



Original Article

Bridging Heritage and Innovation: Digital Pathways for Indian Knowledge Systems

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Abstract

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India's Indigenous Knowledge Systems (IKS), encompassing Ayurveda, Yoga, Vastu Shastra, astronomy, mathematics, linguistics, and ecological practices, represent a civilizational legacy of empirical wisdom accumulated over millennia. In the 21st century, as digital technologies reshape education, research, and cultural preservation, opportunities arise to create new pathways for embedding IKS within contemporary digital infrastructures. This article investigates how digital platforms, artificial intelligence, data visualization, immersive media, and open-access repositories can foster the documentation, dissemination, and application of Indian Knowledge Systems in academic, healthcare, and societal contexts. Drawing from policy frameworks such as the National Education Policy 2020, stakeholder perspectives, and global best practices, the paper conceptualizes "digital pathways" as multidimensional strategies integrating heritage knowledge with innovation-driven ecosystems. A qualitative and analytical approach is employed, using a review of 30 scholarly sources and a comparative framework contrasting traditional IKS practices with digital adaptation models. Findings reveal that while digitization offers tools for preservation, access, and pedagogy, challenges persist regarding intellectual property rights, standardization of knowledge, and contextual authenticity. Results highlight the potential of interdisciplinary collaborations, digital heritage repositories, and technology-enabled pedagogies to foster a hybrid ecosystem where cultural heritage and modern innovation converge. The article concludes that indigenizing digital education and research frameworks with IKS not only safeguards heritage but also addresses contemporary challenges in health, sustainability, and community resilience. The process of bridging heritage and innovation must be done with a lot of sensitivity to culture, ethical considerations and the involvement of stakeholders so that digital avenues can empower communities and still be authentic. The integration will make India a global leader in knowledge diplomacy, which promises sustainable, inclusive and culturally-based innovation in the future.

Keywords: Indian Knowledge Systems, digital heritage, innovation, National Education Policy 2020, Ayurveda, pedagogy, interdisciplinary integration, cultural sustainability.

Introduction

The Indians have deep intellectual traditions and an eclectic storehouse of Indigenous Knowledge Systems (IKS), which are what sets Indian civilization apart. IKS is based on years of observation, experimentation, communal practice, Ayurveda, Siddha, Yoga, architecture (Vastu Shastra), astronomy, mathematics, literature, linguistics and ecological knowledge. These traditions of knowledge are not simply aspects of cultural continuity but also elaborate systems of questioning nature, society and human condition. According to Moitra and Madan (2025), the incorporation of IKS in the mainstream education is getting accepted as a critical component to foster the development of the holistic learning and critical thinking in the modern education.

Over the past few decades, the production, preservation and sharing of knowledge have been redefined by digital transformation. New possibilities are provided by artificial intelligence, cloud computing, big data analytics, blockchain, and immersive media (AR/VR) in order to preserve weak manuscripts, codify oral traditions, and establish global cross-cultural learning platforms.

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The digital pathways approach underlines the ways on how such technologies could be used to connect heritage and innovation in order to make IKS relevant and accessible among new generations. As an illustration, ancient manuscripts can be preserved through digital archives, Sanskrit texts can be translated into other world languages with the assistance of AI, and VR simulations can be used to create environments of learning heritage to experience learning. National Education Policy (NEP) 2020 specifically requests mainstreaming Indian Knowledge Systems into higher education and making heritage a dynamic resource in interdisciplinary research and innovation (University Grants Commission, 2020). Conceptualizing it in this way, digitalization is not a preservation instrument but a democratization and recontextualization agent of IKS in various fields such as healthcare, environmental sustainability, architecture, and social sciences. Nevertheless, there are complicated issues with digitalizing IKS. Issues of ownership, authenticity and contextualization arise when there is mapping of cultural traditions onto a globalized digital platform. The threat of commodification or loss of meaning should be mitigated via moral theories, protection of intellectual property, and participatory paradigms of people holding knowledge. In addition, digital access differences may also intensify inequalities and it is important to create infrastructures that are inclusive and provide community involvement and benefits sharing.

The digital pathways strategy is also aligned with the world discourses on decolonizing education and epistemology. Like researchers in Africa and Latin America insist on developing indigenous epistemologies as an alternative to scientific inquiry (da Silva et al., 2023; Seehawer and Breidlid, 2021), IKS can be used in India to provide a pluralistic, sustainable, and holistic understanding of knowledge that does not replace scientific research. India can become part of the debate on sustainability, interculturality, and ethical innovation at the global level by integrating these customs into the digital context. In this article, the interface is, thus, discussed through the lens of how digital technologies may be used as facilitators of IKS. It evaluates the opportunities and challenges and strategies of developing digital pathways using structured literature review of 30 references and inspires based on stakeholder studies (Moitra and Madan, 2025). A comparative framework juxtaposes the conventional ways of looking at IKS preservation with those where technology is used, and the research results and discussion focus on policy implications, pedagogic innovations and community engagement. Finally, this paper contends that not only is heritage-meets-innovation not a technological undertaking but a cultural and ethical one. Innovation and epistemic integrity required by digital pathways must be developed. Developed in an inclusive, authentic, and strategic way, the digital pathways can guarantee that Indian Knowledge Systems can be viewed as a growing, vibrant repository of information that can inform the current discourses of problem-solving and global sustainability.

Literature Review

1. Indian Knowledge Systems and Education

Interest in Indian Knowledge Systems (IKS) has been revived by the national policies and global arguments of decolonizing education. IKS is explicitly mentioned in the National Education Policy (NEP) 2020 as the foundation of a holistic and multidisciplinary learning (University Grants Commission, 2020). Moitra and Madan (2025) highlighted that educators, learners, and administrators believe that IKS can be valuable to integrate, but there are still issues in pedagogy and implementation. Kumar (2024) pointed out that the incorporation of IKS encourages the element of critical thinking as well as cultural grounding in higher education. In a comparable manner, Banerjee (2022) highlighted IKS as one of the main pillars of NEP 2020, which seeks to reconcile heritage and modernity.

It has been suggested by scholars that IKS integration facilitates intellectual development as well as cultural sustainability (Barnhardt and Kawagley, 2008; Bruchac, 2014). Yeseraw, Melesse, and Kelkay (2023) discovered that the representation of indigenous epistemologies in curricula generated inclusivity and contextual relevance in Ethiopia. The results are consistent with the literature on pluralistic knowledge systems that emphasizes the importance of pluralistic knowledge systems in tackling societal issues (Jima, 2022; Ogunniyi, 2007).

2. Digital Heritage and Knowledge Preservation

Digital technology has been at the forefront in safeguarding eroded manuscripts, oral tradition and traditional ecological knowledge. Dorji et al. (2024) have shown that indigenous knowledge, when digitalized may lead to greater resiliency within the approach of climate adaptation. AI and natural language processing are automating Sanskrit books and making them available in multiple languages (Pandey, Rastogi, and Rawat, 2013). Similarly, VR/AR immersive technologies may be applied to create virtual heritage areas where learners will be able to experience the traditions in the real-life (Hatcher et al., 2009). According to Burford et al. (2012) intercultural learning is achievable through digital participation provided communities have their agency. The investment by India in digital preservation is demonstrated by digital repositories developed by the Ministry of Ayush (n.d.) and projects such as the National Mission of manuscripts. Nonetheless, it was proposed by Harris (2012) that technology should be integrated in pedagogical change in order to prevent superficial digitization.

3. Global Case Studies in Indigenous Knowledge Digitization

The practices in other places provide lessons on how to create IKS digital pathways. Seehawer (2018) recommended Ubuntu-grounded approaches to indigenizing research in Africa. The authors of the research article by Mavuso, Olawale, and Mkosi (2021) found that the digital integration of local epistemologies enhanced the inclusivity of curricula but had to be well supported by the institution. Pineda, Celis, and Rangel (2020) examined the implementation of sabedores (knowledge keepers) in schools via digital storytelling in Latin America. According to



Connolly et al. (2020), digital continuing education to nurses was found to be beneficial when the indigenous practices were put into the local knowledge. All of these world examples indicate that digital technologies can be used to preserve native traditions under the condition of being translated to cultural backgrounds and referred to by means of the involvement of the stakeholders.

4. Challenges in Digitizing IKS

Despite potential, digitization poses risks. Breidlid (2013) warned against commodifying indigenous knowledge under development frameworks. Nasrabadi et al. (2021) highlighted that educators often feel unprepared to implement innovative approaches involving IKS. Intellectual property rights and benefit-sharing remain unresolved, particularly in contexts where indigenous communities are marginalized (Chando et al., 2021a). Moreover, disparities in digital infrastructure risk creating exclusions. As Moitra and Madan (2025) observed, stakeholders expressed implementation hesitancy due to unclear policies and lack of digital readiness. Ogunniyi (2007) also pointed out that without culturally responsive pedagogy, attempts to merge science and IKS often falter.

5. Opportunities: Toward Digital Pathways for IKS

Both heritage and innovation need to converge using collaborative strategies. Dialogue between epistemologies was proposed by Seehawer and Breidlid (2021) as a model of combining indigenous and Western knowledge in the digital world. Dorji et al. (2024) demonstrated that digitized indigenous practices can have the direct contribution to sustainability and climate adaptation. Experiential online technologies, including simulation, online case studies, and interactive archives, are considered potential (Allen and Penuel, 2015; Chando et al., 2021b). Interdisciplinary courses with Ayurveda, data science, and AI have the potential to be a novel trend with proper policy encouragement (Ministry of Ayush, n.d.). Finally, digital paths should not only be able to keep heritage intact but enable communities to share knowledge together. Even when technology is mediating, it is important to note that indigenous knowledge should be dynamic, participatory, and community-led as Bruchac (2014) emphasized.

Research Objectives

This study aims to examine how digital technologies can serve as pathways for preserving, disseminating, and innovating Indian Knowledge Systems (IKS). Specifically, the objectives are:

- To explore the role of digital technologies (AI, digital archives, VR/AR, data platforms) in documenting and preserving IKS.
- To evaluate opportunities and challenges in integrating IKS into contemporary digital infrastructures and higher education.
- To compare traditional methods of knowledge preservation with digital pathways, identifying complementarities and gaps.
- To propose a conceptual framework for digital pathways that balance authenticity, accessibility, and innovation in IKS.
- To provide policy and pedagogical recommendations for embedding IKS in India's digital and educational ecosystem.

Methodology

This research follows a qualitative and analytical approach, inspired by exploratory frameworks used in prior studies of IKS integration (Moitra & Madan, 2025). The methodology consists of:

- **Research Design:** A thematic literature review of 30 scholarly works on IKS, digital heritage, education policy, and global indigenous knowledge digitization practices.
- **Data Sources:** Peer-reviewed journals, government reports (e.g., NEP 2020, UGC guidelines), and case studies from Africa, Latin America, and India.
- **Analytical Framework:**
 - Comparative analysis between traditional IKS preservation methods (oral traditions, manuscripts, gurukul system) and digital pathways (archives, AI, immersive technologies).
 - Stakeholder analysis highlighting roles of educators, learners, policymakers, and communities.
 - Thematic coding of literature into five categories: Education, Digital Preservation, Global Case Studies, Challenges, and Opportunities.
- **Conceptual Modeling:** Development of a "Digital Pathways Framework for IKS" that synthesizes findings into a visual schema (described in Findings).

Findings

The findings are presented in three parts: (1) A comparative table, (2) A conceptual framework figure description, and (3) Key thematic insights.

Table 1. Comparison of Traditional vs. Digital Pathways for IKS

Aspect	Traditional Pathways (Heritage)	Digital Pathways (Innovation)
Preservation	Oral transmission, palm-leaf manuscripts, community rituals	Digitized archives, AI-based translation, cloud repositories
Access	Limited to local communities, language-specific	Open access, multilingual platforms, global reach
Pedagogy	Gurukul, experiential learning, oral mentorship	E-learning, VR/AR immersive heritage classrooms
Validation	Community consensus, experiential testing	Data-driven validation, interdisciplinary peer review
Challenges	Fragility of manuscripts, limited reach, risk of extinction	Intellectual property issues, digital divide, authenticity
Opportunities	Deep cultural immersion, sustainability of practices	Scalable innovation, global collaborations, inclusivity



Key Thematic Insights

- Preservation Gains:** Digitization enables long-term conservation of manuscripts (e.g., Charaka Samhita) and makes oral traditions globally accessible.
- Pedagogical Innovation:** Digital tools can transform IKS pedagogy from passive knowledge transfer to experiential, technology-mediated learning.
- Global Relevance:** Case studies in Africa and Latin America demonstrate that digital integration of indigenous knowledge enhances resilience and inclusivity.
- Challenges Identified:** Concerns about authenticity, intellectual property, and contextualization require ethical frameworks and policy interventions.
- Opportunities:** With NEP 2020 support, India can pioneer digital pathways for IKS, positioning itself as a leader in global knowledge diplomacy.

Results and Discussion

The analysis highlights both the **transformative potential** and the **critical challenges** of building digital pathways for Indian Knowledge Systems (IKS). Results are organized into three major dimensions: preservation, pedagogy, and policy.

1. Preservation: From Fragile Manuscripts to Digital Continuity

The analysis brings out the transformative possibility and the discontinuity of the digital ways to build Indian Knowledge Systems (IKS). The findings have been tabulated under three broad categories: preservation, pedagogy and policy. The findings indicate that digitization has been effective to preserve some of the ancient manuscripts, including those deposited in the National Mission for Manuscripts. Sanskrit writings are being translated into other world languages by the use of AI-based translation models, and cloud repositories improve accessibility. Digital preservation, in contrast to traditional preservation, which relied on palm-leaf manuscripts or oral tradition, is scalable, resilient, and democratized. However, stakeholders remain concerned about authenticity and contextual fidelity (Moitra & Madan, 2025). Without community involvement, digital archives risk becoming

static "museums" of culture rather than living repositories. As Bruchac (2014) argued, indigenous knowledge must remain dynamic and participatory. This underscores the need for **community-led digitization projects**, ensuring cultural custodianship is maintained.

2. Pedagogy: Digital Learning Ecosystems for IKS

The evidence suggests that digital technologies like the simulation of immersive VR/AR are the means through which IKS can be taught in new ways. Case studies may be used as an interactive method of teaching Ayurveda concepts, and Vastu Shastra concepts may be modelled in architectural design programs. Students who have undergone this form of digital learning acquire technical and cultural literacy. However, there are still difficulties of curriculum integration. Teachers might also be reluctant because they are not trained and fear being misrepresented as pointed out by Ogunniyi (2007). Findings indicate an inconsistency between policy intention (NEP 2020) and classroom practice, which is usually explained by the lack of digital preparedness in institutions of higher education. Interdisciplinary courses and faculty development programs are then instrumental in mainstreaming digital IKS pedagogy.

3. Policy and Governance: Toward a Digital IKS Framework

From a governance perspective, results show that India's NEP 2020 provides a strong foundation for digital pathways, emphasizing inclusivity, interdisciplinarity, and heritage preservation. The University Grants Commission (2020) has also given recommendations on how to train faculty in IKS. Nevertheless, implementation reluctance is still present because of the lack of clarity in the operational frameworks, the problem of intellectual property, as well as, the insufficiency of funding mechanisms. Comparative analysis with Africa (Seehawer, 2018) and Latin America (Pineda et al., 2020) implies that the challenges can be alleviated through the multi-stakeholder collaboration between educators, policymakers, indigenous and technologists.

Table 2. Policy Challenges and Suggested Interventions

Policy Challenge	Suggested Digital Pathway Intervention
Lack of standardization	Develop national IKS digital repositories with peer-reviewed content
Intellectual property concerns	Implement blockchain-based ownership and benefit-sharing systems
Limited faculty readiness	Mandatory digital IKS training modules in teacher education
Student engagement gap	Gamified and experiential IKS learning platforms (apps, VR labs)
Risk of cultural dilution	Community-led digitization with local custodians as co-creators

4. Global and Local Relevance

Its results are in line with international discussions of decolonizing education (Seehawer & Breidlid, 2021). Indian IKS when incorporated in digital constructs can offer long-term, comprehensive solutions to health, environment, and social resilience. Locally, it is able to increase the cultural identity and empower the students with contextual knowledge and globally it is increasing the India presence in the knowledge diplomacy.

Conclusion:

This paper has discussed how digital technologies can be used to connect the heritage and innovation using Indian Knowledge Systems. The results show that although the traditional paths provided continuity of cultures, they were not always scalable and resilient. The opportunities provided by digital pathways through AI, immersive media, and cloud platforms offer the possibilities of preservation,



access and pedagogy like never before. Nevertheless, such problems as intellectual property rights, authenticity, and digital divides should be considered. Digital implementation of IKS has to be based on the collaboration of multiple stakeholders, ethical standards, and community involvement. Policymaking with NEP 2020 and UGC guidelines gives an ideal opportunity to reform education, although success requires developing digital capacity of educators and institutions.

The planned Digital Pathways Framework of IKS provides the model in which heritage knowledge (core) intermittently communicates with digital enablers (middle layer) and produces transformative effects in education, in healthcare, and in sustainability (outer layer). This three-level model will ensure that the heritage is not substituted with innovation but redefined in it so that IKS can continue being a living, developing system of knowledge. To sum up, the process of connecting the past and the present via online avenues is not only a technological activity, but a cultural and moral quest, as well. When adopted in an inclusive manner, the digital IKS strategy of India can enhance the Global cultural resilience, promote sustainable innovation, and redefine the India civilizational identity as the global knowledge leader of tomorrow.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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