaction, classroom discourse, reflective thinking, and teacher decision-making remain comparatively scarce. While experimental studies provide robust evidence regarding instructional effectiveness, they often overlook the contextual factors influencing technology implementation in authentic classrooms. This methodological imbalance restricts opportunities to understand how learners with special educational needs negotiate meaning, collaborate with peers, and interact with digital learning environments over time. Therefore, future investigations should adopt longitudinal, mixed-methods, and design-based research approaches capable of capturing the complexity of constructivist learning processes.

An additional research gap concerns the limited attention given to primary special education within the broader educational technology literature. A considerable proportion of existing studies have been conducted in higher education or general primary education, while comparatively fewer investigations have focused specifically on learners with special educational needs in primary schools. Furthermore, studies frequently concentrate on individual disability categories such as autism spectrum disorder, intellectual disability, dyslexia, or sensory impairments, making it difficult to develop pedagogical models applicable across diverse learner populations. While disability-specific interventions provide valuable insights into targeted instructional strategies, they contribute less to understanding how inclusive digital learning environments can be designed to accommodate learner diversity more broadly. This limitation is particularly important because inclusive classrooms increasingly comprise learners with multiple and overlapping educational needs, requiring pedagogical frameworks that extend beyond disability-specific adaptations. Constructivism Theory offers considerable potential in this regard because its emphasis on learner-centred instruction, social interaction, and differentiated scaffolding aligns closely with the principles of inclusive education.

Perhaps the most significant theoretical gap identified through this review is the absence of an integrated pedagogical model connecting Constructivism Theory, digital learning materials, Universal Design for Learning (UDL), assistive technology, and artificial intelligence within primary special education. Existing reviews generally examine these topics independently, resulting in parallel bodies of evidence that rarely converge into a coherent theoretical framework. Bray et al. (2024) focused primarily on UDL, Voultsiou and Moussiades (2025) examined AI in special education, while Navas-Bonilla et al. (2025) reviewed digital technologies for inclusive education more broadly. Although each review contributes valuable insights, none fully explains how these educational innovations collectively support active knowledge construction within inclusive digital learning environments. This fragmentation represents a significant gap because educators increasingly implement multiple technologies simultaneously rather than in isolation. The present review therefore proposes that Constructivism Theory provides the conceptual foundation necessary to integrate these diverse innovations within a unified pedagogical framework capable of guiding future instructional design.

An additional gap identified through this review concerns the limited integration of learning theory within educational technology research. Existing studies frequently examine digital innovation from technological, psychological, or accessibility perspectives, yet comparatively few investigations integrate these dimensions within a coherent constructivist framework

capable of explaining how knowledge is actively constructed in inclusive digital learning environments. Addressing this theoretical fragmentation represents an important priority for future research because pedagogical coherence is essential for translating technological innovation into sustainable educational improvement.

As established earlier, the principal challenge facing inclusive digital education is therefore not technological capability but pedagogical coherence: digital learning materials, artificial intelligence, assistive technologies, and adaptive learning systems possess considerable educational potential, but their effectiveness depends on how far they support the constructivist processes outlined above. The following section builds on this conclusion by proposing an integrated framework that translates this coherence into a concrete pedagogical model.

An Integrated Constructivist Framework for Inclusive Digital Learning Materials

The critical synthesis presented throughout this review indicates that the educational potential of digital learning materials cannot be adequately explained through isolated technological features or individual instructional strategies. Rather, meaningful learning emerges from the dynamic interaction between pedagogical principles, technological affordances, teacher facilitation, learner characteristics, and authentic learning experiences. Despite the rapid expansion of research concerning educational technology, artificial intelligence (AI), Universal Design for Learning (UDL), assistive technology, and inclusive education, the existing literature remains conceptually fragmented because these domains are frequently investigated independently (Bray et al., 2024; Navas-Bonilla et al., 2025; Voultsiou & Moussiades, 2025). Consequently, there remains limited theoretical guidance regarding how these diverse educational innovations can be integrated into a coherent pedagogical model for primary special education. A critical examination of the reviewed literature further reveals that existing conceptual frameworks have generally addressed educational technologies from isolated perspectives. Reviews focusing on Universal Design for Learning primarily emphasise accessibility and instructional flexibility (Bray et al., 2024), whereas studies examining artificial intelligence concentrate on adaptive learning and personalisation (Voultsiou & Moussiades, 2025). Similarly, assistive technology research has predominantly focused on compensating for disability-specific barriers, while digital learning studies more broadly often evaluate technological effectiveness through learner engagement and academic achievement. Although these perspectives contribute valuable insights, they rarely explain how these diverse innovations collectively facilitate meaningful knowledge construction within inclusive learning environments. This fragmentation provides the theoretical justification for developing an integrated constructivist framework capable of connecting these previously disconnected research domains.

The present review argues that Constructivism Theory provides the conceptual foundation necessary to overcome this fragmentation. Unlike previous reviews that have examined individual technologies or isolated pedagogical strategies, the proposed framework conceptualises digital learning as an integrated pedagogical ecosystem in which technology functions as a mediator of learning rather than its primary determinant. Across the reviewed evidence, six constructivist principles—active knowledge construction, scaffolding, collaborative learning, authentic learning, learner autonomy, and reflective practice—consistently emerged as the pedagogical mechanisms underpinning successful inclusive

digital learning. Rather than functioning independently, these principles interact dynamically to explain how diverse educational technologies collectively support meaningful learning among students with special educational needs.

The proposed framework therefore conceptualises Constructivism Theory as the central pedagogical core from which digital learning materials should be designed. Rather than positioning technology as the primary driver of educational innovation, the framework argues that pedagogical principles should determine the selection, design, and implementation of digital technologies. This interpretation challenges technology-deterministic assumptions frequently encountered within educational technology research. For example, Voultsiou and Moussiades (2025) demonstrated that AI improves accessibility and instructional adaptation but acknowledged that its effectiveness depends heavily on teacher mediation and learner engagement. Likewise, Bray et al. (2024) concluded that UDL supports inclusive education most effectively when technological flexibility is accompanied by pedagogical intentionality. These findings collectively reinforce the proposition that digital technologies function most effectively as pedagogical mediators rather than autonomous instructional solutions.

Within the proposed framework, teacher expertise occupies a central mediating role connecting constructivist pedagogy with digital innovation. Although digital technologies increasingly provide automated feedback, adaptive learning pathways, and personalised instructional recommendations, the reviewed evidence consistently indicates that teachers remain responsible for designing authentic learning experiences, interpreting learner responses, facilitating collaborative interaction, and providing appropriate scaffolding. Abdelwahab et al. (2025) reported that structured professional development enhances teachers' capacity to integrate assistive technologies into inclusive classrooms, while Utami et al. (2025) argued that digital competence should encompass pedagogical reasoning in addition to technological proficiency. These findings extend traditional interpretations of teacher competence by suggesting that effective digital learning depends not merely on teachers' ability to operate technological systems but on their capacity to orchestrate constructivist learning processes within technology-rich environments.

Another important component of the proposed framework concerns the relationship between learner diversity and pedagogical flexibility. Primary special education is characterised by substantial variation in cognitive abilities, communication skills, behavioural characteristics, sensory functioning, and learning preferences. Consequently, instructional environments designed according to standardised pedagogical models frequently fail to accommodate learner diversity. While UDL provides multiple pathways for accessing curriculum content (Bray et al., 2024), Constructivism Theory explains how learners transform these learning opportunities into meaningful conceptual understanding through active engagement and social interaction. Similarly, assistive technologies improve functional accessibility, whereas constructivist pedagogy ensures that accessibility leads to meaningful participation rather than passive content consumption. This distinction is theoretically significant because it positions technology as a mechanism supporting participation, while constructivism explains the learning processes that follow participation.

The framework also reconceptualises the educational role of artificial intelligence within inclusive digital learning. Current educational discourse frequently portrays AI as an

autonomous instructional innovation capable of replacing traditional teaching practices through intelligent tutoring systems, predictive learning analytics, and adaptive content generation. However, the reviewed literature challenges this assumption. While AI enhances instructional efficiency and personalisation (Voultsiou & Moussiades, 2025), meaningful learning continues to depend upon inquiry, reflection, collaborative dialogue, and teacher-guided scaffolding. Therefore, AI should not replace constructivist pedagogy but should instead strengthen its implementation by providing timely feedback, adaptive support, and opportunities for differentiated instruction. This reinterpretation represents an important theoretical contribution because it positions AI as an extension of constructivist learning rather than an alternative pedagogical paradigm.

Based on these findings, this review proposes the Integrated Constructivist Framework for Inclusive Digital Learning Materials (ICF-IDLM) (Figure 1). The framework illustrates that Constructivism Theory functions as the pedagogical foundation underpinning the design of inclusive digital learning materials. Unlike existing conceptual models that predominantly focus on specific technological innovations, the proposed Integrated Constructivist Framework for Inclusive Digital Learning Materials (ICF-IDLM) places pedagogical theory at the centre of digital innovation. This represents the principal theoretical contribution of the present review. By positioning Constructivism Theory as the overarching framework integrating artificial intelligence, assistive technology, adaptive learning systems, multimedia resources, and Universal Design for Learning, the model provides a coherent explanation of how these technologies collectively contribute to inclusive learning rather than functioning as isolated instructional tools. Six interrelated constructivist principles—active knowledge construction, scaffolding, collaborative learning, authentic learning, learner autonomy, and reflective practice—operate as the core pedagogical processes guiding instructional design. These processes are subsequently supported by digital innovations, including artificial intelligence, assistive technology, adaptive learning systems, multimedia resources, and Universal Design for Learning. The interaction between pedagogical processes and technological affordances ultimately contributes to improved learner engagement, conceptual understanding, educational participation, self-regulated learning, and academic achievement among primary school students with special educational needs. Importantly, the framework conceptualises technology as a facilitator of constructivist learning rather than the primary determinant of educational success, thereby reinforcing the central argument advanced throughout this review.

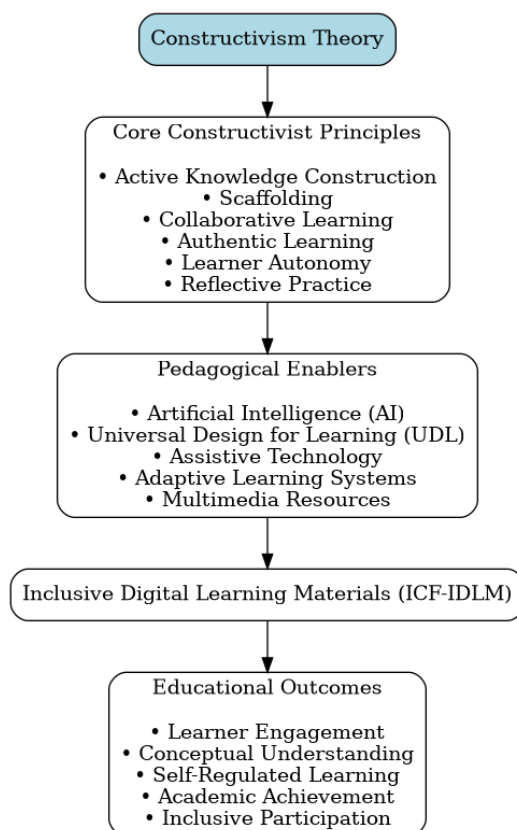


Figure 1. Integrated Constructivist Framework for Inclusive Digital Learning Materials (ICF-IDLM).

Figure 1 summarises the central argument of this review by illustrating that Constructivism Theory functions as the pedagogical foundation underpinning inclusive digital learning materials. Emerging technologies—including artificial intelligence, adaptive learning systems, assistive technologies, multimedia resources, and Universal Design for Learning—operate as pedagogical enablers that collectively facilitate learner engagement, conceptual understanding, self-regulated learning, academic achievement, and inclusive participation.

Overall, the proposed ICF-IDLM extends previous scholarship in three important ways. First, it integrates fragmented research domains that have traditionally been investigated independently within educational technology literature. Second, it repositions Constructivism Theory from a classroom-based instructional theory to an overarching pedagogical framework capable of guiding contemporary digital learning environments. Third, it provides a theoretically grounded foundation for future empirical investigations examining how emerging technologies can be designed and implemented to support inclusive education. Consequently, the framework represents not merely a synthesis of previous literature but an original conceptual contribution that advances theoretical understanding of inclusive digital learning within primary special education.

Original Contributions of the Review

Unlike previous narrative reviews that examine digital technologies from isolated perspectives, this review makes three original contributions to the field of inclusive digital education. First, it reconceptualises Constructivism Theory as an overarching pedagogical

framework integrating artificial intelligence, assistive technologies, adaptive learning systems, Universal Design for Learning, and inclusive digital learning, rather than treating these innovations as independent instructional approaches. Second, it proposes the Integrated Constructivist Framework for Inclusive Digital Learning Materials (ICF-IDLM), a theoretically grounded model explaining how six constructivist principles—active knowledge construction, scaffolding, collaborative learning, authentic learning, learner autonomy, and reflective practice—collectively mediate meaningful learning for primary school students with special educational needs. Whereas existing frameworks such as UDL and AI-in-education models are organised primarily around technological or accessibility functions (Bray et al., 2024; Voultsiou & Moussiades, 2025), ICF-IDLM instead treats pedagogy as the organising principle and technology as its mediating instrument, integrating what previous frameworks have addressed separately within a single constructivist logic. Third, it establishes a future research agenda that shifts scholarly attention from technology-centred evaluation towards theory-driven instructional design, examining not only whether educational technologies improve learning outcomes but also how pedagogical processes mediate those outcomes.

Implications for Theory, Educational Practice and Policy

Building on the constructivist argument established throughout this review, its explanatory value extends beyond traditional classroom instruction into technology-enhanced inclusive learning environments. Successful digital learning environments consistently incorporated learner-centred pedagogical characteristics regardless of the technologies employed: while D’Elia et al. (2025) and Navas-Bonilla et al. (2025) associated differentiated, participatory instructional approaches with positive outcomes for students with special educational needs, Bray et al. (2024) found that many technology initiatives remain disproportionately focused on accessibility while neglecting learner agency and collaborative knowledge construction. These findings are not contradictory but reflect complementary dimensions of the same pedagogical phenomenon: technology provides opportunities for learning, whereas constructivist pedagogy determines whether those opportunities become meaningful educational experiences. Future research should therefore examine how technological affordances interact with pedagogical principles to influence learner engagement and inclusive participation, rather than continuing to evaluate emerging technologies as isolated instructional innovations.

From a practical perspective, the reviewed evidence consistently shows that technology integration alone does not improve learning quality; teachers remain central to designing and orchestrating constructivist learning experiences. Abdelwahab et al. (2025) reported that teachers who receive structured professional development in assistive technologies are more successful in facilitating inclusive learning than those whose preparation focuses solely on technical skills, while Utami et al. (2025) argued that effective digital instruction requires integrating technological competence with pedagogical knowledge and understanding of learner diversity. These findings suggest that professional development should move beyond digital literacy training towards developing teachers’ capacity to design inquiry-based, collaborative, and reflective learning experiences supported by digital technologies—repositioning teachers as pedagogical designers rather than mere users of educational technology.

The implications for instructional design are similarly significant. Much of the current literature evaluates digital learning materials according to interface design, multimedia quality, or technological innovation; however, the evidence synthesised in this review demonstrates that these characteristics become educationally meaningful only when they facilitate constructivist learning processes. Mayer (2021) argued that multimedia environments enhance learning when instructional information supports meaningful cognitive processing, Dahl and Mørch (2025) proposed that digital learning objects should be redesigned according to learner-centred pedagogical principles rather than functioning merely as repositories of reusable content, and D’Elia et al. (2025) found that project-based and problem-based designs achieve stronger educational outcomes when digital technologies enable authentic inquiry rather than passive information delivery. Future digital learning materials should therefore be designed according to pedagogical objectives before technological considerations, ensuring that technological features support rather than determine instructional practice.

At the policy level, governments worldwide have invested substantially in digital infrastructure, yet the reviewed evidence indicates that infrastructure development alone is insufficient to achieve sustainable educational improvement. UNESCO (2023) emphasised that equitable digital transformation requires simultaneous investment in teacher professional development, curriculum innovation, and inclusive pedagogical practices, while OECD (2023) argued that successful digital transformation depends upon educational systems capable of integrating technology with evidence-based instructional approaches rather than focusing exclusively on technological provision. Educational policies should therefore evaluate digital innovation according to improvements in learner participation, educational equity, and long-term learning outcomes rather than technology adoption rates alone, balancing investment in technological infrastructure with sustained investment in teachers’ pedagogical capacity.

A further implication concerns the integration of artificial intelligence within primary special education. Although AI is increasingly promoted as a transformative innovation capable of personalising instruction and supporting adaptive learning pathways, the reviewed evidence indicates that it should function as a pedagogical support system rather than an autonomous instructional agent. Voultsiou and Moussiades (2025) highlighted AI’s considerable potential for improving accessibility and instructional adaptation, while also cautioning that meaningful learning depends upon teacher guidance, collaborative interaction, and reflective inquiry. AI should therefore be evaluated according to its contribution to constructivist learning processes rather than computational sophistication, positioning it as a tool that supports—rather than replaces—human-centred pedagogy and professional educational judgement.

Limitations of the Review

Although the present review provides a comprehensive synthesis of contemporary literature concerning Constructivism Theory and inclusive digital learning materials, several limitations should be acknowledged. First, the review focused primarily on English-language publications indexed in internationally recognised databases, potentially excluding relevant studies published in other languages or regional journals. Second, as a critical narrative review, the study emphasised conceptual interpretation and theoretical synthesis rather than statistical aggregation of empirical evidence. Consequently, the findings should be interpreted as

theoretical propositions rather than quantitative generalisations. Third, the rapid evolution of educational technologies, particularly artificial intelligence, may produce emerging evidence that extends or refines the proposed Integrated Constructivist Framework for Inclusive Digital Learning Materials (ICF-IDLM). Future systematic reviews, meta-analyses, and longitudinal empirical investigations are therefore recommended to validate and further develop the conceptual framework proposed in this review.

Conclusion

The rapid evolution of digital technologies has created unprecedented opportunities to improve teaching and learning for students with special educational needs. Nevertheless, the critical synthesis presented in this review demonstrates that the educational effectiveness of digital learning materials cannot be explained solely by technological innovation. Instead, meaningful learning emerges through the interaction of pedagogically informed instructional design, teacher expertise, learner participation, and technological affordances. Across the reviewed literature, successful digital learning environments consistently integrated constructivist principles such as active knowledge construction, scaffolding, collaborative learning, authentic learning, learner autonomy, and reflective practice, regardless of the specific technologies employed. These findings reinforce the enduring relevance of Constructivism Theory as a comprehensive pedagogical framework for inclusive digital education.

The proposed ICF-IDLM addresses these challenges by positioning technology as a pedagogical mediator rather than the primary driver of educational innovation, offering theoretical clarity for researchers and practical guidance for educators, instructional designers, and policymakers. Persistent challenges—including the predominance of technology-centred research, fragmented application of Constructivism Theory, and limited longitudinal evidence in primary special education—remain priorities for future theory-driven, design-based, and longitudinal research. Ultimately, the future of inclusive digital learning will depend not upon technological advancement alone but upon the successful integration of robust pedagogical theory with emerging educational innovations.

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