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PEDAGOGICAL USE OF ARTIFICIAL INTELLIGENCE AND DIGITAL EDUCATIONAL TECHNOLOGIES TO PROMOTE ACCESSIBILITY FOR DIVYANGJAN LEARNERS

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ABSTRACT

Artificial Intelligence (AI) and Digital Educational Technologies (DETs) are transforming inclusive education worldwide. In India, the implementation of the National Education Policy (2020) has accelerated interest in using digital technologies to improve educational opportunities for Divyangjan learners. Despite this progress, challenges related to accessibility, teacher preparedness, digital inequality, and ethical concerns continue to limit effective implementation. This study systematically reviews literature published between 2010 and 2025 to examine the pedagogical role of AI in promoting inclusive education. Guided by Universal Design for Learning, TPACK, Sociocultural Theory, and the Capability Approach, the review synthesizes evidence on AI-enabled assistive technologies, adaptive learning systems, and multilingual educational platforms. The findings suggest that AI can significantly improve learning accessibility and learner autonomy when supported by inclusive policies, teacher capacity building, and ethical implementation. The study concludes with policy recommendations for integrating AI into inclusive education in India.

KEYWORDS: Artificial intelligence; Assistive technology; Divyangjan learners; Inclusive education; Digital educational technology; NEP-2020; Universal Design for Learning.

1. INTRODUCTION

Digital accessibility has emerged as one of the defining imperatives of twenty-first-century education. Globally, the World Health Organization (WHO) estimates that approximately 16% of the world's population-nearly 1.3 billion individuals-live with a significant disability (World Health Organization, 2022). In India, the 2011 Census recorded approximately 26.8 million persons with disabilities, a figure widely regarded as an undercount given definitional limitations and social stigma (Registrar General of India, 2011). More recent estimates suggest that the actual prevalence, when accounting for the expanded categories recognised by the Rights of Persons with Disabilities (RPwD) Act of 2016, may be substantially higher. These learners collectively identified as Divyangjan-a term introduced in national discourse to reflect the inherent capabilities of persons with disabilities-represent a population whose educational needs have historically been marginalised, misunderstood, and inadequately resourced.

The NEP-2020 represents a watershed moment in India's educational history, articulating a vision of universal, equitable, and inclusive learning that extends explicitly to children and youth with special needs (Ministry of Education, 2020). Among its foundational commitments, NEP-2020 recognises digital technology as a critical enabler of inclusive pedagogy, mandating investment in accessible educational software, multilingual content, assistive devices, and teacher training programs that embed technology meaningfully into special education practice. This policy orientation aligns with the global commitments of the United Nations Sustainable Development Goal 4, which calls for inclusive and equitable quality education for all (United Nations, 2015), and with the imperatives of the UN Convention on the Rights of Persons with Disabilities (CRPD, 2006), which established inclusive education as a legal obligation for signatory nations.

Artificial Intelligence (AI) and broader Digital Educational Technologies (DETs) have begun to reshape the pedagogical landscape in ways that hold particular relevance for Divyangjan learners. AI-driven tools-from Intelligent Tutoring Systems (ITS) and Natural Language Processing (NLP)-based assistants to computer vision applications and adaptive learning platforms offer unprecedented capacities for personalisation, content adaptation, real-time support, and multi-modal communication. In a country as linguistically and culturally diverse as India, where students may navigate instruction in languages other than their mother tongue

and where disability intersects with socio-economic disadvantage, these technologies represent both an opportunity and an obligation (Fitas, 2025; Chemnad & Othman, 2024).

However, the integration of AI into inclusive education is not without risk. Issues of algorithmic bias, data privacy, inadequate infrastructure in rural areas, and the persistent gap between policy aspiration and classroom reality demand critical attention (Bećirović, 2023). The promise of AI will remain largely unrealised unless it is accompanied by robust teacher training, ethical governance frameworks, participatory design processes that centre the voices of persons with disabilities, and institutional cultures genuinely committed to inclusion rather than mere compliance.

Against this backdrop, the present paper makes a threefold contribution. First, it provides a systematic and theoretically grounded synthesis of the pedagogical applications of AI and DETs for Divyangjan learners in the Indian context. Second, it critically interrogates the limitations and ethical dimensions of current approaches, resisting an uncritical techno-optimism that can obscure structural inequalities. Third, it advances a multi-stakeholder policy agenda that translates research findings into actionable recommendations for the diverse actor's policymakers, educational institutions, technology developers, and researchers who must collaborate to build genuinely inclusive educational futures.

2. Research Background and Theoretical Framework

2.1 The Global and Indian Context of Inclusive Education

Inclusive education understood as the right of all learners, including those with disabilities, to access quality education in mainstream settings with appropriate support has been progressively enshrined in international law and policy over recent decades. The 1994 Salamanca Statement established the principle that 'schools should accommodate all children regardless of their physical, intellectual, social, emotional, linguistic, or other conditions' (UNESCO, 1994, p. viii). This was subsequently reinforced by the CRPD (UN, 2006), which in Article 24 obligates state parties to ensure an inclusive education system at all levels, requiring 'reasonable accommodation' and 'individualised support' for persons with disabilities.

In India, legislative progress has been substantial. The Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act of 1995 represented the first major statutory commitment to disability rights. This was superseded by the Rights of Persons with Disabilities Act (RPwD) of 2016, which expanded the recognised categories of disability from seven to twenty-one, introduced stronger enforcement mechanisms, and

explicitly guaranteed the right to inclusive education (Ministry of Law and Justice, 2016). Concurrently, the Rehabilitation Council of India Act (1992) established standards for professionals working in special education. Yet despite this legislative scaffolding, implementation has remained deeply uneven. Studies document persistent barriers at the institutional, pedagogical, communicational, and attitudinal levels that prevent Divyangjan learners from fully participating in and benefiting from mainstream educational settings (Alves, 2019; Silva et al., 2022).

The NEP-2020 represents perhaps the most ambitious attempt yet to transform Indian education in ways that address these structural deficits. Among its key provisions for inclusion, NEP-2020 mandates the development of specialised teaching-learning materials in multiple formats and languages, the training of all teachers in inclusive practices, investment in assistive technologies, and the establishment of educational technology platforms that are accessible to students with diverse needs (Ministry of Education, 2020). Critically, NEP-2020 explicitly recognises the transformative potential of AI and digital tools for personalising learning, breaking language barriers, and supporting Divyangjan students an orientation that frames the present inquiry.

2.2 Theoretical Frameworks

2.2.1 Universal Design for Learning

Universal Design for Learning (UDL), developed by Rose and Meyer (2002) and subsequently elaborated by the Center for Applied Special Technology (CAST), offers a foundational theoretical framework for inclusive pedagogy. Drawing on neuroscience and educational research, UDL proposes that curricula should be designed from the outset to accommodate diverse learners through three core principles: providing multiple means of representation (the 'what' of learning), multiple means of action and expression (the 'how' of learning), and multiple means of engagement (the 'why' of learning). The integration of AI technologies can meaningfully enhance each of these principles: AI enables dynamic content personalisation and multi-modal representation, supports diverse modes of student interaction and expression, and can tailor motivational supports to individual learner profiles (Rose & Meyer, 2002; CAST, 2018).

2.2.2 Vygotsky's Sociocultural Theory

Vygotsky's (1978) sociocultural theory highlights the central role of social interaction and cultural mediation in cognitive development. His concept of the Zone of Proximal Development (ZPD) the space between what a learner can do independently and what they can achieve with guidance has profound implications for AI-assisted learning. AI systems

that provide personalised scaffolding, adaptive feedback, and just-in-time support can function as technological mediators that extend the ZPD for Divyangjan learners, enabling them to achieve levels of understanding and performance that might be unattainable without such assistance (Woolf, 2010). This theoretical lens also alerts us to the social dimensions of learning that AI must complement rather than supplant.

2.2.3 The TPACK Model

Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge (TPACK) model provides a framework for understanding the complex competencies teachers must develop to integrate technology effectively into their instructional practice. TPACK posits that effective technology integration requires the intersection of technological knowledge, pedagogical knowledge, and content knowledge. In the context of inclusive education for Divyangjan learners, this model must be extended to incorporate knowledge of accessibility and assistive technologies, awareness of disability-specific pedagogical adaptations, and ethical sensitivity to the diverse needs of learners with disabilities (Bećirović, 2023; Fruauff et al., 2024).

2.2.4 Sen's Capability Approach

Amartya Sen's (1999) Capability Approach offers a normative philosophical framework that reframes the purpose of educational interventions for persons with disabilities. Rather than focusing narrowly on outcomes or functionings, Sen argues that genuine social justice requires expanding the real freedoms or capabilities that individuals have to live lives they have reason to value. Applied to inclusive education, this framework demands that we evaluate AI and DET interventions not merely by whether they produce measurable learning gains, but by whether they genuinely expand the autonomy, agency, and participatory opportunities of Divyangjan learners (Nussbaum, 2011). This perspective is particularly important in the Indian context, where disability frequently intersects with poverty, caste, gender, and geographic disadvantage.

2.2.5 Habermas's Theory of Communicative Action

Habermas's (1984) Theory of Communicative Action, with its emphasis on dialogue, inter-subjectivity, and the collaborative construction of meaning, enriches the inclusive education discourse in important ways. In educational settings serving Divyangjan learners, genuine inclusion requires not only physical or digital access but the creation of communicative spaces in which all learners can participate as equals. AI-mediated communication tools when designed inclusively can lower communicative barriers and create conditions more conducive to the dialogic learning relationships that Habermas envisions. At the same time,

his framework alerts us to the risks of systems that simulate dialogue while actually foreclosing it through algorithmic standardisation.

Research Gap

Existing studies have examined AI-supported learning, assistive technologies, and inclusive education independently. However, limited research has synthesized these perspectives within the Indian context while considering recent policy developments under NEP-2020. Furthermore, few studies integrate pedagogical theories such as UDL, TPACK, Sociocultural Theory, and the Capability Approach to evaluate AI-enabled accessibility for Divyangjan learners. This study addresses these gaps through a comprehensive systematic review.

3. RESEARCH OBJECTIVES

The present study is guided by the following research objectives:

1. To systematically examine the pedagogical applications of AI and DETs designed to support Divyangjan learners across disability categories in the Indian context.
2. To critically analyse the documented impacts of AI-powered assistive technologies on learning accessibility, academic achievement, and learner autonomy for students with disabilities.
3. To evaluate the influence of AI innovations on teacher roles, professional development needs, and institutional capacities for inclusive pedagogy.
4. To formulate evidence-based policy recommendations for the equitable and ethical integration of AI in Indian inclusive education.

4. Research Design and Methodology

The present study adopts a qualitative, systematic literature review methodology, consistent with approaches established in the social sciences and education research for synthesising evidence on complex, multidisciplinary topics (Booth et al., 2012). This approach was selected as the most appropriate means to achieve the study's objectives, given the breadth of the relevant literature, the interdisciplinary nature of the field, and the absence of a sufficient body of comparable primary empirical studies from the Indian context to support a meta-analytic approach.

Literature was identified through systematic searches of the following electronic databases: ERIC, Scopus, Web of Science, PsycINFO, Google Scholar, and the Shodhganga Repository of Indian theses. Search terms included combinations of the following keywords and their synonyms: 'artificial intelligence', 'digital educational technology', 'assistive technology',

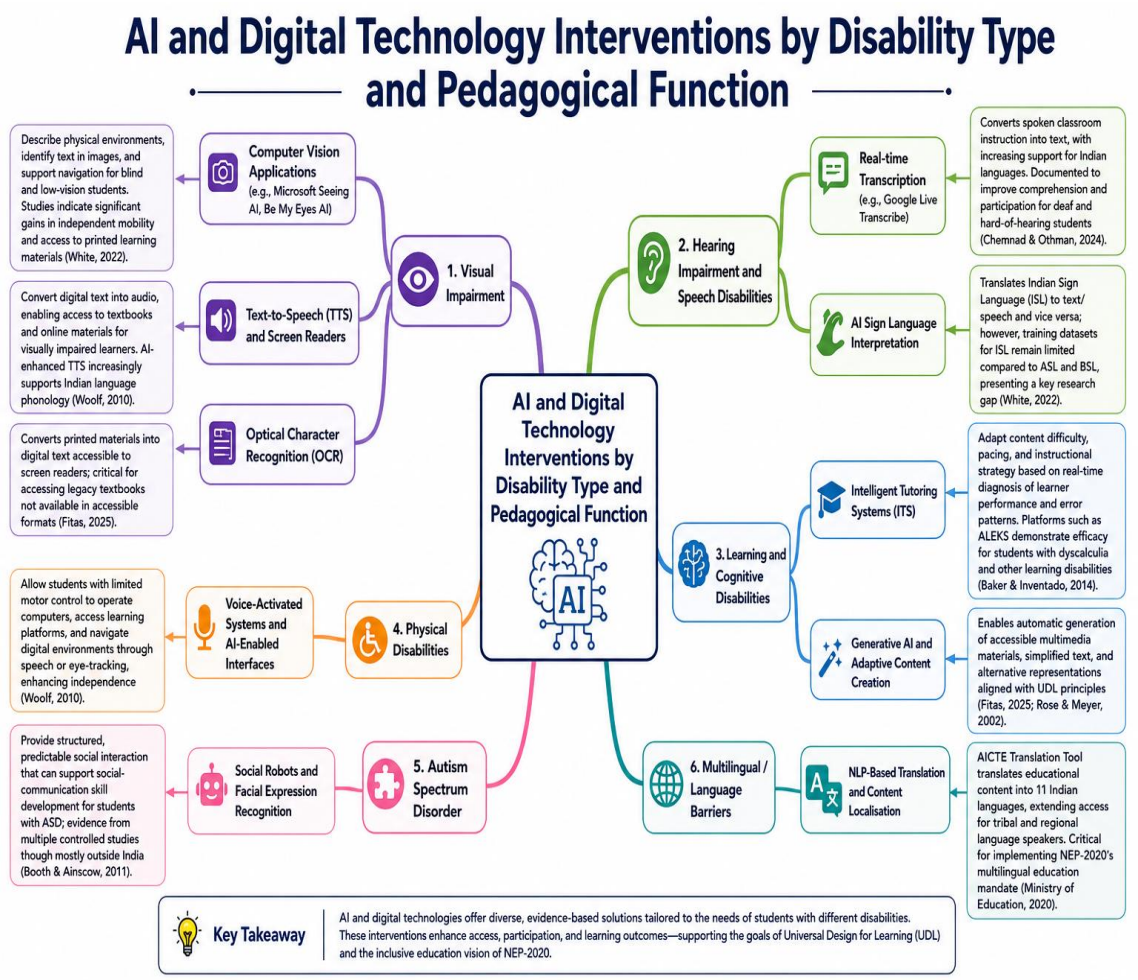
'inclusive education', 'disability', 'Divyangjan', 'Special education', 'India', 'NEP-2020', 'Universal Design for Learning', 'Natural Language Processing', 'Intelligent Tutoring Systems', and 'language barriers'. The temporal scope of the review was 2010–2025, with particular attention to post-2016 literature reflecting the RPwD Act and post-2020 literature reflecting NEP-2020.

Inclusion criteria required that sources: (a) addressed accessibility or inclusion for learners with disabilities or linguistic minorities; (b) examined pedagogical applications of AI or DETs; (c) were peer-reviewed empirical studies, systematic reviews, policy documents, or institutional reports; and (d) were published in English or Hindi, or available in English translation. Sources were excluded if they focused exclusively on technical AI development without pedagogical application, or if they addressed disability in non-educational contexts only. Following initial screening of titles and abstracts, full texts were retrieved and subjected to thematic analysis guided by the theoretical frameworks outlined above. The analysis process involved iterative coding, category development, and cross-case synthesis to identify converging themes, tensions, and gaps in the literature.

5. FINDINGS

5.1 AI and Digital Technologies for Divyangjan Learners: A Typological Overview

The literature reveals a rich and rapidly evolving ecosystem of AI and digital tools with documented or potential applications for Divyangjan learners across disability categories. Drawing on the synthesis of evidence, the following typology organises these technologies by disability type and pedagogical function.



5.2 AI-Driven Assistive Technologies in Indian Inclusive Education

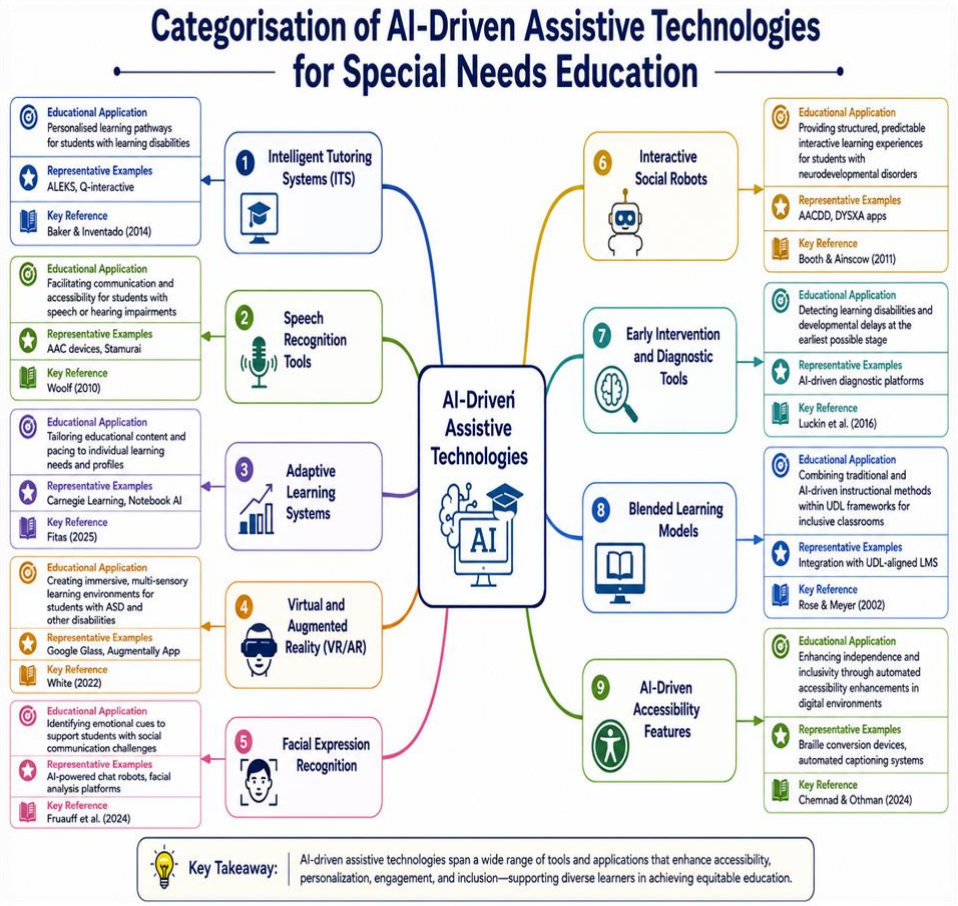
Within the Indian context, a distinctive ecosystem of AI-driven initiatives has emerged, reflecting both the scale of the challenge and the growing recognition of technology's potential to democratise education for Divyangjan learners. Three platforms merit particular attention for their demonstrated reach and impact.

I-Stem, developed at IIT Bombay, represents one of the most significant advances in accessible education technology in India. The platform employs AI to make educational content including textbooks, research papers, and examination materials accessible to students with visual impairments through automated conversion to accessible formats. Critically, I-Stem has enabled blind students to access science, technology, engineering, and mathematics (STEM) content at the higher education level, a domain traditionally regarded as almost inaccessible to this population due to the visual complexity of diagrams, equations, and laboratory materials (Fitas, 2025). The platform's recognition by international disability rights organisations underscores its significance as a model of AI-enabled educational equity.

The AssisTech Foundation (ATF) has emerged as a significant civil society actor in India's AI-for-accessibility ecosystem, explicitly positioning AI as a 'great equaliser' for persons with disabilities. ATF's work spans the development of vernacular screen readers, AI-powered alternative communication devices calibrated to Indian languages and contexts, and capacity-building programmes for special educators (Fitas, 2025). The Foundation's framing of AI as an equaliser resonates with Sen's Capability Approach insofar as it foregrounds the expansion of real freedoms rather than mere technological provision.

The AICTE Translation Tool, developed under the All India Council for Technical Education, directly addresses the language barriers that compound educational disadvantage for students from linguistic minority communities. By automating the translation of technical educational content into eleven regional languages, the tool has the potential to significantly expand access for tribal and rural students whose first language is neither Hindi nor English — two languages that dominate India's formal education system (Ministry of Education, 2020). This initiative aligns directly with NEP-2020's mandate for multilingual education and its recognition of linguistic diversity as an asset rather than a barrier.

5.3 Categorisation of AI-Driven Assistive Technologies for Special Education



5.4 Teacher Training and Institutional Capacities

A consistent finding across the reviewed literature concerns the critical role of teacher preparation in determining whether AI and assistive technologies are effectively translated into improved learning outcomes for Divyangjan students. Fruauff et al. (2024) conducted a systematic review of digital inclusive education studies and found that, while assistive technologies demonstrated positive impacts on learning, on-going teacher training remained persistently insufficient in most institutional contexts. Teachers reported low self-efficacy in using AI tools, limited understanding of disability-specific pedagogical adaptations, and inadequate institutional support for professional development.

Bećirović (2023) further identified that attitudinal barriers teachers' beliefs about the educability of students with disabilities and the appropriate role of technology in their learning were as significant as knowledge deficits in limiting effective technology integration. This finding resonates with TPACK theory's emphasis on the necessity of pedagogical and content knowledge operating alongside technological competence. Without a genuine commitment to inclusive values, technical training alone cannot produce inclusive practice (Mishra & Koehler, 2006).

Silva et al. (2022) emphasised that structured, evidence-based, and continuous professional development programs rather than isolated one-off workshops are essential to building institutional capacity for technology-enhanced inclusive education. In the Indian context, this calls for alignment between teacher education institutions, the Rehabilitation Council of India, state governments, and technology providers to co-design training programmes that embed accessibility and AI literacy within both pre-service and in-service teacher education.

5.5 NEP-2020 and the Digital Transformation of Inclusive Education

NEP-2020's vision for technology-enabled inclusive education provides an important policy framework for contextualising the present findings. The policy explicitly mandates the development of accessible educational software and content in multiple Indian languages, the training of special educators and general teachers in assistive technology use, and the establishment of the National Educational Technology Forum (NETF) as a body for guiding evidence-based technology integration (Ministry of Education, 2020). These commitments create institutional opportunities for the systematised deployment of AI tools in service of Divyangjan learners.

Critically, NEP-2020 frames digital technology not as a supplement to inclusive pedagogy but as a fundamental enabling condition for the realisation of educational equity. This framing represents a significant advancement over previous policies, which tended to treat

assistive technology as a specialist provision for a narrow category of 'disabled' students rather than as a dimension of universal educational design (Booth & Ainscow, 2011). The alignment of NEP-2020 with UDL principles creates a policy basis for embedding AI-driven accessibility into mainstream educational planning rather than relegating it to the margins of special education.

However, the gap between policy aspiration and implementation remains considerable. Recent assessments indicate that the majority of Indian schools, particularly in rural and tribal areas, lack the infrastructure, qualified personnel, and institutional cultures necessary to realise NEP-2020's inclusive technology vision (Leite, 2025). Bridging this gap will require sustained investment, multi-stakeholder collaboration, and a commitment to prioritising the most marginalised learners including Divyangjan students from socio-economically disadvantaged backgrounds in the allocation of resources.

5.6 Ethical Dimensions and Critical Challenges

Any credible account of AI's potential for inclusive education must engage critically with the ethical challenges and risks that its deployment entails. The present synthesis identifies five primary domains of concern.

First, algorithmic bias poses a systemic risk. AI systems trained predominantly on data from non-disabled, Standard English-speaking, Western users may perform poorly or actively disadvantage Divyangjan learners, linguistic minorities, and students from non-dominant cultural backgrounds (Chemnad & Othman, 2024). Speech recognition systems, for example, have documented lower accuracy rates for speakers with dysarthria, regional accents, or non-native prosody. Addressing this requires deliberate investment in diverse, inclusive training datasets and on-going algorithmic auditing.

Second, data privacy presents acute concerns in the educational context, where AI systems may collect sensitive information about disability status, learning difficulties, and behavioural patterns. In India, the relatively nascent state of data protection regulation the Digital Personal Data Protection Act of 2023 is still being operationalized creates risks of commercial misuse of student data (Ministry of Electronics and Information Technology, 2023). Educational institutions and technology providers must ensure that data governance frameworks are robust, transparent, and oriented towards student protection rather than commercial advantage.

Third, the digital divide risks reproducing and deepening existing inequalities if AI tools are deployed in well-resourced urban schools while rural, tribal, and economically marginalised schools are left without equivalent access. The intersectionality of disability with poverty,

caste, and geographic disadvantage means that the students who most need accessible education technologies are often the least likely to have access to them (Sen, 1999).

Fourth, the risk of over-reliance on AI in ways that reduce human interaction and the social dimensions of learning must be actively managed. Vygotsky's (1978) emphasis on the social construction of knowledge reminds us that technology should amplify rather than replace the human relationships that are central to meaningful learning. Habermas's (1984) communicative ethics similarly cautions against technological mediation that forecloses genuine dialogue.

Fifth, the absence of participatory design practices in which Divyangjan learners themselves are meaningfully involved in the development, testing, and evaluation of AI tools undermines both the effectiveness and the legitimacy of these technologies. White (2022) argues compellingly that human-AI partnerships in education are most powerful when the human partner retains genuine agency, and that this requires design processes that centre user voice from the earliest stages.

6. Policy Recommendations for Equitable AI Integration in Inclusive Education

6.1 For Policymakers and Educational Authorities

Policymakers must translate NEP-2020's inclusive technology vision into actionable, resourced commitments. This requires multi-year funding allocations for digital infrastructure in underserved schools, with explicit equity provisions ensuring that rural, tribal, and economically marginalised institutions are prioritised. Public procurement policies should mandate that AI educational tools meet minimum accessibility standards (equivalent to WCAG 2.1 or higher), support Indian language varieties, and have undergone testing with diverse disability populations. Legislation should require periodic independent audits of AI systems deployed in educational contexts to assess accuracy, bias, and effectiveness across learner groups. Data governance frameworks aligned with India's evolving Digital Personal Data Protection Act must be extended explicitly to educational AI, with strong protections for sensitive disability-related data (Ministry of Electronics and Information Technology, 2023).

6.2 For Educational Institutions

Institutions must develop integrated AI implementation strategies that embed assistive technology within inclusive pedagogy rather than treating it as a supplementary provision. Inclusive education committees should include members with expertise in disability, technology, and pedagogy, and should be empowered to conduct accessibility audits of learning environments and digital platforms. Professional development programs for teachers

should be redesigned to include hands-on AI literacy training, disability awareness, and supervised practice in UDL-aligned technology integration. These programs should reflect the TPACK model's emphasis on the intersection of technological, pedagogical, and content knowledge, extended to incorporate accessibility knowledge as a distinct competency domain (Mishra & Koehler, 2006). Institutions should adopt UDL as the organising framework for all technology procurement and pedagogical planning, ensuring that AI tools benefit all learners from the outset of their design rather than as retrospective accommodations.

6.3 For AI Developers and EdTech Providers

Technology developers must prioritise inclusive design — or 'ethical-by-design' principles — from the earliest stages of product development. Co-design processes that meaningfully involve persons with disabilities, including Divyangjan users with diverse disability experiences and linguistic backgrounds, should be built into product development lifecycles. NLP and speech recognition models must be trained on diverse Indian language datasets, including regional varieties and the speech patterns of users with communication disabilities. User interfaces must be tested against international accessibility standards, and regular algorithmic audits should be conducted to identify and mitigate bias. Interoperability with existing Learning Management Systems and assistive technologies in use in Indian schools should be prioritised to avoid creating siloed, non-compatible solutions. Transparent data usage disclosures, parental and institutional consent mechanisms, and clear opt-out provisions should be built into platform architecture.

6.4 For Researchers

The present review identifies several critical research gaps that future investigation must address. Longitudinal studies examining the sustained impacts of AI-powered learning on academic achievement, psychological wellbeing, and post-school outcomes for Divyangjan students in India are urgently needed. Comparative research across socio-economic, regional, and cultural contexts will enable more nuanced understanding of the conditions under which AI tools are most effective and equitable. Participatory action research designs in which Divyangjan learners are co-researchers as well as participants are particularly warranted, both for their epistemic value and for the ethical commitments they embody. Research on the Indian Sign Language recognition corpus, regional language assistive technologies, and the intersection of disability with caste, gender, and geographic disadvantage represents a particularly important area for investigation.

7. CONCLUSION

This paper has offered a theoretically grounded, critically engaged synthesis of the pedagogical applications of AI and Digital Educational Technologies for Divyangjan learners in India. The evidence reviewed supports a cautiously optimistic appraisal of AI's transformative potential for inclusive education: Intelligent Tutoring Systems, adaptive learning platforms, real-time transcription tools, computer vision applications, and NLP-based translation technologies have each demonstrated meaningful capacity to personalise learning, remove barriers, and expand the educational opportunities of students with diverse disabilities and linguistic backgrounds.

At the same time, the present analysis has underscored that this potential will remain unrealised or worse, will be actively undermined unless AI integration is guided by robust ethical frameworks, genuine commitment to inclusive design, sustained investment in teacher professional development, equitable infrastructure provision, and the active participation of Divyangjan learners in shaping the technologies that affect their lives. The theoretical frameworks brought to bear in this paper UDL, Vygotsky's sociocultural theory, TPACK, Sen's Capability Approach, and Habermas's communicative ethics together provide a rich normative architecture for evaluating and guiding these interventions beyond the narrow metrics of efficiency or test score improvement.

India's context is distinctive in ways that demand context-specific analysis and solutions. The country's extraordinary linguistic diversity, the intersection of disability with caste and poverty, the infrastructural disparities between urban and rural educational settings, and the cultural dimensions of disability identification and disclosure all shape how AI tools can and should be deployed. The ambitious vision of NEP-2020 provides an important policy framework, but its realisation requires the sustained collaborative effort of policymakers, institutions, developers, teachers, researchers, and most importantly the Divyangjan learners whose educational futures are at stake.

In conclusion, AI-driven inclusive education is not merely a technological challenge but a social justice imperative. The goal is not simply to digitise accessibility but to use the transformative capacities of AI to build educational environments in which every learner regardless of disability, language, or background can participate, contribute, and flourish. Meeting this goal will require the best of human creativity, ethical commitment, and collaborative endeavour, in partnership with but never superseded by the remarkable tools that artificial intelligence provides.

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