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Pedagogical pathways for embedding Indian knowledge systems in contemporary education

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Abstract
The Indian Knowledge System **(**IKS**)** represents a vast and multidisciplinary body of scientific, philosophical, ecological, and cultural wisdom cultivated over millennia in India. In the context of contemporary education, embedding IKS requires innovative pedagogical approaches that move beyond preservation toward active integration into curricula. This paper contributes by identifying and analyzing pedagogical pathways—such as digital platforms, Artificial Intelligence **(**AI**)** for translation and adaptive learning, Augmented and Virtual Reality **(**AR/VR**)** for experiential immersion, and collaborative online knowledge communities—that enable the systematic embedding of IKS into mainstream education. Reinforced by the National Education Policy **(**NEP**)** 2020, these pathways demonstrate how technology, when paired with culturally responsive teaching, creates inclusive, engaging, and accessible learning environments that bridge traditional wisdom and modern needs. The paper also evaluates key challenges, including digital inequalities, linguistic and translation barriers, limited teacher preparedness, and gaps in policy implementation. It further recommends strategies such as equitable digital infrastructure, modular multilingual content, and sustained educator training to strengthen pedagogical capacity. By foregrounding these pathways, the study illustrates how integrative pedagogies can enrich education, preserve India's intellectual heritage, and align with national visions of cultural resilience and global competitiveness.

Keywords: Indian Knowledge System (IKS), pedagogical pathways, educational technology, Indigenous knowledge, Artificial Intelligence (AI), Augmented Reality (AR), Virtual Reality (VR), National Education Policy (NEP) 2020, multilingual learning

Introduction
India's Indian Knowledge System (IKS) is a vast and multifaceted body of traditional wisdom developed over millennia, integrating Ayurveda and Siddha (traditional medical sciences), Vedic mathematics, classical performing arts, ecological consciousness, and diverse philosophical traditions such as Vedanta and Nyaya (Khan & Sharma, 2024) [2]. Far beyond a collection of facts, IKS embodies a holistic worldview—a way of understanding the interconnectedness of cultural heritage, ethics, intellectual inquiry, and practical living. Today, this knowledge remains highly relevant for addressing global challenges of health, environment, and sustainable education (Mandavkar & Baliya, 2025) [5].

Historically, however, IKS was marginalized during colonial and post-independence education reforms that privileged Western epistemologies, leaving indigenous traditions underrecognized in mainstream curricula (Kumar, 2024) [4]. Although recent policy frameworks such as the National Education Policy (NEP) 2020 emphasize the importance of IKS, systematic, research-informed methods for embedding IKS within contemporary educational pedagogy remain underdeveloped and underexplored. This highlights a critical gap between policy aspirations and practical classroom implementation.

Emerging digital technologies—including Artificial Intelligence (AI), Augmented Reality (AR), Virtual Reality (VR), and large-scale digital repositories—offer unprecedented opportunities to bridge this gap by transforming static traditional knowledge into dynamic, interactive educational experiences (Mane & Suryawanshi, 2025) [6]. These tools not only enhance accessibility but also overcome barriers of geography, language, and discipline, allowing multilingual, remote, and experiential learning across diverse learner communities.

In this context, the present study aims to conceptualize and analyze the pedagogical pathways through which technology can effectively facilitate the integration of IKS into mainstream education. By examining enabling opportunities, identifying fragile and contested pathways, and proposing strategic reinforcements, this paper seeks to provide a systematic framework that connects traditional wisdom with modern pedagogical innovation. This approach aligns with the educational philosophy of Sardar Vallabhbhai Patel, who championed value-based, inclusive education that bridges rural-urban divides and nurtures

self-reliant citizens prepared to be innovators and nation-builders (Press Information Bureau, 2019) [8].

By foregrounding these pedagogical pathways, this paper contributes to the scholarly discourse on IKS integration and offers practical insights for educators, policymakers, and technology developers committed to revitalizing India's intellectual heritage in contemporary education.

The Indian Knowledge System (IKS): An Overview

Definition and Scope

The Indian Knowledge System (IKS) encompasses a wide spectrum of traditional sciences such as Ayurveda and Siddha, indigenous mathematics including Vedic techniques, linguistics, classical literature, performing arts, diverse philosophical schools such as Vedanta, Nyaya, and Samkhya, and ecological wisdom rooted in sustainable living practices (Khan & Sharma, 2024) [2]. More than a catalog of subjects, IKS represents an **i**ntegrative worldview where knowledge is both empirical and ethical, pragmatic and spiritual, and inherently interdisciplinary. This holistic knowledge matrix is deeply embedded in India's socio-cultural fabric and provides a critical foundation for designing pedagogical pathways that honor heritage while addressing contemporary educational needs.

Relevance to Contemporary Education

In the context of modern education, IKS offers unique opportunities to embed ethical orientations, ecological sensitivity, and critical inquiry into pedagogy. IKS-based pedagogies emphasize sustainability, local responsiveness, and holistic growth that transcends rote academic learning (Mandavkar, 2025; Kumar, 2024) [5, 4]. By nurturing creativity, problem-solving, and culturally grounded innovation, IKS becomes not just content to be taught, but a pedagogical pathway for cultivating learners who can link tradition with new-age knowledge systems.

Thus, the relevance of IKS in contemporary education lies in its potential to serve as a framework of pedagogical pathways where:

- Ethics and values become integral to classroom practice,
- Experiential and practice-oriented methods replace rote memorization,
- Interdisciplinary approaches connect science, arts, and philosophy, and
- Cultural rootedness is harmonized with global knowledge systems.

In this way, IKS can move beyond preservation into a dynamic pedagogical resource, guiding how knowledge is taught, contextualized, and applied in the 21st century.

Opportunities and Challenges of Technology-IKS Integration: Pedagogical Pathways

Enabling Pedagogical Pathways

1. **Democratized Access as a Pedagogical Pathway:** Technology dismantles geographical and socio-economic barriers, extending IKS learning to diverse populations, including marginalized and rural learners (Sharma & Baliya, 2025) [9, 10]. Platforms such as DIKSHA and SWAYAM exemplify this pathway by enabling equitable access to indigenous knowledge resources.
2. **Holistic & Interdisciplinary Learning as a Pedagogical Pathway:** The fusion of traditional wisdom with modern scientific paradigms cultivates critical thinking, creativity, and ethical awareness (Kumar, 2024) [4]. This pathway demonstrates the holistic nature of IKS pedagogy.
3. **Cultural Preservation as a Pedagogical Pathway:** Digitization of endangered manuscripts, languages, and oral traditions safeguards cultural heritage while simultaneously embedding it into formal education (Mandavkar, 2025) [5].
4. **Research Expansion as a Pedagogical Pathway:** AI-driven analysis of manuscripts and big-data applications fosters cross-disciplinary exploration and innovation (Sharma & Baliya, 2025) [9, 10]. This pathway expands the scope of IKS-based pedagogy.
5. **Skill Development as a Pedagogical Pathway:** Interactive AR/VR technologies nurture culturally rooted problem-solving, innovation, and digital literacy (Khan & Sharma, 2024) [2]. This pathway links traditional learning with modern employability.
6. **Policy Support as a Pedagogical Pathway:** NEP 2020 institutionalizes IKS integration by advocating translation into regional languages, MOOCs, and the National Educational Technology Forum (NETF). This pathway gives legitimacy and direction to IKS pedagogy (Press Information Bureau, 2019) [8].

Table 1: Opportunities Presented by Technology-IKS Integration across Pedagogical Pathways

Pedagogical Pathway	Impact Description
Democratized Access	Technology dismantles geographical and socio-economic barriers, extending IKS learning to diverse populations, including marginalized and rural learners (Sharma & Baliya, 2025) [9, 10].
Holistic & Interdisciplinary Learning	Fuses traditional wisdom with modern scientific paradigms, cultivating critical thinking, creativity, and ethical awareness (Kumar, 2024) [4].
Cultural Preservation	Digitization conserves endangered manuscripts, languages, and oral traditions, ensuring intergenerational knowledge transfer (Mandavkar, 2025) [5].
Research Expansion	AI and big data tools drastically accelerate manuscript analysis, cross-disciplinary research, and innovative knowledge applications (Sharma & Baliya, 2025) [9, 10].
Skill Development	Integrative AR/VR and interactive platforms develop culturally rooted problem-solving, innovation, and digital literacy skills among learners (Khan & Sharma, 2024) [2].
Policy Support	NEP 2020 enshrines technology-IKS integration as foundational for India's educational modernization and cultural renaissance (Press Information Bureau, Government of India, 2019) [8].

Fragile, Vulnerable, or Contested Pedagogical Pathways(Challenges)

1. **Infrastructure as a Fragile Pedagogical Pathway:** Persistent inequalities in broadband access, electricity, and device availability limit equitable access to technology-enabled pedagogy, especially in rural areas (Khan & Sharma, 2024) [2].
2. **Teacher Preparedness as a Pedagogical Pathway Under Strain:** Educators often lack expertise in both IKS content and digital tools, weakening instructional effectiveness. This pathway requires urgent strengthening through professional development (Sharma & Baliya, 2025) [9, 10].
3. **Language and Translation as a Vulnerable Pedagogical Pathway:** With much IKS locked in Sanskrit and local dialects, AI-assisted translations without cultural expertise risk distortion (Kumar, 2024) [4]. This pathway remains essential yet precarious.
4. **Policy and Attitudes as a Contested Pedagogical Pathway:** Perceptions of IKS as antiquated, coupled with inconsistent institutional funding and fragmented leadership, undermine integration efforts (Mandavkar, 2025) [5].
5. **Equity and Sustainability as a Critical Pedagogical Pathway:** Unless technological updates and inclusive design are sustained, IKS pedagogy risks reinforcing caste, gender, or regional exclusion rather than dismantling it (Sharma & Baliya, 2025) [9, 10].

Table 2: Challenges in Technology-IKS Integration across Pedagogical Pathways

Fragile/Vulnerable/Contested Pedagogical Pathway	Impact Description
Infrastructure as a Fragile Pedagogical Pathway	Persistent digital divides (limited broadband, unreliable electricity, inadequate devices) create inequities in access to technology-driven IKS pedagogy, disproportionately affecting rural and marginalized learners (Khan & Sharma, 2024) [2].
Teacher Preparedness as a Pedagogical Pathway Under Strain	Many educators lack expertise in both IKS content and emerging digital pedagogies. Without sustained professional development, this results in weakened instructional quality and reduced learner engagement (Sharma & Baliya, 2025) [9, 10].
Language and Translation as a Vulnerable Pedagogical Pathway	Much of IKS resides in Sanskrit and regional languages. AI-assisted translations without cultural and contextual expertise risk misinterpretation, dilution, or distortion of meaning, thereby compromising knowledge integrity (Kumar, 2024) [4].
Policy and Attitudes as a Contested Pedagogical Pathway	Negative perceptions of IKS as outdated, coupled with inconsistent institutional support and fragmented policy leadership, hinder effective mainstreaming of technology-enabled IKS pedagogy (Mandavkar, 2025) [5].
Equity and Sustainability as a Critical Pedagogical Pathway	Without inclusive design and regular technological updating, integration initiatives risk reinforcing existing hierarchies of caste, gender, and region, undermining the democratizing goals of IKS pedagogy (Sharma & Baliya, 2025) [9, 10].

Reinforcement Pedagogical Pathways (Recommendations)

1. **Strengthening Digital Infrastructure Pathways:** Extend broadband, ensure affordable device distribution, and improve power reliability in rural and marginalized regions, reinforcing equity in access.
2. **Teacher Training as a Capacity-Building Pathway:** Establish systematic, interdisciplinary programs to build educator expertise in both IKS content and technology-enabled pedagogy.
3. **Multilingual Content as an Inclusivity Pathway:** Promote AI-assisted translation combined with expert contextualization to ensure authenticity across India's linguistic diversity.
4. **Activity-Based Curriculum as an Experiential Pathway:** Develop modular, participative, and inquiry-driven digital resources that reflect the traditional experiential nature of IKS pedagogy.
5. **Assessment and Feedback as a Reflective Pathway:** Use data-driven evaluations to continuously adapt pedagogical models for relevance and inclusivity.
6. **Equity Sensitization as a Justice Pathway:** Embed proactive strategies to address gender, caste, disability, and regional inequities, ensuring that IKS pedagogy fosters social inclusion.

Case Studies and Recent Policy Initiatives as Pedagogical Pathways

National Education Policy (NPE) 2020: Policy as a Pedagogical Pathway

The NEP 2020 institutionalizes a futuristic vision for embedding IKS by establishing the National Educational Technology Forum (NETF), advocating for the translation of educational resources into regional languages, and promoting Massive Open Online Courses (MOOCs) that incorporate indigenous knowledge domains (Press Information Bureau, Government of India, 2019) [8]. Through these measures, NEP 2020 operates as a policy-driven pedagogical pathway, legitimizing the role of IKS in contemporary education and providing a systemic framework for its integration.

Swayam and E-Pathshala: Digital Platforms as Pedagogical Pathways

National online initiatives such as SWAYAM and E-Pathshala exemplify Indo-academic-government collaborations that create accessible, peer-reviewed digital learning materials. By offering courses on Indian cultural, philosophical, and scientific heritage, these platforms democratize knowledge and operationalize pedagogical pathways for embedding IKS into classrooms nationwide (Sharma & Baliya, 2025) [9, 10]. Their reach across diverse socio-economic and geographical contexts helps situate IKS as part of mainstream curriculum delivery rather than an optional add-on.

Manuscript Digitization and AI Innovations: preservation as a Pedagogical Pathway

The National Mission for Manuscripts serves as a landmark project digitizing India's vast textual heritage. Recent AI-powered innovations—including automated translation, annotation, and categorization tools—enable dynamic

accessibility of these sources (Mandavkar, 2025) [5]. By transforming archival materials into usable pedagogical resources, this initiative creates a pathway from preservation to classroom pedagogy, ensuring learners and educators engage with authentic primary materials in relevant and interactive formats.

Critical Analysis: Strengths and Fragile Pathways

While these initiatives demonstrate powerful enabling pathways for embedding IKS, critical challenges remain. Most digital IKS experiences are limited to elite institutions, risking replication of educational disparities rather than dissolving them (Kumar, 2024) [4]. Learners' engagement often remains theoretical and sporadic rather than immersive and sustained. Without blended pedagogical approaches that combine technology-mediated learning with experiential, practice-based models, IKS integration may remain surface-level.

Additionally, large-scale translation and contextualization efforts are still insufficient. Without addressing linguistic diversity in depth, many initiatives risk narrowing inclusion (Sharma & Baliya, 2025) [9, 10]. Thus, while NEP 2020, SWAYAM, and the Manuscripts Mission act as structural and technological pedagogical pathways, their long-term success depends on reinforcement through equitable access, continuous teacher capacity-building, and culturally grounded contextualization.

Recommendations and the Way Forward

1. **Digital Infrastructure as a Pedagogical Pathway for Equity and Access:** Expanding broadband networks, ensuring affordable device distribution, and strengthening rural power reliability form the foundation for embedding IKS inclusively. This pathway dismantles geographical and socio-economic barriers, enabling equitable participation in technology-mediated IKS education.
2. **Teacher Training as a Pedagogical Pathway for Capacity Building:** Developing systematic, interdisciplinary programs to enhance educators' expertise in both IKS content and digital pedagogy is essential. By equipping teachers with culturally contextualized technological skills, this pathway transforms educators into facilitators of meaningful IKS integration.
3. **Multilingual Content as a Pedagogical Pathway for Inclusivity:** Creating AI-assisted translations and culturally nuanced contextual interpretations of IKS resources in regional languages ensures accessibility. This pathway allows learners from diverse linguistic backgrounds to engage authentically with indigenous knowledge.
4. **Modular, Participative Curriculum as a Pedagogical Pathway for Engagement:** Designing activity-based, inquiry-driven, and hands-on modules embeds IKS knowledge into learners' critical thinking and problem-solving practices. This pathway shifts from rote transmission to experiential learning, fostering innovation while remaining culturally grounded.
5. **Assessment and Feedback Systems as a Pedagogical Pathway for Continuous Improvement:** Leveraging data-driven evaluations and learner-centered feedback mechanisms ensures evidence-based refinement of IKS integration. This pathway supports sustainable pedagogical models by keeping curricula dynamic, relevant, and adaptable.
6. **Equity and Inclusion as a Pedagogical Pathway for Social Justice:** Embedding targeted strategies to address gender, caste, disability, and regional disparities ensures that IKS integration reflects social equity. This pathway ensures that IKS pedagogy empowers marginalized voices and strengthens education as a tool for inclusion.

Conclusion

The integration of technology with the Indian Knowledge System is not merely a modernization effort; it is a pedagogical reimagining of how IKS can be systematically embedded into education for twenty-first-century learners**.** By identifying concrete pedagogical pathways—digital platforms, AI-assisted translation and personalization, AR/VR-based immersive learning, and collaborative online knowledge communities—this study demonstrates how timeless wisdom can be harmonized with contemporary innovations. These pathways ensure that IKS becomes an active, meaningful, and inclusive component of mainstream education, rather than remaining peripheral or symbolic.

However, realizing this vision demands sustained attention to persistent challenges. Digital divides, resource limitations, linguistic complexities, and policy implementation gaps pose significant barriers. Embedding IKS effectively thus requires expanded infrastructure, comprehensive teacher training, multilingual content development, and equity-sensitive program design**.** Such measures will make IKS pedagogy both practical and sustainable, ensuring its longevity and impact across diverse learner groups.

Ultimately, embedding IKS through carefully designed pedagogical pathways advances national goals of cultural preservation, educational innovation, and holistic development. It reaffirms Sardar Vallabhbhai Patel's vision of accessible, value-based education while aligning with NEP 2020's call for equitable, technology-enabled learning systems. By linking tradition with innovation, these pathways chart a roadmap for India's educational renaissance—fostering not merely job seekers, but culturally grounded innovators and global citizens committed to safeguarding India's intellectual and ethical heritage. In this way, pedagogy rooted in both heritage and innovation becomes a powerful driver for national unity, cultural resilience, and global competitiveness.

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