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A Study of Indian Knowledge Systems (IKS) and Art-Integrated Learning in Mathematics

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ABSTRACT

Present study explores the integration of Indian Knowledge Systems (IKS) with art-integrated learning approaches in the teaching of mathematics at the school level. Indian Knowledge Systems, rooted in classical traditions such as the Vedas offer rich mathematical insights expressed through patterns, geometry, and logical reasoning. Art-integrated learning, which connects academic concepts with visual and performing arts, provides an engaging and experiential approach to mathematics education.

The study examines how the fusion of IKS and art-integrated pedagogy can enhance conceptual understanding, creativity, and student engagement in mathematics. It highlights the use of traditional art forms, patterns, and cultural designs to teach mathematical concepts such as symmetry, measurement, and geometry. The research also analyzes the alignment of this approach with the vision of the National Education Policy 2020, which emphasizes holistic, multidisciplinary, and experiential learning.

Furthermore, the study identifies potential benefits such as reduced math anxiety, improved critical thinking, and increased cultural awareness among learners. It also discusses challenges, including limited teacher training, lack of instructional resources, and the need for curriculum restructuring.

The study concludes that integrating Indian Knowledge Systems with art-integrated learning can make mathematics more meaningful, culturally relevant, and engaging. It suggests that effective implementation requires teacher capacity building, development of appropriate teaching materials, and institutional support to realize the goals of contemporary education.

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Keywords: Indian Knowledge Systems (IKS), Art Integration Education (AIE)

Introduction:

Education in the contemporary era is increasingly shifting toward approaches that emphasize holistic development, interdisciplinary learning, and cultural relevance. Within this framework, the integration of indigenous knowledge with modern pedagogy has emerged as a significant area of academic inquiry. The Indian Knowledge Systems (IKS) encompass a rich and diverse intellectual tradition that has developed over millennia, contributing profoundly to fields such as mathematics, astronomy, philosophy, and the arts. Foundational texts like the Vedas that mathematical ideas in ancient India were not treated as isolated abstractions but were embedded in practical, artistic, and spiritual contexts. Contributions of scholars such as Aryabhata and Brahmagupta further highlight the depth and sophistication of mathematical thinking within this tradition.

Historically, mathematics in India has been closely linked with art, architecture, and everyday practices. Concepts such as symmetry, proportion, geometry, and patterns were expressed through temple architecture, textile designs, music, and ritual practices. This natural integration of disciplines provides a strong foundation for contemporary educational strategies that seek to connect cognitive learning with creativity and lived experience.

Art-Integrated Learning (AIL) has gained prominence as an innovative pedagogical approach that uses artistic processes to facilitate the understanding of academic subjects. In mathematics education, AIL enables learners to grasp abstract concepts through visualization, hands-on activities, and creative expression. Traditional Indian art forms such as Warli painting, Madhubani painting, and Kolam offer meaningful contexts for exploring mathematical ideas including patterns, symmetry, fractions, and spatial relationships. These art forms not only enhance engagement but also make learning culturally contextual and relevant.

The integration of IKS with Art-Integrated Learning aligns with the vision of the National Education Policy 2020, which advocates for experiential, multidisciplinary, and culturally rooted education. By bridging traditional knowledge systems with modern classroom practices, this approach fosters deeper conceptual understanding, creativity, and critical thinking among learners.

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This research paper aims to examine the significance of Indian Knowledge Systems in mathematics education through the lens of Art-Integrated Learning. It seeks to explore how combining cultural heritage with innovative pedagogy can enhance students' engagement and conceptual clarity in mathematics, while also promoting appreciation for India's rich intellectual and artistic traditions.

Need and Importance of the present Study:

In recent years, mathematics education has faced persistent challenges such as students' fear of the subject, lack of conceptual clarity, and minimal connection between abstract concepts and real-life experiences. Traditional teaching methods often emphasize rote learning and procedural knowledge, which can limit students' creativity and deeper understanding. This highlights the urgent need for innovative and engaging pedagogical approaches that make mathematics meaningful, relatable, and enjoyable.

The integration of Indian Knowledge Systems (IKS) into education responds to this need by reconnecting learners with India's rich intellectual heritage. Contributions of scholars such as Aryabhata and Brahmagupta further illustrate how mathematical thinking was deeply rooted in observation, logic, and creativity. However, this rich legacy remains underutilized in contemporary classrooms, creating a gap between traditional knowledge and modern education.

At the same time, Art-Integrated Learning (AIL) has emerged as a powerful strategy to address the limitations of conventional teaching. By incorporating artistic elements into the learning process, AIL helps students visualize abstract mathematical concepts, enhances engagement, and promotes experiential learning. Traditional Indian art forms such as Warli painting, Madhubani painting, and Kolam naturally embody mathematical principles like symmetry, patterns, proportion, and spatial reasoning, making them effective tools for teaching mathematics in a culturally relevant manner.

The present study is important as it attempts to bridge the gap between traditional knowledge systems and modern pedagogical practices by integrating IKS with Art-Integrated Learning in mathematics education. This integration aligns with the vision of the National Education Policy 2020, which emphasizes holistic, multidisciplinary, and experiential learning. By

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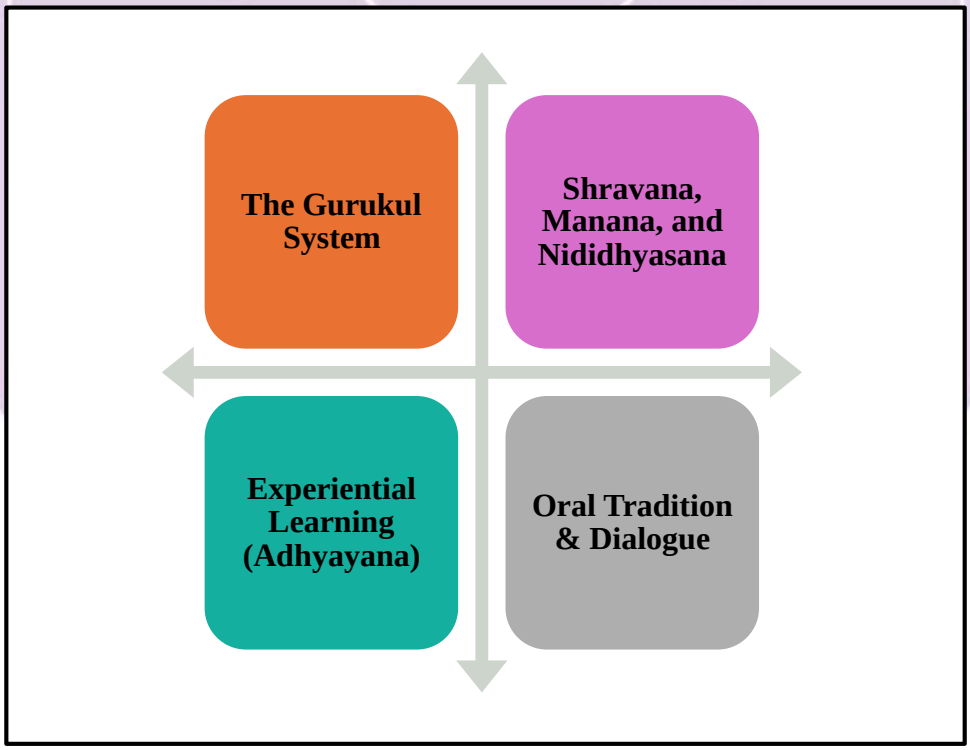
contextualizing mathematics within cultural and artistic frameworks, the study seeks to enhance students' conceptual understanding, creativity, and critical thinking skills.

Furthermore, this study is significant for educators, curriculum designers, and policymakers as it provides insights into innovative teaching strategies that can make mathematics more inclusive and engaging. It also contributes to the preservation and promotion of India's cultural heritage by incorporating indigenous knowledge and art forms into the educational process.

In essence, the need for the present study arises from the necessity to transform mathematics education into a more meaningful, enjoyable, and culturally grounded experience, while its importance lies in its potential to improve learning outcomes and foster a holistic development of learners.

Ancient Indian Education:

Ancient Indian education was characterized by a holistic, experiential, and value-based approach that aimed at the overall development of an individual—intellectual, spiritual, and practical. Learning was not limited to theoretical knowledge but was closely connected with life, nature, and society.



1. Gurukul System: The Gurukul system was a residential education model where learners stayed with their teacher under the same roof of an ashram. Personalized Mentorship. It

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developed a very intimate and personal relationship between the Guru-Shishya, in which not only knowledge but guidance regarding academic as well as personal development were provided by the Guru to the Shishya. The whole day routine covered early wake-up, then the day starts with meditation, strong study, daily work (Seva), and living with others. This shows a mix of topics like the Vedas, thought, art, and science. It used to talk and do to learn by heart and set rules for good behavior. There was no cost; thanks were given through Guru Dakshina after completing the learning.

2. Shravana, Manana, and Nididhyasana: This three-stage Vedantic teaching method was crucial for spiritual realization: Sravana (Hearing), hearing the scriptural texts (Upanishads, Gita) with great attention and hearing profound elucidations from a realized preceptor to gain a basic theoretical understanding of the nature of ultimate realities (like Atman and Brahman). Manana (Contemplation) means deep thought, reason, and discussion (debate) in the analysis of doubt about heard knowledge. The purpose is to remove misconceptions and gain clarity at an intellectual level. Nididhyasana (Assimilation/Meditation) means continuous one-pointed contemplation and actual practice by which knowledge is assimilated into the being. It transforms the understanding gained intellectually into direct experience realization, which leads to Moksha.

3. Experiential Learning: This kind of learning was mostly by doing and not only by reading books. Students learned by observing the principles in action.

4. Manual Participation: This involves daily work like farming, cooking, and fetching water. Which develops the dignity of labor and some specific tasks related to metallurgy and astronomy, among others, that inculcate self-dependence as well as moral discipline. Application practice, observation, storytelling (as in Panchatantra), and integration of knowledge with life skills result in students being both scholars and responsible citizens.

The traditions of ancient teachers depended heavily on passing along knowledge through the spoken word and providing opportunities for intellectual debate.

- Oral Tradition: Sacred texts (the Vedas) were passed down by learning and reciting what had been written down to allow people to learn them from one generation to another. The process of passing down texts was based on the precision of the written words.

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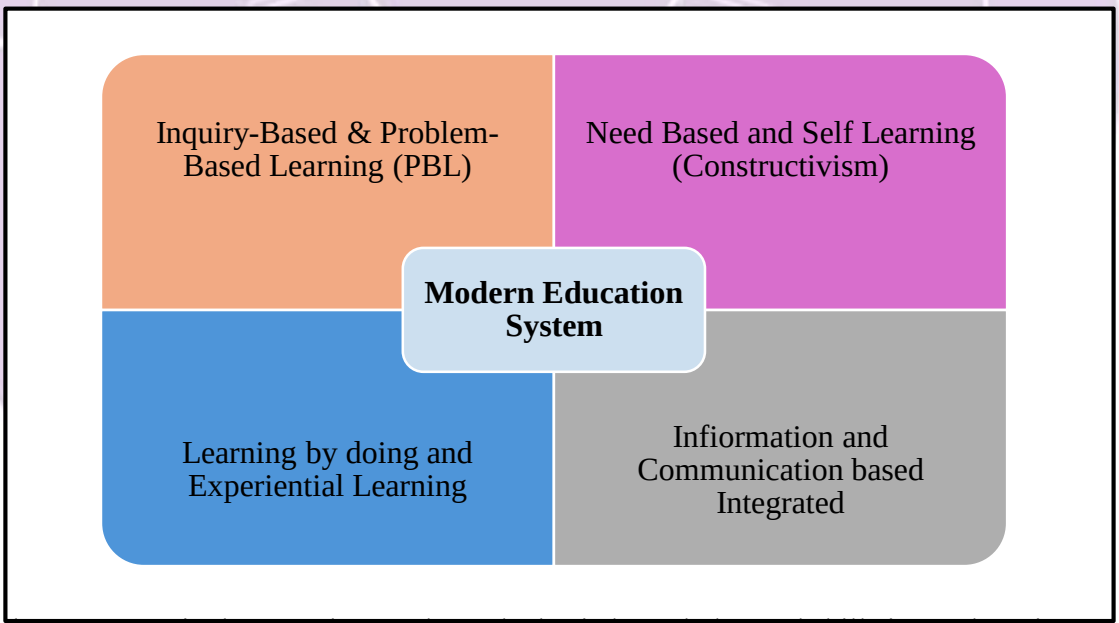
- Techniques for Dialogue: The process of using techniques to provoke discussion between scholars (Shastrartha), using a method known as "Socratic" questioning (Vada, Jalpa), or holding meeting-style talks to enhance critical thought, grow in ethical reasoning, or turn what one knows into how he/she lives.

Modern Education System:

The integration of Indian Knowledge Systems (IKS) with the modern education system promotes a more holistic, culturally rooted, and experiential approach to learning. Traditional sources like the Vedas emphasize interconnected knowledge, which complements today's interdisciplinary education. Modern frameworks such as the National Education Policy 2020 encourage incorporating indigenous knowledge to enhance relevance and identity. IKS supports value-based education, critical thinking, and real-life application of concepts. When combined with contemporary methods, it makes learning more meaningful, engaging, and contextually rich. Thus, IKS strengthens modern education by bridging tradition with innovation.



The modern core curriculum teaches students the basic knowledge and skills in Math, Science, English / Language Arts, and Social Studies, along with teaching them the 21st Century Skills, sometimes referred to as the 4Cs (Critical Thinking, Communication, Collaboration, and Creativity). Through experiential learning and a variety of teaching methods (hands-on, project-based, integrated), students develop the skills required to thrive in an increasingly

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complex world by applying what they learn to real-life situations while also gaining cultural awareness and becoming adaptable learners for life. The Modern Core Curriculum integrates the subject areas and skills that will help students be successful in their education and future careers. These include Critical Thinking, Communication, Collaboration, Creativity, Problem Solving skills, Digital Literacy and Technology, Cultural Competencies, and Personal and Social Development, such as Character building and Emotional Intelligence. The hands-on learning aspect of the curriculum encourages teachers to connect knowledge and skills to students' real lives and the world around them. The 21st Century Skills or 4Cs (Critical Thinking, Communication, Collaboration, Creativity) are intended to prepare students for success in today's global, digital economy. Through 21st Century Learning experiences, learners develop strong critical thinking skills; effective communicators, team players, innovative thinkers, digital learners, and culturally aware citizens who are prepared to thrive professionally and personally in our diverse world. The Modern Core Curriculum includes integrated or theme-based learning opportunities across multiple subject areas. Students are to use their experiences from their home cultures to help them understand the learning process better by developing the knowledge and skills needed to apply what they learn to their lives and communities. This is an example of an integrated learning strategy.

The modern education system for mathematics in schools emphasizes conceptual understanding rather than rote memorization. It focuses on developing problem-solving skills, logical reasoning, and analytical thinking among students. Teaching methods include activity-based learning, use of digital tools, and real-life applications to make mathematics more engaging. Approaches like experiential learning and competency-based education are promoted under the National Education Policy 2020. Visual aids, models, and interactive techniques help students better understand abstract concepts. Continuous assessment methods are used to evaluate students' understanding and progress. The curriculum also encourages collaborative learning and critical thinking. Overall, the modern approach aims to make mathematics meaningful, practical, and student-centered.

Key Aspects of the Study:

- Integration of Traditional Knowledge with Mathematics

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The study highlights how concepts from ancient sources like the Sulba Sutras and contributions of Aryabhata can be connected with modern mathematical topics.

- Use of Art as a Pedagogical Tool

  It focuses on incorporating traditional art forms such as Warli painting, Madhubani painting, and Kolam to teach mathematical concepts like symmetry, patterns, and geometry.
- Enhancement of Conceptual Understanding

  The approach aims to improve students' clarity of abstract mathematical ideas through visualization, creativity, and hands-on learning.
- Promotion of Experiential and Activity-Based Learning

  Learning becomes more engaging through practical activities, aligning with the principles of experiential education encouraged by the National Education Policy 2020.
- Cultural Relevance and Contextual Learning

  The study emphasizes connecting mathematics with students' cultural backgrounds, making learning more meaningful and relatable.
- Development of Creativity and Critical Thinking

  Art-integrated approaches encourage students to think creatively while applying logical and analytical skills in mathematics.
- Interdisciplinary Approach

  It promotes the integration of mathematics with art, history, and culture, reflecting the holistic nature of Indian Knowledge Systems.
- Improvement of Student Engagement and Interest

  By combining art and mathematics, the study aims to reduce fear of the subject and increase student participation and motivation.
- Preservation and Promotion of Heritage

  The study supports the inclusion of indigenous knowledge and traditional art forms in education, helping preserve India's cultural heritage.
- Implications for Teaching Practices

  It provides insights for teachers to adopt innovative, student-centered teaching methods in mathematics classrooms.

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Outcome: Learning Methods and Classroom Implications:

- **Improved Conceptual Understanding:** Mathematical concepts become easier to understand when taught through familiar cultural and artistic contexts.
  Example: Using rangoli designs to explain symmetry and geometric shapes.
- **Enhanced Learner Engagement:** Art-based activities make mathematics lessons interactive and enjoyable, increasing student participation.
  Example: Creating mandalas to learn fractions and ratios.
- **Reduction of Mathematics Anxiety:** A creative and stress-free learning environment helps reduce fear and negative attitudes towards mathematics.
  Example: Exploring number patterns through folk art motifs instead of repetitive exercises.
- **Development of Creativity and Critical Thinking:** Students analyze, design, and justify mathematical ideas through artistic expression.
  Example: Designing textile patterns to understand tessellations and proportional reasoning.
- **Cultural Awareness and Identity Building:** Learners appreciate indigenous knowledge and develop pride in cultural heritage.
  Example: Studying temple architecture to understand measurement and geometry.

Classroom Implications:

- **Shift Towards Experiential Learning:** Teachers adopt activity-based and learner-centered teaching methods.
  Example: Hands-on creation of kolam patterns in geometry lessons.
- **Inclusive Teaching Practices:** Supports diverse learning styles, especially visual and kinesthetic learners.
  Example: Mapping traditional art designs on graph paper for coordinate geometry.
- **Interdisciplinary Approach:** Mathematics is linked with art, history, and culture, encouraging holistic learning.
  Example: Integrating mathematics and social studies through craft-based projects.
- **Flexible Assessment Methods:** Assessment includes observation, project work, and creative outputs alongside written tests.

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Example: Evaluating students' mathematical understanding through their artwork explanations.

Conclusion:

The present study highlights the significant potential of integrating Indian Knowledge Systems (IKS) with Art-Integrated Learning (AIL) in enhancing the teaching and learning of mathematics. Integrating Indian Knowledge Systems and art in mathematics teaching enhances conceptual clarity, engagement, creativity, and cultural relevance. It transforms classrooms into inclusive, interactive learning spaces where mathematics is experienced as meaningful and connected to real life. The use of art forms such as Warli painting, Madhubani painting, and Kolam demonstrates that mathematical concepts can be effectively taught through visual and experiential methods. This integration not only improves conceptual understanding but also fosters creativity, critical thinking, and active participation among learners.

The study aligns with the vision of the National Education Policy 2020, which emphasizes holistic, multidisciplinary, and culturally rooted education. By bridging traditional knowledge with modern teaching practices, the approach supports a more inclusive and student-centered learning environment.

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