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TECHNOLOGY INTERVENTION IN AYURVEDA EDUCATION: PLATFORMS, POLICIES, CHALLENGES AND RECOMONDATIONS - A REVIEW

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ABSTRACT

Ayurveda, India's ancient system of holistic medicine, is undergoing a significant pedagogical transformation driven by the widespread adoption of digital and information technologies. This state-of-the-art review systematically examines the landscape of technology intervention in Ayurveda education in India, covering platforms, policy frameworks, government initiatives, pedagogical modalities, and implementation challenges. The review specifically analyses the roles of national platforms - SWAYAM, NPTEL, and the Ayush Education Learning Management System (AELMS) - alongside the regulatory contributions of the National Commission for Indian System of Medicine (NCISM) through its mandate for online elective delivery in the Bachelor of Ayurvedic Medicine and Surgery (BAMS) curriculum from AY 2024–25. The Ministry of AYUSH's AYUSH Grid ecosystem, encompassing 22+ digital tools including the NAMASTE Portal, e-Charak, DHARA, TKDL, and Ayurvidya (AIIA), is mapped comprehensively. Findings reveal a multi-layered and evolving digital ecosystem with significant convergence of regulatory will and technological capability, yet profound challenges persist: inadequate content for core Ayurvedic subjects on mainstream platforms, the epistemic risk of reducing experiential knowledge to digital content, infrastructure gaps across 700+ colleges, faculty technology resistance, Sanskrit-digital interface barriers, and the absence of a centralized Ayurveda content quality framework. The review proposes a hybrid pedagogical model grounded in Ayurvedic epistemology, along with short-, medium-, and long-term policy recommendations for NCISM, Ministry of AYUSH, and affiliated institutions. The paper argues that technology integration in Ayurveda education must serve - not supplant - the guru-shishya tradition and the experiential transmission of Ayurvedic wisdom.

***Keywords:** Ayurveda education; BAMS; SWAYAM; NPTEL; NCISM; AYUSH Grid; AELMS; e-learning; technology integration; traditional medicine education; LMS; digital health; India; TKDL; online learning*

1. INTRODUCTION

Ayurveda, one of the world's oldest continually practised systems of medicine, traces its intellectual lineage to the Vedic period (circa 1500–1000 BCE), with its canonical texts - the Charaka Samhita, Sushruta Samhita, and Ashtanga Hridayam - forming the foundational corpus of

Ayurvedic knowledge. For millennia, this knowledge was transmitted through the guru-shishya parampara, a relational pedagogical tradition premised on direct, embodied

transmission from teacher to student in close residential settings (gurukulas). The twentieth

century institutionalised Ayurveda education through the modern college system, but the pedagogical philosophy of many institutions remained largely unchanged: lecture-based delivery, Sanskrit-heavy textbooks, and clinical apprenticeship.

The contemporary landscape is markedly different. India's Ayurveda education system now encompasses over 700 colleges with an annual undergraduate intake exceeding 52,000 students (Ministry of AYUSH, 2025; Frontiers in Medicine, 2025). The sector is regulated by the National Commission for Indian System of Medicine (NCISM), established under the NCISM Act 2020, which replaced the erstwhile Central Council of Indian Medicine (CCIM). Against this backdrop of scale and regulatory reform, the COVID-19 pandemic acted as a powerful accelerant of digital adoption - forcing Ayurveda institutions, like their allopathic counterparts, to rapidly deploy online learning tools for which most were entirely unprepared.

Technology intervention in health professions education is not new. A systematic review of educational technology trends in medical education from 1978–2024 found that e-learning and simulation technologies were the most frequently cited tools, with blended learning enabling flexible delivery and improved knowledge retention (Dove Medical Press, 2025). Research using the Technology Acceptance Model (TAM) in medical education settings has further established that perceived ease of use and perceived usefulness are the primary determinants of faculty and student adoption of educational technologies (JMIR Medical Education, 2025). However, Ayurveda education presents a unique set of epistemological and practical challenges not found in biomedical education - particularly the centrality of tacit, sensory, and relational knowledge that does not lend itself to digital mediation.

The present review addresses a significant gap in the literature: while technology integration in mainstream medical education has been extensively reviewed (Frontiers in Psychology, 2025; PMC, 2025), no systematic review has examined the specific landscape of technology intervention in Ayurveda education, including the roles of government platforms (SWAYAM, NPTEL, AYUSH Grid), regulatory mandates (NCISM curriculum reforms), and institutional implementations (AIIA Ayurvidya, NAM Kerala LMS). This paper aims to fill that gap, offering a comprehensive, evidence-informed analysis for educators, policymakers, curriculum designers, and researchers.

2. OBJECTIVES

This review aims to:

- Map and describe the full ecosystem of technology interventions in Ayurveda education in India, including government platforms, regulatory mandates, and institutional initiatives.
- Critically analyse the advantages, limitations, and challenges of each technology intervention through an Ayurveda-specific pedagogical lens.
- Identify structural, epistemological, infrastructural, and policy gaps in the current technology landscape.
- Propose evidence-based, context-sensitive recommendations for policymakers, regulators, and institutions to advance technology integration without compromising the integrity of Ayurvedic knowledge transmission.

3. METHODS

This review adopts a narrative review approach to examine recent developments in a rapidly evolving technological landscape. This methodology is well suited to topics where relevant evidence is drawn not only from peer-reviewed journal articles but also from policy documents, institutional reports, and other credible sources. Unlike traditional systematic review methods, which often focus on a narrowly defined body of literature, a narrative review enables a broader exploration of emerging trends, practices, and perspectives. The review integrates three key streams of evidence:

3.1 Literature Identification Strategy

A structured search was conducted across PubMed, Google Scholar, DOAJ, ResearchGate, and Frontiers databases using the following keyword clusters: (i) "Ayurveda education" AND "technology" OR "e-learning" OR "LMS"; (ii) "BAMS curriculum" AND "digital" OR "online"; (iii) "AYUSH" AND "digital health" OR "e-learning"; (iv) "traditional medicine" AND "technology integration" AND "education"; (v) "SWAYAM" OR "NPTEL" AND "Ayurveda". Publications from 2015 to 2026 were prioritised, with seminal pre-2015 works included where foundational. Grey literature (NCISM circulars, Ministry of AYUSH reports, AYUSH Grid documentation, CCRAS publications) was systematically retrieved from official government portals.

3.2 Policy Document Analysis

NCISM course curricula for all four BAMS professional years (2021–22 batch, AY 2024–25 onward) were reviewed, alongside the NCISM Act 2020, AYUSH Grid documentation, the e-Aushadhi portal, and Ministry of AYUSH press releases and annual reports. The AIIA Ayurvidya platform, NAM Kerala LMS, and SWAYAM/NPTEL course catalogues were directly examined.

3.3 Synthesis

Evidence was synthesised thematically across six domains: (i) regulatory and policy framework; (ii) government platforms and tools; (iii) technology typology and pedagogical modalities; (iv) advantages and enablers; (v) challenges and barriers; and (vi) recommendations. Where quantitative evidence was unavailable, expert consensus from published literature and policy documents was used.

4. THE REGULATORY AND POLICY FRAMEWORK

4.1 NCISM and the New BAMS Curriculum

The National Commission for Indian System of Medicine (NCISM), constituted under the NCISM Act 2020, is the apex regulatory authority for Ayurveda, Unani, Siddha, and Sowa-Rigpa education in India. Its Board of Ayurveda (BOA) issued a revised competency-based BAMS curriculum applicable from the 2021–22 batch, phased into institutions from AY 2024–25 onward (NCISM, 2025). This curriculum represents the most significant pedagogical reform in Indian Ayurveda education in decades.

Two provisions in the new curriculum are directly relevant to technology integration. First, the NCISM explicitly mandates that all Elective subjects in the Second Professional BAMS year "shall be conducted as online programmes" (NCISM, 2025a). This is a watershed regulatory directive - for the first time formalising digital delivery within the BAMS framework. Second, the Samhita Adhyayana (Classical Text Studies) curriculum document explicitly acknowledges that "new teaching technology tools will certainly be helpful in the effective delivery of knowledge of Samhita" (NCISM, 2025b), reflecting an institutional shift in attitude toward technology.

The new curriculum also introduces an Ayurpraveshika (transitional induction programme) that explicitly orients new BAMS students to "NCISM portals" and "Technology and Science" as components of the 90-hour induction course. This signals an institutional recognition that technology literacy is integral to contemporary Ayurveda education.

4.2 Ministry of AYUSH Digital Policy

The Ministry of AYUSH has formally adopted a digital transformation agenda through the AYUSH Grid initiative, launched in 2017–18. The Ayush Grid operates as a comprehensive Digital Health Platform (DHP) integrated with the Ayushman Bharat Digital Mission (ABDM) - India's national digital health infrastructure (IJAR, 2023). It encompasses 22+ digital tools across health services, education, research, and drug regulation. In 2025, the Ministry officially announced that Artificial Intelligence (AI) would be integrated into the AYUSH Education Learning Management System (AELMS), with the CCRAS Director General specifically calling for AI-driven research methodology modules to enable data-driven traditional medicine research (Digital Health News, 2025).

The e-Aushadhi portal, launched for drug licensing digitisation (now in fresh registration phase from April 2026), and the NAMASTE Portal for standardised Ayurvedic terminologies and morbidity reporting, provide foundational digital infrastructure that directly supports educational standardisation efforts.

5. GOVERNMENT PLATFORMS FOR AYURVEDA EDUCATION

5.1 SWAYAM

SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) is India's national e-learning platform under the Ministry of Education, co-developed by NPTEL (IIT Madras), Google Inc., and Persistent Systems. It hosts free courses delivered by multiple national coordinators including NPTEL, UGC, CEC, NCERT, NIOS, IGNOU, and IIM Bangalore (SWAYAM, 2026). Courses are freely accessible; optional proctored certification exams are available at designated centres for a nominal fee.

The UGC Gazette Credit Framework for Online Learning through SWAYAM is particularly significant for Ayurveda institutions: it allows universities to award up to 40% of total academic credits through SWAYAM courses (SWAYAM, 2026). When aligned with the NCISM mandate for online electives, this creates a viable pathway for BAMS institutions to formalise SWAYAM course credits. However, the platform currently lacks a dedicated Ayurveda or AYUSH vertical. The most prominent Ayurveda-relevant course - "Roots of Ayurveda" by Dr. M. S. Valiathan (NPTEL) - remains an isolated offering

Table 1: Ayurveda-Relevant Courses on SWAYAM/NPTEL

Roots of Ayurveda	Dr. M. S. Valiathan / NPTEL
Indian Traditional Medicinal & Aromatic Plants	SWAYAM / CEC
Biostatistics for Health Sciences	IIT Bombay / NPTEL
Molecular Biology & Biochemistry	IIT / NPTEL
Research Methodology	Multiple / NPTEL
Sanskrit Language Basics	SWAYAM / NCERT

5.2 NPTEL

The National Programme on Technology Enhanced Learning (NPTEL), launched in 2003 by a consortium of IITs and IISc, is India's most comprehensive online certification platform for higher education, offering 54,000+ hours of video content and recording 819 million+ YouTube views as of 2026 (NPTEL, 2026). Its strength for Ayurveda education lies not in Ayurveda-specific courses - which are minimal - but in building the cross-disciplinary competencies that Ayurveda researchers urgently need: bioinformatics, computational biology, data analytics, molecular biology, and pharmacology.

The absence of a formal AYUSH-NPTEL partnership or subject cluster represents a critical gap. No AYUSH body has been designated as an NPTEL national coordinator, limiting the platform's reach for formal Ayurveda education. A proposal for co-development of 20–30 core BAMS courses by premier Ayurveda institutions (AIIA New Delhi, NIA Jaipur, ITRA Jamnagar) on the NPTEL platform would address this gap systematically.

5.3 AYUSH Grid and AELMS

The AYUSH Education Learning Management System (AELMS), the education-specific component of the Ministry of AYUSH's AYUSH Grid, is the most consequential institutional technology initiative for Ayurveda education. The Ministry has announced AI integration as a priority feature, with AELMS expected to function alongside the AHMIS (Ayush Hospital Management Information System) for integrated academic-clinical learning (Digital Health News, 2025). The AYUSH Grid's four-layer architecture - Core, National, State, and Citizen Access - creates a scalable infrastructure for AYUSH educational delivery across all institutional tiers.

Documented AYUSH Grid components with direct educational relevance include: NAMASTE Portal (standardised terminology - essential for clinical education); TKDL (Traditional Knowledge Digital Library - 3.5 lakh+ formulations from classical texts, serving as a primary reference resource); DHARA (Digital Helpline for Ayurveda Research Articles - an indexed Ayurveda research repository); e-Granthasamuccaya (digitised classical manuscripts and library networking); AYUSH Research Portal (centralised research database); and e-Charak (herbal plant networks for Dravyaguna education) (PMC, 2022; Frontiers in Medicine, 2025).

5.4 Ayurvidya - AIIA e-Learning Portal

Ayurvidya (ayurvidya.aiia.gov.in), the official e-learning platform of the All India Institute of Ayurveda (AIIA), New Delhi, represents the most content-rich government-backed Ayurveda-specific online learning initiative. It offers certificate courses in clinical Ayurveda, Panchakarma, nutrition, and disease management, using presentations, case studies with animations, and interactive webinars (Ayurvidya, 2025). As the apex national Ayurveda institution, AIIA's endorsement of digital education through Ayurvidya carries significant institutional weight for the broader sector.

5.5 NAM Kerala LMS

The National AYUSH Mission's Kerala State implementation launched a dedicated Learning Management System under SAAP 2023–24, approved by the Government of India. This LMS offers Massive Open Online Courses (MOOCs) for AYUSH professionals and the public, covering herbal gardening, Yoga, clinical Ayurveda, and Panchakarma skills (NAM Kerala, 2024). Its multi-device accessibility, standardised training delivery, and focus on geographically distributed AYUSH human resources make it a replicable template for other states.

6. TECHNOLOGY TYPOLOGY IN AYURVEDA EDUCATION

6.1 Learning Management Systems (LMS)

LMS platforms form the foundational infrastructure for all other technology interventions. In Ayurveda, LMS adoption spans government (AELMS, Ayurvidya, NAM Kerala), academic (institution-deployed Moodle, Google Classroom), and private (Ayurved Bharati LMS, ayurvedbharati.org) implementations. Key LMS features required for Ayurveda-specific deployment include: Devanagari script rendering and Sanskrit text support; video hosting for practical demonstrations (Panchakarma,

Abhyanga, Marma therapy); offline content accessibility for low-bandwidth environments; and integration with clinical records systems (AHMIS) for case-based learning.

6.2 E-Learning Content Modalities

Different Ayurveda subjects require distinctly different digital content modalities. Samhita Adhyayana (Classical Text Studies) benefits from annotated digital texts with audio recitation of Sanskrit verses and NLP-aided commentary navigation. Dravyaguna (Ayurvedic Pharmacognosy) is well-suited to high-resolution digital herbariums, AR-based plant identification, and the e-Charak platform. Kriya Sharira (Ayurvedic Physiology) lends itself to 3D animations of Srotas (channel systems), Dhatu (tissue) metabolism, and Tridosha dynamics. Roga Nidan (Diagnosis) requires clinical case videos, virtual patient scenarios, and digital tongue/pulse analysis demonstrations. Panchakarma (therapeutic procedures) demands haptic simulation and step-by-step procedural video libraries.

6.3 Artificial Intelligence and Machine Learning

AI applications in Ayurveda education are emerging at multiple levels. The Ministry of AYUSH's announcement of AI integration into AELMS reflects the broader trend of AI adoption in health professions education, where AI-driven analytics for personalised learning, automated assessment, and clinical decision support are increasingly documented (PMC, 2025; JMIR, 2025). For Ayurveda specifically, AI applications include: adaptive learning platforms that adjust content difficulty based on student performance; Natural Language Processing (NLP) tools for Sanskrit text analysis and cross-referencing classical commentaries; AI chatbots for 24/7 student support; and machine learning models for Prakriti classification research (IJAR, 2023).

The CCRAS-led initiative to integrate AI into research methodology courses represents a strategically important development: equipping Ayurveda researchers with the computational tools needed to conduct large-scale, data-driven studies on classical formulations and clinical outcomes. This directly addresses the evidence base deficit that has historically limited Ayurveda's global acceptance.

6.4 Augmented and Virtual Reality

VR and AR technologies hold significant promise for Ayurveda procedural training. In mainstream medical education, VR-trained students have demonstrated better knowledge retention and psychomotor skill acquisition compared to traditional training methods, consistent with Cognitive Load Theory (Frontiers in Psychology, 2025). In the Ayurveda context, VR simulation of Panchakarma procedures (Vamana, Virechana, Basti, Nasya, Raktamokshana) and AR overlay of Marma points on 3D body models could substantially expand training quality and access. Virtual herb gardens for immersive Dravyaguna learning are also feasible using existing AR frameworks. However, the high infrastructure costs and limited content development capacity currently restrict these modalities to pilot or premium institutional contexts.

6.5 Mobile Technology and Telemedicine

Mobile-first applications are particularly relevant in the Indian context, where smartphone penetration significantly outpaces laptop/desktop ownership among BAMS students from rural or semi-urban backgrounds. Herb identification apps using camera-based image recognition, Prakriti assessment questionnaire apps, BAMS exam preparation platforms (AIAPGET coaching), and the e-Sanjeevani telemedicine platform - which has been used for training AYUSH practitioners in teleconsultation - all represent practical mobile technology applications. The AYUSH Telemedicine Practice Course developed under CCIM telemedicine guidelines has trained practitioners in digital patient interaction, representing an important curriculum innovation (Doctorguru, 2023).

7. ADVANTAGES OF TECHNOLOGY INTEGRATION

Technology integration in Ayurveda education yields several categories of advantage that justify its systematic pursuit.

7.1 Democratisation of Access

India's 700+ Ayurveda colleges are geographically dispersed, with significant disparities in faculty quality, clinical case load, and library resources between premier institutions (AIIA New Delhi, NIA Jaipur) and smaller, rural government colleges. Technology - specifically MOOCs, LMS-based content, and live-streamed expert lectures - creates a mechanism for distributing the intellectual resources of apex institutions to peripheral ones, reducing the quality gap without requiring student or faculty migration.

7.2 Knowledge Preservation and Archiving

The TKDL's documentation of 3.5 lakh+ classical formulations, the e-Granthasamuccaya project's digitisation of manuscripts, and NIMH's ongoing

digitalisation of rare texts collectively represent an irreplaceable contribution to Ayurvedic knowledge preservation. Beyond preventing knowledge loss, these archives create searchable, hyperlinked educational resources that transform how students can navigate and cross-reference the classical corpus - a capability simply impossible with physical texts.

7.3 Standardisation of Training Quality

Technology enables the delivery of standardised educational content across all institutions, ensuring that students in any accredited BAMS college encounter the same quality of explanation for core competencies. This is particularly important given the NCISM's new competency-based curriculum, which defines specific learning outcomes that must be achieved regardless of institution. LMS-based content, video demonstrations, and online assessments provide the mechanism for this standardisation.

7.4 Continuing Education and Lifelong Learning

A significant unmet need in the Ayurveda sector is continuing professional education for practicing Vaidyas. Online platforms - particularly Ayurvidya (AIIA), NAM Kerala LMS, and SWAYAM - provide accessible, flexible continuing education without requiring practitioners to leave their clinical practice. This is critical for a profession where knowledge is rapidly evolving through integrative research.

7.5 Research Capacity Building

The integration of NPTEL's bioinformatics, statistics, and data science courses with Ayurveda PG programmes provides researchers with computational tools essential for modern pharmacological and clinical research. The AYUSH Research Portal and DHARA create the literature access infrastructure. Together, these resources support the evidence-generation pipeline that Ayurveda urgently needs for global credibility.

8. CHALLENGES AND BARRIERS

8.1 The Epistemological Challenge

The most fundamental challenge is epistemological. Ayurveda's knowledge system is not merely a compendium of information but a structured system of knowing grounded in Pratyaksha (direct sensory perception), Anumana (inference), and Apta Vakya (authoritative testimony) (Charaka Samhita, Sutrasthana 11). The guru-shishya parampara transmitted not just content but a perceptual orientation - the Vaidya's trained capacity to observe, smell, touch, and listen in ways that elude standardised formats. Technology, by reducing knowledge to transferable content, risks systematically excluding the tacit, embodied, and relational dimensions of Ayurvedic expertise.

This epistemological tension mirrors challenges documented in other traditional health systems. Just as osteopathic and naturopathic education has grappled with the limits of simulation-based training for holistic clinical skills (Dove Medical Press, 2025), Ayurveda educators must consciously design technology integration that preserves the primacy of direct clinical experience and mentored observation.

8.2 Infrastructure and Connectivity Gaps

India's Ayurveda colleges present a highly heterogeneous infrastructure landscape. While premier institutions (AIIA New Delhi, NIA Jaipur) have adequate digital infrastructure, many state government Ayurveda colleges in rural areas lack reliable electricity, broadband connectivity, and IT support staff. The NCISM's current minimum standards for college establishment focus on physical infrastructure (laboratories, hospital beds, library books) with no explicit WiFi campus or digital infrastructure mandate. Without regulatory pressure to invest in digital infrastructure, technology mandates from NCISM (such as online electives) cannot be meaningfully implemented.

8.3 Faculty Technology Resistance and Capacity

Faculty adoption is the critical variable in any educational technology implementation. Research using the Technology Acceptance Model across medical education settings consistently identifies perceived ease of use and perceived usefulness as the primary determinants of adoption (JMIR Medical Education, 2025). In Ayurveda colleges, three faculty archetypes present distinct challenges: senior classical scholars (deep content expertise, minimal technology comfort and motivation); mid-career clinician-teachers (moderate technology familiarity, absent pedagogical technology training); and young post-NTET faculty (technology-native, requiring content depth). No structured Faculty Development Programme (FDP) specific to Ayurveda educational technology currently exists under NCISM mandate.

8.4 Content Quality and Authenticity

The proliferation of unverified Ayurveda content online constitutes a significant educational risk. Classical text interpretations vary across Sampradayas (schools of interpretation); translations of Sanskrit verses require deep specialised expertise; and clinical protocols must

meet evidence quality standards. Without a formal content quality framework analogous to ICMR's health app rating system, students have no mechanism to distinguish authoritative institutional content from commercial or unverified sources. The NCISM has not yet published quality standards or an empanelment process for digital Ayurveda educational content providers.

8.5 The Sanskrit-Digital Interface Challenge

Ayurveda's classical literature is in Sanskrit, Devanagari script. The digital ecosystem has a profound Sanskrit gap: screen readers, search algorithms, and NLP tools still struggle with classical Devanagari and Sanskrit linguistic structures. The multi-layer commentary tradition (original verse + Chakrapanidatta's commentary on Charaka; Dalhana's on Sushruta), classical verse meters that affect meaning, and cross-referential reading practices of classical scholarship do not map cleanly onto standard LMS architectures. Additionally, most SWAYAM/NPTEL content is in English, presenting a language barrier for Ayurveda students whose academic identity and comfort is in Hindi or regional languages.

8.6 Absence of Centralised Content Governance

Perhaps the most actionable structural gap is the absence of a centralised body responsible for developing, approving, and maintaining Ayurveda digital educational content. The AELMS is under development but its governance structure, content development protocols, and institutional onboarding process have not been publicly specified. Without this governance framework, the online electives mandate (NCISM, 2025a) risks being implemented in a fragmented, low-quality manner across individual institutions.

9. DISCUSSION

The findings of this review reveal a technology ecosystem for Ayurveda education that is simultaneously promising and incomplete. The convergence of three forces - regulatory reform (NCISM's new curriculum), institutional digital infrastructure (AYUSH Grid, AELMS), and national platform availability (SWAYAM, NPTEL) - creates an unprecedented opportunity window. Yet the structural, epistemological, and capacity challenges documented above suggest that this opportunity risks being squandered without deliberate, coordinated policy action.

The analogy with mainstream medical education is instructive but limited. While the broader medical education literature affirms the value of e-learning, simulation, and AI tools (PMC, 2025; Frontiers in Psychology, 2025), these studies are almost entirely situated within a biomedical epistemological framework that presupposes the primacy of measurable, reproducible outcomes. Ayurveda's knowledge system does not share this epistemological foundation. The risk of "biomedical colonisation" of Ayurveda through poorly designed technology integration - where Doshas are reduced to biochemical markers and Prakriti is turned into a genetic classification exercise - is real and must be actively guarded against (IJAR, 2024).

The hybrid pedagogical model proposed in this review - where technology handles content delivery, reference access, and standardised assessment, while the classroom, clinic, and guru-shishya relationship remain the sites of experiential and relational knowledge - reflects an emerging consensus in educational theory on the complementarity of digital and face-to-face learning (Dove Medical Press, 2025). The post-COVID blended learning literature is particularly relevant: institutions that implemented purposive blended models (rather than emergency remote teaching) reported sustained improvements in student satisfaction, knowledge retention, and flexible learning access.

The language dimension warrants particular attention. India's Ayurveda students are predominantly Hindi or regional-language educated, yet the dominant platforms (NPTEL, SWAYAM) deliver in English. The National Education Policy 2020's emphasis on mother-tongue instruction provides a policy anchor for demanding multilingual Ayurveda digital content - a demand that NCISM and Ministry of AYUSH should formalise as a content development standard for AELMS.

On the question of infrastructure investment: the NCISM's college rating system (Grades A, B, C - published digitally for AY 2024–25) provides a mechanism for incentivising digital infrastructure investment. Rating criteria could be extended to include LMS adoption, faculty technology training, and student digital access - creating a market-like pressure on institutions to invest in technology without requiring direct government funding.

The Traditional Knowledge Digital Library (TKDL) deserves special mention as perhaps the most significant single digital contribution to Ayurvedic knowledge infrastructure. Its 3.5 lakh+ documented formulations serve simultaneously as an intellectual property protection mechanism and an educational resource. Integrating TKDL access into AELMS as a searchable, annotated reference platform for BAMS and MD students would be a high-impact, low-cost intervention.

10. RECOMMENDATIONS

10.1 Immediate Policy Actions (0–2 Years)

- NCISM to publish operational guidelines for online elective delivery - including approved platforms, minimum content quality standards, assessment protocols, and institutional compliance requirements.
- Ministry of AYUSH to release the AELMS public roadmap with timelines, pilot institution list, governance structure, and content onboarding process.
- NCISM to appoint AIIA or NIA Jaipur as SWAYAM national coordinator for Ayurveda/AYUSH, and commission development of 10 foundational bilingual BAMS courses on the SWAYAM platform by 2027.
- NCISM to include WiFi campus and digital infrastructure in minimum standards for Ayurveda college establishment and renewal of permission.
- CCRAS to publish "Standards for Digital Ayurveda Educational Content" - covering classical attribution, evidence levels, linguistic accuracy, and copyright protocols.

10.2 Medium-Term Institutional Actions (3–5 Years)

- Establish a Centre for Ayurveda Educational Technology (CAET) - a national body for content development, faculty training, technology standards, and pedagogy research.
- Develop a National Ayurveda Virtual Lab - shared simulation infrastructure accessible to all BAMS colleges for Panchakarma, anatomy, and pharmacognosy practicals.
- Mandate a minimum 40-hour "Technology for Ayurveda Teaching" FDP for all BAMS faculty as a condition of NCISM recognition, integrated into the NTET framework.
- Launch a Sanskrit-Digital Bridge project - partnering with IIT Sanskrit NLP projects to develop Devanagari-native LMS tools, verse annotation systems, and multilingual classical text interfaces.

10.3 Long-Term Vision (5–10 Years)

- Develop a nationally accredited hybrid BAMS programme: 30% online (theory, electives, research methods) + 70% campus/clinical - creating a scalable, quality-assured national standard.
- Position India as the global hub for authentic digital Ayurveda education through globally accessible MOOCs aligned with WHO's Traditional Medicine Strategy 2025–2034.
- Develop an AI Vaidya Study Companion - an LLM-based educational tool trained on TKDL, classical Samhitas, and validated clinical outcomes data - serving as a reference and formative assessment tool for BAMS students

11. CONCLUSIONS

This state-of-the-art review has mapped the landscape of technology intervention in Ayurveda education in India, revealing an ecosystem of substantial promise shaped by converging regulatory, institutional, and infrastructural forces. The NCISM's competency-based BAMS curriculum with its online electives mandate, the Ministry of AYUSH's AYUSH Grid ecosystem and emerging AELMS, and the availability of national platforms (SWAYAM, NPTEL) together constitute a qualitatively new environment for Ayurveda education - one that did not exist even a decade ago.

Yet the review also surfaces fundamental tensions that cannot be resolved by technology alone. The epistemological distinctiveness of Ayurvedic knowledge, with its emphasis on sensory perception, relational transmission, and contextual judgment, resists reduction to standardised digital formats. The infrastructure, faculty capacity, content quality, and language challenges are real and require sustained investment and regulatory attention. Most critically, the absence of a centralised content governance framework threatens to fragment and dilute the quality of digital Ayurveda education precisely when standardisation is most needed.

The path forward lies in what we term an epistemically grounded hybrid model - where technology serves as the vehicle for content access, knowledge reference, and scalable assessment, while the clinic, the classroom, and the Vaidya-student relationship remain the irreducible sites of experiential wisdom. In the language of Ayurveda itself: technology is the Anupana (vehicle) that carries the Dravya (medicine) of classical knowledge to a wider patient - the learner. But it is the Dravya, not the Anupana, that heals.

Future research should prioritise: controlled studies measuring learning outcomes in digitally-augmented versus traditional BAMS pedagogy; student and faculty perception surveys on technology readiness in Indian Ayurveda colleges; evaluations of NAM Kerala LMS and Ayurvidya course completion and competency outcomes; and longitudinal tracking of technology adoption following NCISM's online electives mandate.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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