

A Critical Review of Advancing Inclusive Education in South Asia through Universal Design for Learning and Human-Centered AI

Perera, Yohan¹ and Jayavindi, Sachithra²

¹Business School, Sichuan University, Chengdu, China &

Department of Human Resources Management,

Faculty of Management and Finance, University of Colombo, Sri Lanka

²Sri Lanka Institute of Development Administration (SLIDA), Sri Lanka

Abstract

Artificial Intelligence (AI) is rapidly transforming education globally, yet its potential to foster inclusive learning in South Asia remains under-examined. This study explores how Universal Design for Learning (UDL) and Human-Centred Artificial Intelligence (HCAI) can be jointly leveraged to reduce access disparities and support learner diversity in the region. UDL promotes curricular design that anticipates learner variability, while HCAI emphasizes AI systems that are transparent, ethical, and responsive to human needs, particularly in low-resource and high-diversity settings. Using secondary data, this paper conducts a critical review of recent scholarship on inclusive pedagogy, AI in education, and South Asian educational ecosystems. The review finds that UDL-HCAI integration presents promising avenues for inclusion, including assistive technologies, multilingual interfaces, adaptive content delivery, and teacher-guided AI applications. However, persistent challenges such as infrastructure gaps, uneven digital literacy, and insufficient teacher training remain significant obstacles to equitable adoption. The study concludes that meaningful implementation requires ethical AI design, systemic support for educators, and participatory co-design with affected learner groups. It recommends piloting integrated UDL-HCAI models in real South Asian classroom contexts to assess their practical and longitudinal impact on inclusion and learning outcomes.

Keywords: artificial intelligence, human-centered AI, inclusive education, South Asia, universal design for learning

1. Introduction

Inclusive education remains a critically important topic in South Asia, where classrooms often encompass a wide diversity of learners in terms of ability, language, and socioeconomic background (Byker & Witenstein, 2024; Mishra et al., 2025). Governments in the region have committed to frameworks such as the United Nations Sustainable Development Goal 4 on equitable quality education. Yet, many students, especially those with disabilities or other learning barriers, continue to face exclusion or inadequate support (UNICEF ROSA, 2021). Universal Design for Learning (UDL) and Human-Centered Artificial Intelligence (HCAI) are two complementary frameworks that have gained global attention for addressing such challenges (Dickinson & Gronseth, 2020; Holzinger et al., 2024).

UDL is an educational framework focused on designing curriculum and instruction to accommodate all learners from the start, rather than modernizing for exceptions (UNICEF ROSA, 2021). HCAI, on the other hand, is an approach to technology (specifically, AI) design that prioritizes human needs, control, and values, ensuring AI systems augment rather than replace human capabilities (Geyer et al., 2022). Further, this review seeks not only to describe existing knowledge, but to advance conceptual understanding and practical direction for inclusive education in South Asia through the complementary lenses of UDL and HCAI. Hence, this review explores how these frameworks can postulate an inclusive, technology-supported education strategy in South Asia. This study utilizes a detailed and critical review of existing literature to synthesize insights. The focus on South Asia is motivated by the regional distinctive context, including large student populations, resource variability, and cultural considerations, which demand careful adaptation of global best practices in inclusion and educational technology (Sharma, 2025).

Furthermore, the core focus of this paper is the advancement of inclusive education in South Asia, explored through the combined frameworks of Universal Design for Learning and Human-Centred Artificial Intelligence. In line with this focus, although these frameworks have been developed

largely in separate domains, both share a common vision of equity and accessibility (Burgstahler, 2022; Cheng et al., 2022; Coffman & Draper, 2021). By analyzing prior research, policy reports, and conceptual writings, we aim to design a conceptual study framework grounded in existing knowledge that can guide future educational interventions and policies in South Asia.

To guide the analysis of existing scholarship, this review is directed by the following questions. First, how are UDL and HCAI conceptualized in existing scholarship on inclusive education, particularly in relation to learner diversity and the design of supportive learning environments? Second, what opportunities and limitations have been identified regarding the application of UDL and HCAI within South Asian learning settings? Finally, what conceptual tensions, contradictions, or research gaps emerge from existing studies, and how do these insights inform directions for future scholarship and educational practice? Thus, this review is supposed to integrate UDL and HCAI providing a realistic and context-sensitive pathway for advancing educational inclusion in South Asia despite systemic constraints by synthesizing existing research rather than diagnosing or empirically investigating a specific problem.

2. Methodology

This study adopted a secondary-data critical literature review approach. As a critical literature review, this approach emphasized not only summarizing findings but also interrogating assumptions, contrasting interpretations, and identifying conceptual tensions, contradictions, and research gaps within the literature (Fu & Weng, 2024; Lachheb et al., 2025). Relevant sources were identified through targeted keyword searches including “Universal Design for Learning,” “inclusive education,” “South Asia,” “Human-Centered AI,” “ethical AI,” “AI in education,” and “accessibility.” Materials were drawn from peer-reviewed academic databases and from major institutional publishers, capturing both conceptual perspectives and regional educational insights. An initial pool of 168 sources was identified. After relevance screening based on thematic alignment with UDL, HCAI,

and inclusive learning, 47 studies were retained for final review. Of these, 41 were peer-reviewed articles, 3 were reports of UNICEF and UNESCO, 2 were parliamentary legislative/policy acts, and 1 was an applied industry report. Foundational theoretical writings were included alongside newer empirical contributions, especially where recent AI-related developments supported to the interpretive depth.

Further, the analysis involved a narrative and critical synthesis of findings. We examined UDL and HCAI scholarship separately to distill core conceptual insights and then drew upon regional sources to contextualize these frameworks within South Asian learning realities (e.g., teacher capacity, socio-linguistic diversity, infrastructural constraints). Ethical considerations were minimal given the reliance on published material, though attention was paid to author positionality and cross-verification of claims. The reviewed literature spans recent contributions from 2020 to 2025 and includes conceptual, empirical, and policy sources relevant to inclusive pedagogy and human-centered AI.

3. Theoretical Frameworks

Mainly, we outline the two theoretical frameworks that underpin our study: Universal Design for Learning (Rose & Meyer, 2002) and Human-Centered Artificial Intelligence (Shneiderman, 2020). Each is discussed in terms of its origin, core principles, and relevance to inclusive education. These frameworks will later be used as lenses through which to interpret the literature on South Asia.

3.1 Universal Design for Learning (UDL)

Universal Design for Learning is a research-based framework developed to guide the design of inclusive educational environments (Rose & Meyer, 2002). Originating from the broader concept of universal design in architecture, UDL applies similar principles to curriculum and instruction (Doyle et al., 2025). The fundamental premise of UDL is that learner diversity is the norm, not the exception (Morgan, 2024). Every student

learns in a unique way, and curricula should be designed from the outset to accommodate this variability (UNICEF ROSA, 2021). Rather than trying to ‘fix’ the student or make after-the-fact accommodations, UDL focuses on fixing the curriculum by removing barriers to learning (Moore, 2007). It is a rights-based approach that strives to make learning accessible to all students, especially those who have historically been marginalized by one-size-fits-all teaching methods (Coffman & Draper, 2021; UNICEF ROSA, 2021). Empirically, this means anticipating a wide range of needs (due to disabilities, language differences, cultural backgrounds, etc.) and proactively offering multiple ways for students to engage with content and show their learning (Eyland & Leung, 2025). UDL is operationalized through three core principles, which serve as guidelines for educators and instructional designers (Rose & Meyer, 2002; Moore, 2007; UNICEF ROSA, 2021):

- **Multiple means of representation:** Provide flexible ways of presenting or explaining information and content. This principle acknowledges that learners perceive and comprehend information differently, so key content should be available in multiple formats in terms of text, audio, and visuals.
- **Multiple means of action and expression:** Allow flexible options for students to demonstrate what they have learned. Students differ in how they navigate learning environments and express their knowledge. Therefore, UDL encourages offering choices (such as writing an essay, creating a video, or doing a presentation) so that assessment is not limited to one modality.
- **Multiple means of engagement:** Use diverse methods to motivate and involve learners. Recognizing that students are motivated by different interests and rewards, this principle suggests providing various ways to stimulate interest and sustain effort (e.g. real-world problem examples, collaborative activities, game-based learning, etc.).

By applying these principles, UDL aims to avoid a ‘one-size-fits-all’ curriculum and build a flexible curriculum where barriers are identified and addressed within the instructional design itself (Burgstahler, 2022; Gilmore et al., 2022). For example, a UDL-based lesson plan might include captions or transcripts for video materials by anticipating the needs of students with hearing impairments or those who learn better through reading, or it might incorporate both individual and group tasks in order to suit learners who thrive in different social settings (Leung et al., 2023). This approach not only benefits students with disabilities but also includes all learners. It can support students facing language barriers, those from different cultural backgrounds, or any learner who might be disengaged by traditional methods (Vučković & Sikimić, 2024). Research and policy literature emphasize that UDL is about addressing systemic inequality in education by redesigning learning experiences to be equitable and flexible (Emeka et al., 2025).

The importance of UDL has been increasingly recognized worldwide as a cornerstone of inclusive education and practice. UNESCO Global Education Monitoring Report (2020), for instance, strongly recommends the adoption of UDL at the government level so that it becomes an integral part of inclusive education policies of the country (Song et al., 2024). This endorsement highlights the view that UDL offers a concrete strategy for implementing commitments of inclusive education in international frameworks, such as the Convention on the Rights of Persons with Disabilities (CRPD) and Education 2030 (UNESCO, 2016). However, implementing UDL often requires significant teacher training, curriculum redesign, and resource development (Han & Lei, 2025).

Moreover, evidence suggests that UDL-based instruction can improve student outcomes and reduce achievement gaps (Gilmore et al., 2022). But in Low-and Middle-Income Countries (LMICs), a category that includes most of South Asia, there is minimal evidence and guidance on effective UDL implementation (Sharma, 2025). This gap in research suggests that while UDL principles are universal, educators in resource-constrained

settings may need tailored strategies and capacity-building to make UDL a reality. Our literature review will explore this issue further in the South Asian context (Kataria et al., (2025)). Hence, UDL provides a pedagogical foundation for inclusion by addressing learner variability through flexible design. However, pedagogy alone cannot overcome structural constraints in South Asia. This is where HCAI, as a technology design paradigm which offers complementary support for enabling scalable, personalized inclusion.

3.2 Human-Centered Artificial Intelligence (HCAI)

While UDL focuses on designing learner-centered pedagogy, HCAI brings a parallel set of tools and principles for designing learner-centered technology. Together, they address both instructional design and technological augmentation. Human-Centered AI (HCAI) emphasizes designing AI systems around human needs, values, and well-being rather than prioritizing automation for its own sake (Shneiderman, 2020; Abaddi, 2025). Rather than replacing human judgment, HCAI positions AI as a tool to augment human capabilities (Geyer et al., 2022). This requires human involvement in system design, transparency of algorithms, and retention of meaningful human oversight and decision authority (De Silva et al., 2025; Begum & Elahi, 2025). Several key principles have been articulated to characterize HCAI as documented by De Silva et al. (2025) and Shneiderman (2020) as illustrated by figure 1.

Figure 1

Key HCAI Principles Guiding Inclusive AI Integration in South Asian Education Systems, Supporting Human Oversight, Fairness, and Collaborative Learning Augmentation

Augmentation over Automation	AI should enhance human decision-making rather than replace it, with teachers retaining final pedagogical authority (Troussas et al., 2025).
User Control and Customization	Users must be able to understand, adjust, and override AI functions, ensuring meaningful human control (Tzirides et al., 2024).
Fairness and Bias Mitigation	AI should be designed to minimize bias and ensure equitable outcomes through careful dataset curation and ethical safeguards (Shao et al., 2024).
Human–AI Collaboration	AI and humans should work synergistically, with AI handling routine tasks while educators focus on mentorship and higher-order instruction (Cheng et al., 2025; Cao, 2025; Fu & Weng, 2024).

Underlying these principles is a philosophy articulated by experts like Shneiderman (2020) that HCAI systems should “augment, amplify, empower, and enhance humans rather than replace them” (Shneiderman, 2020). When AI is developed with this mindset, it can lead to technology that is safer, more transparent, and more trustworthy (HCIL, 2022). In contrast to ‘dystopian’ fears of autonomous systems overtaking human roles or making inscrutable decisions, HCAI aims for AI that people can understand and manage (Lachheb et al., 2025). An HCAI approach thus helps reduce the risk of ‘out-of-control’ technologies and aligns AI development with human values such as dignity, creativity, and agency (Shneiderman, 2020). It also places importance on ethical considerations (privacy, accountability, transparency) from the design stage onward, effectively bridging the gap between AI ethics and practical system design (Lund et al., 2025; Selvaratnam & Venaruzzo, 2024).

In educational context, HCAI translates into AI-driven tools and platforms that are designed with teachers and learners at the center (Verma et al., 2025). UNESCO has explicitly called for a human-centered approach to AI in education to ensure that the introduction of AI does not inadvertently widen existing educational divides (UNESCO, 2020). A human-centered paradigm in educational AI would ensure that technologies address real educational needs, such as helping struggling readers, personalizing learning for different paces, and supporting children with disabilities, while preserving the roles of educators and protecting student rights (Vučković & Sikimić, 2024). It also requires that these AI systems operate transparently and equitably (Lund et al., 2025). For instance, if an algorithm recommends certain learning materials or flags students at risk, the rationale should be explainable to teachers, and the system performance should be consistent across different student demographics.

To summarize, HCAI provides a design and governance framework for AI that prioritizes human well-being, agency, and fairness in high-stakes fields, such as education, where AI interventions can significantly influence life opportunities (Nkwo et al., 2025). The next sections of this review will explore how HCAI principles intersect with the drive for inclusive education, and why combining HCAI with UDL could be a promising strategy in South Asia. However, we consider the regional context: what challenges and opportunities exist in South Asia that such a combined framework would need to account for.

4. Inclusive Education in South Asia: Context and Challenges

South Asia, encompassing India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan, the Maldives, and Afghanistan, is home to nearly 600 million school-aged children, presenting both a tremendous opportunity and a challenge for inclusive education (Mishra et al., 2024; Sharma, 2025). Many South Asian nations have adopted policies of “Education for All” in recent decades and have ratified international commitments, such as the

Convention on the Rights of Persons with Disabilities (CRPD) (Byker & Witenstein, 2024). There is growing recognition of the rights of all children to equitable education. For example, India's Rights of Persons with Disabilities Act (2016) and national education policies in countries like the Maldives explicitly mention concepts of universal design and accommodations to facilitate inclusion (Parliament of India, 2016; UNICEF ROSA, 2021). Sri Lanka's policy shifted terminology from 'special education' to 'inclusive education' as early as 2003, reflecting a conceptual move toward integration (UNICEF ROSA, 2021). Despite these positive policy frameworks, the implementation on the ground often falls short.

Resource constraints and capacity gaps are significant barriers. A UNICEF regional study reports that across South Asia, there is a general lack of accessible learning materials and assistive devices for children with disabilities, especially in rural or remote areas (UNICEF ROSA, 2021). Even where materials like Braille textbooks, audio resources, or augmentative communication tools exist, they may not reach all schools or learners who need them (Byker & Witenstein, 2024). Furthermore, there is a lack of flexible and adaptable teaching and learning materials, which is linked to a deficiency of teacher training on universal design principles and inclusive pedagogies (Dickinson & Gronseth, 2020; UNICEF ROSA, 2021). In other words, many teachers in South Asia have not been equipped with strategies to modify their curriculum or utilize multiple means of representation/engagement (Han & Lei, 2025; Lachheb et al., 2025). Rigid curricula and high-stakes examination systems prevalent in the region can also limit teacher-autonomy in implementing UDL-like flexibility in their classrooms (Mishra et al., 2024).

Another challenge is that inclusive education efforts in South Asia have historically focused narrowly on disability access, neglecting broader dimensions of learner diversity (Hossain, 2025; Kataria et al., 2025). While bringing children with disabilities into mainstream schools is a critical first step (Emeka et al., 2025). However, true inclusion requires changes in teaching methods and materials, which is where UDL principles become

relevant (Gilmore et al., 2022; Kataria et al., 2025). However, evidence of UDL implementation in low-income contexts is scarce, and South Asia is no exception (Omidvar & Meihami, 2025). Innovations in inclusive pedagogy often originate from small-scale pilot projects but scaling these initiatives within public education systems remains challenging (Gilmore et al., 2022; Morgan, 2024). Teachers frequently witness large class sizes, lack of specialized support staff, and insufficient time as obstacles to differentiating instruction for diverse needs (Popov et al., 2025). This context suggests that any strategy to embed UDL in South Asia must address systemic issues, such as teacher professional development and curriculum reform, and likely requires strong policy backing and investment (Asad & Anwar, 2025; Popov et al., 2025).

Simultaneously, South Asia has seen promising grassroots initiatives and growing awareness (Abaddi, 2025). In India, for instance, reforms to UDL have been promoted in certain teacher training modules and through organisations focusing on inclusive education (Byker & Witenstein, 2024). There are documented cases where simple UDL-inspired adjustments, such as using multi-sensory teaching aids or providing lesson content in both English and the local language, could improve engagement for all students in a class, not only those with identified disabilities (Kataria et al., 2025). Across the region, community and non-governmental organisations are key drivers of inclusive education innovation, often introducing UDL concepts informally as they train teachers or develop learning materials (Hossain, 2025). The momentum is building, but these efforts remain fragmented.

Cumulatively, South Asian education landscape exhibits a tension between progressive inclusive education policies and the practical difficulties of transforming traditional education systems (Lachheb et al., 2025). The need for adaptable, learner-centered approaches is evident, and UDL offers a guiding framework for that transformation (Leung et al., 2023). The primary hurdles include inadequate teacher preparation in inclusive methods, scarcity of accessible materials, and legacy examination systems that reward uniformity over individualized learning (Kataria et al., 2025).

Recognizing these challenges is essential when considering the introduction of advanced technologies, such as AI, which we explore in the next section. If not thoughtfully deployed, technology could exacerbate disparities; but if guided by human-centered and universally designed principles, it might help leapfrog some barriers (Begum & Elahi, 2025).

5. UDL in Practice: Global Lessons and South Asian Perspectives

Global research affirms that Universal Design for Learning (UDL) significantly enhances inclusive education by promoting accessibility, learner engagement, and pedagogical innovation (Burgstahler, 2022; Doyle et al., 2025). In the Global North, UDL-based strategies, including providing content in multiple formats and offering learners diverse methods of demonstrating mastery, have reduced reliance on individualized accommodations while bolstering overall student motivation and participation (Coffman & Draper, 2021; Eyland & Leung, 2025). UDL's emphasis on learner autonomy and continuous reflection has also been shown to foster more responsive and effective teaching practices in heterogeneous classrooms (Dang et al., 2024; Hossain, 2025).

Internationally, UDL has gained policy traction, including formal adoption in U.S. federal legislation (Higher Education Opportunity Act of 2008), reflecting a growing recognition of inclusive design as a broad equity strategy addressing barriers tied not only to disability but also to poverty, language, and gender (Dang et al., 2024). In South Asia, explicit UDL implementation is limited (Kataria et al., 2025), though elements appear in NGO-led initiatives such as multisensory teaching programmes in Nepal and Bangladesh (Sharma, 2025) and assistive technology efforts in India's "Accessible India Campaign" (Mishra et al., 2024). Yet systemic application remains constrained, as teacher preparedness consistently emerges as the pivotal factor (Han & Lei, 2025), with many educators lacking training and resources to operationalize UDL in practice (Han & Lei, 2025; Ostick et al., 2025). Exam-oriented and rigid pedagogical

traditions further limit flexible, learner-centered approaches (Kataria et al., 2025). Thus, South Asia's progress requires strengthened teacher development, localized tools, and supportive pedagogical culture to move UDL from theoretical promise to meaningful classroom practice (Hossain, 2025; Kataria et al., 2025).

While the literature highlights encouraging examples of UDL-inspired practice, there remains limited systematic analysis of how such approaches scale in public education systems across South Asia. For instance, although UDL is advocated as a form of pedagogical equity (Gilmore et al., 2022; Coffman & Draper, 2021), there is comparatively little research examining implementation constraints in LMIC contexts (Review of UDL in Low- and Middle-Income Countries, 2022). Moreover, teacher readiness remains a significant barrier, as highlighted by Han & Lei (2025), who note variation in teacher beliefs and competencies regarding UDL. This suggests that the current evidence base disproportionately emphasizes theoretical promise rather than operationalized classroom outcomes in the South Asian context. However, much of the literature presents UDL as inherently transformative without sufficiently interrogating why its implementation continues to stall in South Asia. The assumption that flexible pedagogy automatically leads to inclusion needs re-examination in contexts where teacher readiness, assessment culture, and institutional constraints remain under-addressed.

6. Human-Centered AI in Education: Ensuring Inclusive and Ethical Technology

As South Asia undergoes digital transformation of education, the integration of Artificial Intelligence (AI) presents unprecedented potential to enhance educational access, personalization, and effectiveness (Verma et al., 2025). However, the implementation of AI in education must be grounded in Human-Centered Artificial Intelligence (HCAI) principles to ensure these advancements do not exacerbate existing inequalities (De Silva et al., 2025; Muthmainnah et al., 2025). A critical first step is context-sensitive design. Many AI systems are developed using Western-centric

data, rendering them ill-suited to the diverse linguistic, cultural, and curricular contexts of South Asia (Fu & Weng, 2024). Localizing AI tools by incorporating regional languages, cultural examples, and curriculum alignment is essential to prevent exclusion of marginalized learners (Holzinger et al., 2024). HCAI advocates for participatory design that involves educators, students, and local experts to ensure relevance and usability (Nkwo et al., 2025).

Infrastructure inequality remains a substantial barrier. In a region where digital divides are pronounced, AI-driven tools must be accessible offline, compatible with low-cost devices, and adaptable to low-literacy contexts (Nkwo et al., 2025; Omidvar & Meihami, 2025). Strategies such as community tech hubs, affordable device schemes, and simplified user interfaces are crucial to achieving equitable access (Ostick et al., 2025; Shao et al., 2024). The literature underscores that infrastructure planning is integral to human-centered innovation (Han & Lei, 2025). Teacher empowerment is central to HCAI (Cao, 2025). Rather than displacing educators, AI should augment their capacity by automating repetitive tasks and providing actionable insights while respecting their professional agency (Troussas et al., 2025). Teachers must be trained not only to use AI tools but to critically assess algorithmic suggestions, understand their limitations, and adapt them to their classroom realities (Verma et al., 2025). Capacity-building programmes should be prioritized across South Asia to foster AI literacy among educators (Tzirides et al., 2024).

Ethical safeguards are equally important. AI systems used in schools must protect student data, ensure transparency in decision-making, and uphold children rights (Fu & Weng, 2024; Vučković & Sikimić, 2024). Emerging global guidelines on AI ethics offer a valuable foundation for developing context-specific regulatory frameworks in South Asia, where governance structures are still maturing (Emeka et al., 2025). In summary, AI can be a powerful enabler of inclusive education in South Asia, but only when its design, deployment, and evaluation are anchored in human-centered values (Vučković & Sikimić, 2024). HCAI advocates for systems that enhance,

rather than replace, human relationships in education, ensuring that technological progress is aligned with the principles of equity, agency, and cultural integrity (Selvaratnam & Venaruzzo, 2024).

A key tension in the literature lies in the contrast between aspirations for inclusive AI and infrastructural inequity in South Asia. While HCAI frameworks advocate for ethical and user-centered design (Shneiderman, 2020; De Silva et al., 2025), many AI models deployed in education continue to reflect Western-centric assumptions and datasets (Fu & Weng, 2024; Holzinger et al., 2024). Furthermore, adoption studies such as Begum & Elahi (2025) and Omidvar & Meihami (2025) reveal persistent user-readiness gaps, indicating that enthusiasm for educational AI often exceeds actual capacity for meaningful uptake. This highlights a structural disconnect between AI's inclusive potential and its contextual usability within South Asian learning ecosystems. Yet, a recurring limitation is that the promise of AI-supported inclusion often rests on aspirational rhetoric rather than proven classroom-level evidence. While scholars emphasize HCAI design ethics and user-centric values, there remains little research demonstrating how such principles translate into everyday teaching realities across diverse South Asian learning settings.

7. Synergies Between UDL and HCAI: Designing Inclusive AI-Driven Learning

As demonstrated, UDL offers a pedagogical foundation centered on learner variability, while HCAI ensures that technology supports human agency, ethics, and accessibility (Song et al., 2024). Together, they provide a roadmap for designing AI tools that are both inclusive and effective (De Silva et al., 2025; Gilmore et al., 2022). Adaptive learning capabilities of AI align closely with UDL principles of multiple means of representation, engagement, and expression (Selvaratnam & Venaruzzo, 2024). Intelligent tutoring systems and generative AI can personalize content format, learning pace, and assessment types to suit individual learners (Abaddi, 2025). For example, an AI reading tool might switch to audio for students who learn

better through listening. These affordances can support students with disabilities and diverse learning preferences of various students (Begum & Elahi, 2025).

Assistive AI-driven technologies such as speech-to-text and predictive typing powerfully operationalize the UDL principle of representation by widening access modalities for diverse learners (Holzinger et al., 2024; Lund et al., 2025). These tools reflect inclusive design benefits of UDL for all learners (Muthmainnah et al., 2025). HCAI principles ensure these innovations remain ethical, teacher-informed, and contextually relevant (Fu & Weng, 2024; Ostick et al., 2025). Educators should be involved in co-design and customization in order to integrate AI effectively (Emeka et al., 2025). This is especially critical in South Asia, where teachers often manage large, diverse classrooms (Kataria et al., 2025). Crucially, HCAI ensures that AI remains transparent and explainable, aiding teacher trust and informed usage (Dickinson & Gronseth, 2020). Meanwhile, UDL's emphasis on timely, meaningful feedback is also amplified by AI's instant data analysis but must be contextualized with empathetic and culturally sensitive communication (Asad & Anwar, 2025).

In this region, the convergence of UDL and HCAI could help overcome systemic challenges such as teacher shortages and geographic disparities (Verma et al., 2025). However, local curriculum alignment, teacher readiness, and infrastructure must be addressed. Policymakers can support this integration by enforcing UDL-based AI standards, mandating accessibility features, and embedding inclusive AI literacy in teacher education (Vučković & Sikimić, 2024). Education systems can advance toward meaningful equity by ensuring all learners are supported in both design and practice, through the combination of UDL's inclusive pedagogy with HCAI's responsible tech design (Muthmainnah et al., 2025). However, the combined UDL-HCAI model is still largely theoretical in the literature, and its operationalization has not been tested across varying socioeconomic and infrastructural conditions in South Asia (Fu & Weng, 2024). As a result,

the coherence of this synergy remains dependent on assumptions rather than demonstrated outcomes.

8. Critical Synthesis and Identified Gaps

The core argument of this review is that neither UDL nor HCAI alone can fully address the challenges of inclusive education in South Asia, but their strategic integration can produce mutually reinforcing benefits. Across the reviewed literature, there is a clear disconnect between conceptual enthusiasm for UDL and HCAI and the practical realities of their application in South Asia. UDL's flexible curriculum design assumes teacher preparedness and institutional support (Coffman & Draper, 2021), yet teacher capacity remains uneven (Han & Lei, 2025), and institutional constraints persist (Kataria et al., 2025). Similarly, while HCAI emphasizes fairness, oversight, and humancentric design (Shneiderman, 2020; Selvaratnam & Venaruzzo, 2024), most available AI solutions are not locally developed or optimized for the cultural and linguistic conditions of South Asian education environments (Fu & Weng, 2024; Nkwo et al., 2025). Table 1 provides a synthesized mapping of the major research gaps identified in the literature on UDL and HCAI in the realm of South Asian education. It contrasts theoretical assumptions with practical constraints and highlights areas where future empirical and contextual research is required to bridge the divide between conceptual promise and real-world application.

Table 1

Identified Gaps in Literature on UDL and HCAI in South Asian Education

Gap Area	What the Literature Claims	What is Missing / Contradiction	Implication for Research
Evidence of Real-world Implementation	UDL and HCAI are theoretically promising and conceptually supported	Few empirical / classroom-based studies in South Asia to validate outcomes	Need for context-specific case studies and real-world evaluation
Teacher Readiness and Capacity	Teachers are expected to implement flexible pedagogy and AI-supported learning	Little research on actual teacher training, confidence, or competencies for UDL + AI integration	Future studies are needed on teacher training models and pedagogical transformation
Cultural and Linguistic Locality	AI has universal potential to personalize learning	Most AI systems developed using Western data and English-dominant interfaces	Need for multilingual, culturally grounded, locally trained AI tools
System-Level Educational Structures	Inclusive policies exist in South Asia	National exam-pressure, rigid curricula, and uniform assessments block UDL flexibility	More studies are needed on policy alignment and systemic constraints
Learner Perspective	UDL and AI seen from policy and teacher perspective	Lacks data on student experience, agency, and psychological safety regarding AI tools	Needed to incorporate more ethnographic, qualitative, and learner-voice research

Ethical and Governance Safeguards	HCAI emphasizes transparency, fairness, and protection	Limited research on AI ethics frameworks applied in South Asian schools	Need for privacy standards, bias auditing, and governance guidelines
Digital Infrastructure	AI requires digital readiness and access	Schools vary widely in connectivity, device access, and technical maintenance	Studies needed on infrastructural equity and adaptive deployment models

9. Conclusion

This review has rationalized that integrating UDL and HCAI provides a strategically complementary pathway for advancing inclusive education in South Asia. Together, these frameworks support alignment between instructional design and technological tools in ways that prioritize access and fairness (Song et al., 2024). However, current applications of both UDL and HCAI in South Asia remain largely conceptual, with limited practice-based validation, especially in low-resource educational settings (Fu & Weng, 2024). Persistent barriers including infrastructural disparities, teacher readiness, language diversity, and institutional governance which shape the feasibility of implementation (Han & Lei, 2025; Nkwo et al., 2025).

Moving forward, inclusive transformation cannot rely solely on conceptual enthusiasm but must be grounded in contextual realism. A justice-oriented integration of UDL and HCAI requires teacher capacity development (Kataria et al., 2025), equitable digital access and technological usability (Begum & Elahi, 2025), and transparency in AI deployment frameworks (Lund et al., 2025). Iteratively, the synergy between UDL and HCAI holds meaningful potential to contribute to more accessible, equitable, and empowering learning environments throughout South Asian educational realities (Byker & Witenstein, 2024; UNESCO, 2020).

10.Future Directions

Building on these insights, future research should prioritize generating context-rich empirical evidence. First, pilot implementations of UDL+HCAI models in real learning environments are necessary, followed by evaluation of effects on learner inclusion across ability levels, linguistic backgrounds, and socioeconomic conditions (Mishra et al., 2025; Dang et al., 2024). Such studies should verify whether theoretical frameworks translate into measurable educational equity.

Second, teacher perspectives require systematic investigation. Research on teacher readiness and digital confidence will help clarify enabling factors and barriers to adoption (Begum & Elahi, 2025; Cao, 2025; Han & Lei, 2025). This should be complemented by exploring sustainable professional development models that equip teachers to use AI ethically and pedagogically. Third, contextual differentiation is essential. Comparative studies across rural and urban settings may illuminate infrastructural inequities and differentially mediated access to AI-enhanced learning (Nkwo et al., 2025). Similarly, research linking educational inclusion with broader social equity concerns can strengthen regional policy frameworks (Emeka et al., 2025; Byker & Witenstein, 2024).

Finally, the ethical dimensions of HCAI demand continued scrutiny. Future research should also consider data privacy, algorithmic bias, and accessibility frameworks (Abaddi, 2025; Selvaratnam & Venaruzzo, 2024), and incorporate learner and community perspectives to ensure cultural legitimacy and inclusivity (Verma et al., 2025). By anchoring inquiry within South Asian sociocultural realities while engaging thoughtfully with global frameworks, future scholarship can contribute to designing educational systems that are both inclusive and responsibly AI-supported (UNESCO, 2016; HCIL, 2022).

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