



# THE ROLE OF SCIENCE EXPERIENCE CENTRES IN INTEGRATING THE INDIAN KNOWLEDGE SYSTEM WITH SCIENCE EDUCATION UNDER NATIONAL EDUCATION POLICY 2020

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**Abstract:** The National Education Policy (NEP) 2020 recognizes India's vast repository of ancient scientific knowledge. It highlights the restructuring of an education system that strikes a balance between global competitiveness and the nation's rich cultural and intellectual traditions. NEP-2020 promotes various outreach programs to disseminate ancient Indian knowledge on universal human values, ethics, Vedas, Ayurveda, Yoga, Linguistics, Sciences, intellectual learning, and physical and holistic development. There are specific challenges associated with the integration of IKS and NEP. Concerning this, the Science Experience Centres provide accessible spaces for numerous individuals, regardless of age and socio-economic status, to explore various ancient Indian scientific concepts through interactive exhibits, hands-on activities and digital simulations without experiencing any academic pressure or time constraints.

This article discusses the role of Science Experience Centres (SECs) as dynamic platforms for engaging varied stakeholders with rich and diverse ancient Indian scientific knowledge, as outlined in the NEP-2020. Also, it explores their role in revitalizing traditional scientific concepts through modern technological advancements.

**IndexTerms-** Education, Informal-Non-formal Education, National Education Policy (NEP), Indian Knowledge Systems (IKS), Experiential Learning, Science Experience Centres (SECs).

## I. INTRODUCTION

The Ministry of Education proposes the National Education Policy 2020 (NEP-2020), which suggests a radical restructuring of Indian education through an education system based on Indian values, helping the nation grow sustainably into an advanced, knowledge-based society ("National Education Policy 2020", n.d.). By ensuring high-quality education for all, India will position itself as a global leader in learning and innovation.

The National Education Policy 2020 emphasizes the core values and principles that education should instill in students. These are not only cognitive skills but also social and emotional skills, which encompass the 'soft skills,' including cultural awareness, empathy, perseverance, grit, teamwork, leadership, and communication ("National Education Policy 2020", n.d.). NEP 2020 supports a flexible education system that allows students to study a variety of subjects, including those from ancient Indian knowledge systems. It helps students develop a comprehensive understanding of various fields. Research centres are receiving support for in-depth studies and the translation of ancient Indian texts into local languages, thereby preserving our knowledge heritage (Mandavkar 2023, Sharma & Savita, 2024). For NEP 2020 to succeed, schools, institutes, and research centres must effectively implement these ideas into practice.

Science Experience Centres (SECs) serve as a bridge to close the gap between operationalizing the mandate of NEP 2020 and integrating India's traditional knowledge systems with contemporary education. Where formal institutions face implementation challenges, particularly in translating textual knowledge of Ayurveda, Vedic mathematics, classical astronomy, and other shastras into experiential learning, SECs provide an essential platform (Yadav & Ravjani, 2023). Their unique value manifests in three domains:

1. Experiential Translation
2. Cognitive Bridging
3. Pedagogical Innovation.

This methodology directly supports NEP 2020's objectives by

- Providing the hands-on engagement that textbooks cannot deliver.
- Validating IKS as empirically grounded knowledge systems.
- Creating accessible entry points for diverse learners (K-12 students, university researchers, and community members).

Critically, SECs resolve the implementation gap between policy aspiration and classroom reality. When schools introduce Sushruta's contributions in theory, SECs enable practical engagement with surgical instrument replicas. When universities teach the textual analysis of Siddhantic astronomy, SECs offer planetarium simulations that demonstrate the observational accuracy of the subject.

By rendering India's scientific heritage tangible and investigable, these centres transform IKS from an academic abstraction into a lived scientific practice, fulfilling NEP 2020's vision of education rooted in the Indian ethos while advancing pedagogical effectiveness.

## II. NEP 2020: MAPPING EDUCATION'S CORE OBJECTIVES FOR NEW INDIA

Education encompasses academic performance, critical thinking skills, problem-solving abilities, creativity, emotional intelligence, communication skills, social engagement, and physical well-being. It balances academic achievement, vocational training, and a holistic approach to developing human potential across individual, social, and national dimensions. These work together to create well-rounded individuals who contribute positively to society and help advance national progress. This socialization process helps individuals understand their cultural identity and the societal expectations that shape them. The main aim of the National Education Policy in India is to restructure the regulation and governance of the Indian education system to address the country's (sustainable) developmental goals ("National Education Policy 2020", n.d.).

### 1. Pedagogical Foundations & Learning Modalities

The concept of lifelong Learning in Indian education policy is associated with developing foundational skills, higher-order thinking skills, competencies, and cognitive abilities at all levels. Pedagogy must be a fundamental component of education to make it more comprehensive, experiential, intertwined, student-centred, discovery and discussion-based, adaptable, and pleasing (Amani, 2024). Indian formal education is a structured, hierarchically organized, and chronologically progressive system from elementary school through university, that also assigns roles to specific educators. This role-specific nature of education features the need for a strategic approach from policymakers.

### 2. Beyond Formal Structures

Informal and non-formal education can be equally systematic when planned and intentional from the learner's perspective (Johnson & Majewska, 2022). These develop:

- > Cognitive & social-emotional skills
- > Real-world abilities for future success.

However, tension arises when rigid curricula leave little space for unstructured learning, a core strength of non-formal approaches. These Learning concepts are complex but powerful and emphasize skill development that may become a core aspect of education, focusing on developing soft skills, critical thinking, and problem-solving abilities (Sasson, 2014).

### 3. From Vedic Classrooms to Global Learning

Education transmits cultural heritage and social values from one generation to the next. Historical evidence confirms that the ancient Indian vibrant educational ecosystem fostered deep scholarly inquiry. To regain its global standing as Vishwaguru, India must revitalize this intellectual legacy within modern institutions, specifically by cultivating an ethos of critical examination, structured analytical reflection, questioning, and constructive debating. This perspective recognizes that human understanding evolves through questioning, not fixed doctrines, aligning education with its true purpose. Embedding this **knowledge of the many arts** framework (as recognized in NEP 2020) into contemporary liberal education would enrich 21st-century pedagogy significantly. Crucially, the synthesis of formal and informal learning modes (Mishra & Aithal, 2023; "National Education Policy 2020", n.d.), a hallmark of ancient Indian systems, remains essential for holistic student development as India rebuilds its educational leadership.

## III. LEARNING FROM OUR ROOTS: INDIAN KNOWLEDGE SYSTEMS AS EDUCATIONAL TREASURES

The ancient education system was based on India's rich cultural traditions and focused on the holistic development of the students, thus preparing them for the physical, intellectual, transcendental, and artistic aspects of life. The goal of the ancient **Indian Gurukuls** was to teach students practical skills that they could use to solve issues in their daily lives. Students learned through practical approaches and observation. On the other hand, the current learning system is mainly dependent on rote Learning.

The ancient Vedic culture taught about **64 art forms**, which included music, dance, arts and subjects like humanities, languages, science, medicine, technology, and many more. There is a need to rejuvenate and mainstream Indian knowledge systems for the contemporary world ("Ministry of Education", n.d.).

Indian Knowledge Systems (IKS) are recommended to be scientifically integrated, including tribal knowledge, Indigenous and traditional modes of Learning. They intend to embrace topics such as Astronomy, Ayurveda, Mathematics, Yoga, Architecture, Medicine, Agriculture, and more. Key components encompass tribal ethnomedicine, eco-friendly forestry practices, and organic agricultural techniques (Varakhedi, 2022).

#### IV. WHY INDIAN KNOWLEDGE DEMANDS EXPERIENTIAL EDUCATION

The traditional Indian educational system emphasized **hands-on and experiential Learning**. The process of learning through experiences is Experiential Learning. When students participate in hands-on activities followed by critical analysis, they can easily apply the theories and knowledge learned in the classroom to real-life situations. Students gained knowledge through observation, experimentation, participation in competitions, and field visits. This strategy aimed to bridge the gap between theoretical understanding and its real-world implementation.

Ancient Indian knowledge is categorized into various fields, including History, Logic, Architecture, Politics, and others. It infused practical skills and life lessons through experiential learning, such as vocational knowledge, martial arts training, and physical education, that emphasized moral values instilled through **deep respect for gurus**, thereby contributing to the holistic development of individuals.

Experiential Learning involves students' participation in hands-on experiments, real-world problem-solving skills, and fieldwork. This allows them to understand and apply new concepts rather than reading about scientific phenomena in textbooks and journals. Whether it's testing a chemical reaction, observing animal behaviour, or conducting physics experiments, the key is that students learn through doing, think critically about their actions, and reflect on what they have learned (Lohani, 2024).

There are various advantages of experiential Learning:

- Encourages active Learning
- Reinforces theoretical knowledge
- Refines problem-solving and critical thinking skills
- Promotes collaboration and teamwork
- Increases engagement and motivation.

#### V. ROLE OF SCIENCE EXPERIENCE CENTRES IN IMPARTING IKS THAT ALIGN WITH NEP 2020

The Science Experience Centre is usually established to cultivate the culture of science in society, especially among students. The main objective of a Science Experience Centre is to popularise STEM education in cities and rural areas, benefiting students and the general public by organizing a variety of outreach activities such as exhibitions, workshops, seminars, popular lectures, field visits, and science camps. It also supplements the science education provided in schools and colleges, stimulating a spirit of scientific inquiry and creativity among students.

Furthermore, it organizes training programs for science teachers, students, young entrepreneurs, technicians, individuals with disabilities, homemakers, and others on specific science, technology, and industry subjects to boost their motivation and make them progressive and comfortable ("National Council of Science Museums (NCSM)", n.d.). They also help people to address the rapidly changing technological environment and empower them by enhancing their life skills.

Science Experience Centres manage tangible scientific heritage, demonstrate scientific phenomena, and showcase cutting-edge technological innovations alongside contemporary research. These instructively optimized exhibits translate theoretical complexity into multi-sensory public experiences, cultivating active learning environments where visitors of all ages co-construct knowledge through hands-on experimentation.

Additionally, Science Centres present thoughtfully designed exhibits, such as moving sculptures, virtual reality experiences, and hands-on stations. These displays turn complex ideas into direct experiences. This intentional use of technology goes beyond simply showing things, enabling visitors to become active learners who directly explore natural events. For example, SECs may design Quantum Theory galleries that explain empirical parallels to Advaita Vedanta's ontological non-duality, revealing how modern physics resonates with ancient Indian metaphysics of universal oneness.

The exhibits in the experience centres encourage visitors to interact with them, ask questions, seek answers and strengthen their understanding. Exhibits are designed to showcase specific aspects of nature or a concept from the complex world, allowing visitors to explore and begin comprehending it. For example, refraction principles manifest when visitors:

- (a) Direct light through macro-scale acrylic prisms
- (b) Observe wavefront deformation in ripple tanks during depth-transition experiments.

Engaging with objects and concepts during the learning process is a crucial yet frequently neglected aspect of formal education. The playful atmosphere of science centres fosters. This approach teaches the development of skills in observation, experimentation, and testing of ideas, while also providing an opportunity to discover order in nature independently. It innovatively teaches science and develops new Learning Environments (Chantal Barriault & David Pearson, 2010).

#### VI. HOW SECs MAKE IKS TANGIBLE

Including IKS with current scientific education is not just an academic requirement but also a cultural necessity. However, there are specific challenges associated with integrating IKS with NEP in formal science education (Chandel & Prashar, 2024). Science experience centres can easily bridge ancient Indian scientific knowledge with the current scientific revolution by using various techniques such as:

- interactive, informative exhibits
- 3D interactive murals
- digital simulations
- AI technologies can help decode old manuscripts and complex texts into simpler versions that can represent historical artefacts, timelines, and journeys through past, present and future
- Augmented Reality (AR) can engage visitors, making learning more dynamic and accessible
- Virtual reality (VR) creates objects and scenes that appear to be real, giving the user an immersive experience.

Using all the above concepts, it becomes easy to create interactive or informative experiences of IKS, some of which are specified below:

- Storytelling and contextual understanding of the exhibits related to IKS
- Comparing ancient Indian Alchemy and metallurgy with today's material science
- Ayurveda knowledge and principles with herbal and biochemical medicines
- Ancient Indian mathematics and Sanskrit with computational science and machine languages
- Role of Yogashastra in Neuroscience and Psychology
- Connection of Mathematics, Astronomy, Ayurveda, and Architecture
- Unification of Quantum Physics and Advaita Vedanta
- Application of Panchamahabhuta, the building blocks of life.

These experiences deepen students' understanding by connecting theory with tangible cultural artefacts. Also, the SECs can conduct special teacher training programs on IKS experiential Learning methodology. It also incorporates case studies of various ancient Indian universities, such as Nalanda and Takshashila.

## VII. ESSENTIAL PARTNERSHIPS FOR EFFECTIVE SCIENCE EXPERIENCE CENTRES (SECs)

SECs alone cannot fulfil NEP 2020's mandate to integrate Indian Knowledge Systems (IKS) with modern science education. SECs require deep collaboration with three key partners:

**1. Knowledge Institutions (Universities, Vedic Schools, Research Bodies):** These institutions bring essential expertise. Scholars can rigorously examine concepts from Indian Knowledge Systems (like testing Ayurvedic principles in labs). They collaborate directly with SEC staff to create accurate exhibits, such as astronomy professors helping build replicas of ancient Yantras. Crucially, they equip SEC facilitators with the knowledge needed to explain diverse traditions, helping them present topics like the Shulba Sutras alongside modern geometry effectively.

**2. Funding Agencies (Government Schemes, CSR, International Grants):** Financial support makes ambitious projects possible. Grants enable experimental initiatives, such as labs exploring ancient metallurgy, which are funded by agencies like the DST. Corporate Social Responsibility (CSR) funds can help scale proven successes, like expanding Kerala's traditional medicine gardens nationwide. Agencies can also spur creativity by offering awards for innovative collaborations, like teams from SECs and institutions developing bilingual science kits based on Indian Knowledge Systems.

**3. Grassroots Practitioners:** Practitioners bridge the gap between research and the visitor experience, for example, by transforming Harappan urban planning studies into city-building simulations. Their extensive knowledge of the practitioners can be recorded and shared through workshops and interactive exhibits. Furthermore, they also help SECs measure real impact by tracking visitor feedback and results and then sharing these with funders to demonstrate effectiveness.

When SECs partner with knowledge institutions, funders, and local experts, powerful things happen. Students view science not just as facts in books but as a living tradition that continues to this day. Researchers find fresh questions and insights by connecting with community wisdom. India builds more substantial ownership over its unique knowledge heritage. Most importantly, this teamwork brings NEP 2020's big vision of uniting ancient wisdom and modern learning down to earth, where it works.

## VIII. CONCLUSION

Science Experience Centres aren't just museums, they're living workshops where India's past and future collide. By transforming ancient manuscripts into hands-on exhibits and Vedic concepts into VR experiences, SECs finally make our knowledge heritage accessible. However, their real power stems from partnership, universities infuse scholarly rigour into traditions, funders scale grassroots innovations, and local experts keep content grounded in truth.

This three-way alliance solves what classrooms can't. Students don't just read about Sushruta's tools—they hold replicas of them. They don't memorize the Panchamahabhuta; instead, they see elemental principles animated through AR. And when SECs document fading oral traditions or translate Siddhantic astronomy into planetarium shows, they're doing more than teaching science. They're rebuilding India's identity as a knowledge civilization.

Critically, this model proves NEP 2020's boldest idea, that tradition and progress aren't rivals. SECs demonstrate how Ayurvedic biology inspires laboratory research, how tribal farming wisdom informs ecological studies, and how yantras spark curiosity in engineering. Every interactive exhibit quietly answers sceptics; ancient innovation belongs in modern education.

For India to truly reclaim its **Vishwaguru** legacy, SECs must become our national nerve centres. They turn **integrating IKS** from a slogan into student wonder, researcher breakthroughs, and cultural pride. That's how lost knowledge returns, not through decrees but through experiences that make heritage impossible to ignore.

## IX. ACKNOWLEDGMENT

We would like to express our gratitude to Dr. Smita Acharya (Director, IQAC & Professor, Department of Physics, RTMNU, Nagpur, Maharashtra) for technical support and Dr. Saji Varghese (Associate Professor, Christ University, Bengaluru, Karnataka) for the valuable guidance.

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