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Iks-Infused Learning Packages for Improving Student Engagement in Science Education.

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Abstract

Student engagement is fundamental to success in science education, especially at the higher secondary level, where learners face abstract concepts and increased academic pressure. With the changing learning preferences of today's digital native learners incorporating Indian Knowledge Systems (IKS) into structured science learning packages offers a powerful pedagogical solution.. This article examines how IKS-infused learning packages combining traditional knowledge, ICT tools, inquiry-based tasks, and competency-driven learning outcomes can strengthen cognitive, behavioral, and emotional engagement in science classrooms. Drawing from NEP2020 vision,educational psychology and contemporary educational research, the paper demonstrates how integrating IKS elements such as ancient astronomy, environmental ethics, Ayurveda-based biological classifications, traditional metallurgy, and mathematical reasoning from the Sulbasutras can support conceptual understanding. This article proposes a framework for designing IKS integrated learning packages. The article concludes that such integrated packages can make science learning relevant, locally grounded, culturally enriching, and more engaging for today's learners.

Keywords: IKS, Learning Packages, Science Education, Student Engagement, NEP 2020, educational psychology

Introduction

Today's science education encounters challenges such as low student motivation, disengagement, exam-oriented learning, and limited conceptual understanding. Higher secondary learners are required to deal with complex topics such as quantum mechanics, chemical equilibrium, fluid mechanics and thermodynamics.These areas often overwhelm students due to lack of context and real-life connections. Traditional teacher-centered instruction intensifies this problem, making learning passive and memory-driven.

To make science learning relevant, meaningful, and culturally connected, educators are now exploring methods that combine structured content design with indigenous knowledge. NEP 2020 strongly advocates inclusion of Indian Knowledge Systems (IKS) into mainstream education, acknowledging the scientific richness of ancient Indian texts, technologies, and practices.

At the same time,structured learning packages including modules containing objectives, explanations, activities, evaluation tools, and digital resources have gained popularity for improving self-paced and active learning. When enriched with IKS elements, they create a powerful pedagogical tool that connects conceptual learning with heritage knowledge, real-life applications, and cultural identity.

Indian Knowledge Systems in Science Education

Indian Knowledge System

Indian Knowledge System (IKS) refers to India's vast repository of traditional, indigenous knowledge that evolved through centuries of observation, experimentation, and intellectual inquiry. It includes ancient sciences, mathematical knowledge, medicine, astronomy, metallurgy, architecture, environmental ethics, and educational practices.

Historical Background of IKS

- **Early Civilizations and Scientific Culture**

The Indus Valley Civilization displayed advanced town planning, drainage, water management, weights and measurements, and metallurgy.

Evidence of early astronomy, timekeeping, and calendar systems.

- **Vedic and Post-Vedic Knowledge Traditions**

Rigveda, Yajurveda, Samaveda, and Atharvaveda contain scientific principles related to mathematics, cosmology, medicine, and environmental science.

Development of systems like Ayurveda, Yoga, Jyotisha, and agricultural sciences.

- **Classical Period Contributions**

Scholars like Aryabhata, Varahamihira, Charaka, Sushruta, Brahmagupta, and Bhaskara made foundational scientific contributions.

Texts like Charaka Samhita, Sushruta Samhita, and Aryabhatiya recorded advanced medical and mathematical knowledge.

Features of IKS Relevant to Science Education

- **Empirical Foundation**

IKS is deeply rooted in observation (pratyaksha), experimentation (prayoga), and inference (anumana).Traditional Indian thinkers systematically recorded evidence from nature and human experience.

- **Rational Thinking and Logic**

Schools like Nyaya and Vaisheshika cultivated critical thinking, logical reasoning, and methods of scientific inquiry.

- **Holistic and Integrated Perspective**

IKS connects the human body with the environment, science with values and ethics,spirituality with both physical and life science.This approach encourages harmonious development by integrating the mind,body,intellect and emotions.

- **Sustainability and Ecological Awareness**

IKS emphasizes environmental balance, conservation, respect for biodiversity, and sustainable living highly relevant in modern environmental science education.

- **Indigenous Technologies**

Traditional technologies such as metallurgy, water harvesting, architecture, textile production, and agricultural practices provide strong foundations for STEM learning.

Major Scientific Contributions of IKS

Mathematics

- Invention of zero, decimal system
- Geometry from Shulba Sutras
- Aryabhata's trigonometry and approximation of π
- Bhaskara's concepts similar to calculus

Astronomy

- Explanation of Earth's rotation
- Calculation of solar and lunar eclipses
- Planetary motion studies
- Jantar Mantar's physical astronomical instruments

Medicine

- Sushruta's surgical techniques (rhinoplasty, cataract surgery)
- Herbal pharmacology
- Holistic health principles
- Preventive and lifestyle medicine

Metallurgy

- Delhi Iron Pillar (rust resistant)
- Wootz steel (exported for Damascus steel)

Environmental and Agricultural Science

- Traditional water systems: stepwells, tanks, canals
- Sustainable agriculture
- Organic farming and biodiversity management

IKS and Modern Science Education

1. Building Scientific Temper

IKS encourages the core values of scientific temper like observation, questioning, reasoning, and experimentation.

2. Strengthening Conceptual Understanding

Concepts like astronomy through shadow movement,geometry through Shulba Sutras,herbal medicine and plant biology help students connect theoretical science with real-life examples.

3. Promoting Multidisciplinary Learning

IKS naturally integrates physics with astronomy,chemistry with metallurgy,biology with Ayurveda and ecology with environmental ethics.This supports NEP 2020's interdisciplinary vision.

4. Enhancing Sustainability Education

IKS provides local solutions for global environmental problems like water conservation, soil management,climate adaptive architecture and biodiversity conservation.

5. Encouraging Inquiry-Based Learning

IKS methods promote investigation,field-based learning.project-based exploration and experiential learn-

ing

NEP 2020 Recommendations on IKS in Science Education

- **Curriculum Integration**

Include Indian scientific heritage in school and higher education curricula.
Present ancient Indian discoveries using scientific explanations.

- **Establishment of IKS Centres**

Research centres across universities
Documentation and digitization of ancient knowledge
Encouraging interdisciplinary research in IKS

- **Teacher Capacity Building**

Training for teachers to handle IKS content
Workshops, certification courses, and resource books

- **Development of Digital Content**

Virtual labs
Digital repositories
Online modules on IKS disciplines

- **Promotion of Critical Thinking**

Use IKS stories, biographies, experiments, and case studies to train students in evidence-based reasoning.

Pedagogical Approaches for Using IKS in Science Teaching

- Activity-Based Learning
- Storytelling Method
- Local Knowledge Integration
- Field Trips and Community Learning
- Project and Research-Based Learning

Challenges in Integrating IKS with Science Education

1. Lack of Teacher Training
1. Fear of Mixing Science with Myths
2. Limited Teaching Resource
3. Research Gaps
4. Curriculum Overload.

Importance of Integrating IKS in 21st Century Science Education

1. Cultural Relevance

Makes learning meaningful and rooted in local knowledge.

2. Sustainable Future Orientation

IKS teaches eco-friendly practices crucial for addressing climate change,resource depletion and environmental degradation

3. Innovation and Creativity

Inspires new inventions based on indigenous models.

4. Strengthening National Identity

Improves cultural confidence by presenting India's scientific achievements.

5. Enhancing Global Competence

Students learn science from multiple knowledge systems, not just Western frameworks.

Indian Knowledge System (IKS) provides a rich scientific heritage that can significantly enrich modern science education. It offers holistic, empirical, and sustainable insights that align with contemporary scientific goals. NEP 2020 promotes integrating IKS with education to nurture scientifically literate, culturally rooted, innovative, and environmentally responsible citizens. The successful implementation of this integration requires teacher training, validated resources, and research-based teaching practices.

Learning Packages: Concept and Components

A learning package is a well structured set of instructional materials designed to help learners understand a specific concept independently.A good learning package contains components such as clear learning objectives,simplified contents,learner activities,visuals and digital resources,exercises,assessment tools,feedback mechanism and guidelines for self study.These components together make learning more organised,interactive and learner centered,helping students progress at their own pace

Integration of IKS into Learning Packages

The integration of IKS into learning packages aims to enrich the teaching learning process by connecting modern education with India's deep intellectual traditions.Incorporating IKS elements into learning packages makes education more holistic,contextual,and meaningful for learners.A well designed learning package that includes IKS help students understand scientific concepts through culturally familiar examples.Such integration fosters conceptual clarity,problem solving skills,and appreciation of India's scientific heritage.

The NEP 2020 encourages blending IKS with modern education to promote multidisciplinary learning,critical thinking and cultural rootedness.learning packages integrating IKS provide activities,real life examples,ICT based tasks ,worksheets and assessments built around traditional knowledge systems.This approach strengthens subject understanding and nurtures pride,identity and values among students.This will help to connect past with present.The integration of IKS into learning packages will promote a balanced worldview that values both ancient wisdom and contemporary scientific inquiry.

Designing IKS-Integrated Learning Packages

1. Define Learning Outcomes
2. Identify Relevant IKS Elements
3. Develop Module Structure
4. Add ICT Resources
5. Prepare Activity Sheets
6. Include Assessment and Reflection

IKS and Student engagement

Student engagement describes how actively and meaningfully a student participates in and commits to their learning both inside and outside the classroom. It is a multidimensional construct including the interrelated dimensions like cognitive engagement,behavioural engagement and emotional engagement.

When lessons include familiar,culturally rooted examples such as indigenous technologies,traditional ecological practices or ancient mathematical methods,students become more curious and active in learning.This increases student engagement

Suggestions for Teachers and Curriculum Developers

Teachers can enhance learning by using active and student centered methods such as discussions,hands on activities and inquiry based tasks.Connecting lessons to real life situations and IKS helps make learning meaningful and relatable.Using ICT tools ,giving regular feedback, creating a supportive and inclusive classroom environment further improve student engagement and understanding.

Curriculum developers should design flexible ,activity rich learning materials that promote critical thinking ,creativity and experiential learning.Integrating IKS elements ensures cultural relevance and educational value.Providing clear guidelines,assessment tools and teacher training helps effective implementation in diverse classroom settings.

Challenges and Recommendations

Challenges

Integrating innovative approaches like Indian Knowledge Systems and active learning into classrooms presents several challenges,including limited teacher training,scarcity of suitable resources.time constraints and resistance to change in traditional teaching practices.Many schools also struggle with inadequate infrastructure and lack of awareness about the value of culturally rooted learning.

Recommendations

To address the challenges,it is recommended to provide continuous professional development for teachers,create well structured learning packages and ensure administrative support for innovation.Strengthening resource availability,incorporating technology and encouraging collaborative curriculum development can further help schools adopt these approaches effectively and sustainably.

Conclusion

IKS infused learning packages offer a powerful and culturally grounded approach to enhancing student engagement in science education . Integrating IKS into science learning packages provides a pathway to more engaging, meaningful, and culturally relevant science education. Such packages offer rich opportunities for inquiry, experiential understanding, and deeper conceptual clarity. They promote student engagement at cognitive, behavioral, and emotional levels by connecting scientific knowledge with indigenous practices, environmental wisdom, and heritage technologies.Despite challenges such as limited resources,lack of teacher training,and the need for careful curriculum alignment,the benefits are much greater than these difficulties. As India moves toward holistic and multidisciplinary learning under NEP 2020, IKS-infused learning packages have the potential to transform classrooms into vibrant spaces of curiosity, exploration, and scientific temper. The future of science education lies in blending modern pedagogy with traditional wisdom and learning packages serve as an effective medium to achieve this integration.

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