

Role of Vedic Mathematics in NEP 2020 and Indian Knowledge Systems: A Pathway Towards Transformative Mathematics Education

Dr. Yogita

Assistant Professor, Department of Mathematics, Government Degree College, Chaubattakhal, Pauri Garhwal, Uttarakhand, India,

Abstract

The National Education Policy (NEP) 2020 marks a paradigm shift in Indian education by advocating holistic, multidisciplinary, and culturally rooted learning. One of its significant recommendations is the integration of Indian Knowledge Systems (IKS) into curricula across educational levels. Vedic Mathematics, derived from ancient Indian mathematical traditions and popularized through sixteen computational sutras, represents an important component of IKS with considerable educational potential. The present paper examines the role of Vedic Mathematics in the implementation of NEP 2020 and explores its contribution to strengthening mathematical learning, computational fluency, logical reasoning, problem-solving ability, and cultural awareness among students. The paper is based on qualitative analysis of NEP 2020, literature on Indian Knowledge Systems, and recent studies on mathematics education. It argues that the thoughtful integration of Vedic Mathematics into school and higher education can promote experiential learning, reduce mathematics anxiety, encourage critical thinking, and support India's vision of becoming a knowledge-based society. The study concludes with recommendations for curriculum development, teacher education, research, and educational policy.

Keywords: Vedic Mathematics, NEP 2020, Indian Knowledge Systems, Mathematics Education Computational Skills, Experiential Learning.

1. Introduction

Education in the twenty-first century extends beyond knowledge acquisition to developing creativity, analytical thinking, ethical values, and cultural awareness. India's National Education Policy (2020) recognizes this broader vision by proposing an education system that is rooted in Indian traditions [1] while remaining globally competitive. One of its distinctive features is the incorporation of Indian Knowledge Systems into mainstream education [1, 2].

Among the many domains of Indian Knowledge Systems, Vedic Mathematics has attracted considerable attention because of its innovative computational techniques and pedagogical value. Although widely recognized for improving calculation speed, Vedic Mathematics also promotes logical reasoning, flexibility in mathematical thinking, and confidence in solving numerical problems. Integrating these methods with contemporary mathematics teaching can contribute significantly to achieving the objectives of NEP 2020.

Vedic Mathematics, reconstructed by Jagadguru Bharati Krishna Tirthaji (1965), offers innovative computational techniques that support logical reasoning, mental calculation, and mathematical creativity [3].

This paper explores the educational relevance of Vedic Mathematics within the framework of NEP 2020 and discusses its potential role in curriculum design, teacher education, and classroom practice.

2. Literature Review

The National Education Policy (NEP) 2020 emphasizes the integration of Indian Knowledge Systems (IKS) into education to promote holistic learning, critical thinking, innovation, and cultural awareness. The policy recommends that educational institutions incorporate India's rich intellectual heritage into teaching, research, curriculum development, and teacher education. This initiative aims to create learners who possess global competencies while remaining connected to India's knowledge traditions.

Research in mathematics education emphasizes that conceptual understanding and flexible problem-solving strategies significantly improve students' mathematical achievement [4, 5]. Studies have shown that learner-centred approaches reduce mathematics anxiety and improve classroom engagement [6].

Vedic Mathematics, reconstructed and popularized by Jagadguru Bharati Krishna Tirthaji (1965), consists of sixteen Sutras and thirteen Sub-Sutras that provide alternative methods for solving mathematical problems. Although these techniques are primarily associated with arithmetic computations, researchers have increasingly recognized their pedagogical value in developing computational fluency, mental calculation, logical reasoning, and problem-solving skills. Unlike conventional algorithmic approaches, Vedic Mathematics encourages flexible thinking and multiple solution strategies, thereby making mathematics more engaging and learner-centred.

Several studies have reported that the use of Vedic Mathematics improves students' speed and accuracy in numerical calculations. Students exposed to Vedic techniques often demonstrate greater confidence, reduced mathematics anxiety, and increased classroom participation. These findings indicate that Vedic Mathematics can serve as an effective supplementary pedagogical approach rather than a replacement for the existing mathematics curriculum.

Recent research in mathematics education also emphasizes the importance of culturally responsive teaching. Integrating indigenous knowledge systems into classroom instruction helps learners appreciate their cultural heritage while strengthening conceptual understanding [1, 7]. Within this context, Vedic Mathematics represents an important component of Indian Knowledge Systems that can connect traditional mathematical wisdom with modern educational practices.

The establishment of the Indian Knowledge Systems (IKS) Division by the Ministry of Education and AICTE has further encouraged academic institutions to undertake research, curriculum innovation, and faculty development in this area. Universities are increasingly introducing value-added courses, certificate programmes, workshops, and research projects related to IKS. Consequently, Vedic Mathematics has gained renewed importance as a discipline capable of supporting interdisciplinary learning, mathematical creativity, and national educational priorities.

Despite growing interest, systematic empirical research on the integration of Vedic Mathematics within the framework of NEP 2020 remains limited. Most available studies focus on computational techniques, while comparatively fewer studies examine its role in curriculum implementation, teacher education, policy initiatives, and holistic educational development. Therefore, there is a need to critically examine

the role of Vedic Mathematics in achieving the objectives of NEP 2020 and strengthening Indian Knowledge Systems in higher education.

Vedic Mathematics has been recognized as an effective supplementary pedagogical approach that enhances computational fluency and promotes analytical thinking [3, 8].

3. Objectives of the Study

The present study has the following objectives:

- To examine the significance of Vedic Mathematics within the framework of the National Education Policy (NEP) 2020.
- To explore the contribution of Vedic Mathematics towards the promotion of Indian Knowledge Systems in education.
- To analyse the educational benefits of Vedic Mathematics in enhancing computational skills, logical reasoning, critical thinking, and mathematical creativity.
- To identify the opportunities and challenges associated with integrating Vedic Mathematics into school and higher education curricula.
- To suggest policy recommendations for effective implementation of Vedic Mathematics in teaching, teacher education, curriculum development, and educational research in alignment with the vision of NEP 2020.

4. Research Methodology

The present study adopts a qualitative descriptive research design based on a comprehensive review and analysis of secondary data. The study primarily examines the role of Vedic Mathematics within the framework of the National Education Policy (NEP) 2020 and Indian Knowledge Systems (IKS). Since the objective is to explore educational perspectives, policy implications, and pedagogical significance rather than to test a statistical hypothesis, a qualitative approach is considered appropriate.

The present study adopts a qualitative descriptive research design based on secondary sources, including NEP 2020, IKS policy documents, peer-reviewed research articles, books, and institutional reports [1, 2].

4.1 Research Design

This research is conceptual and analytical in nature. It critically analyses existing literature, policy documents, research articles, books, and reports related to Vedic Mathematics, NEP 2020, and Indian Knowledge Systems. The study synthesizes available evidence to identify the educational relevance of Vedic Mathematics in contemporary mathematics education.

4.2 Source of Data

The study is based entirely on secondary sources of information, including:

- National Education Policy (NEP) 2020.
- Publications of the Ministry of Education, Government of India.
- Indian Knowledge Systems (IKS) Division documents.
- Research articles published in peer-reviewed journals.
- Books on Vedic Mathematics, Mathematics Education, and Indian Knowledge Systems.
- Conference proceedings, institutional reports, and scholarly publications indexed in recognized academic databases.

4.3 Method of Analysis

The collected literature was examined using thematic content analysis. Relevant themes emerging from the literature were identified and organized under the following categories:

- Educational philosophy of NEP 2020.
- Integration of Indian Knowledge Systems in education.
- Pedagogical significance of Vedic Mathematics.
- Development of computational skills and higher-order thinking.
- Curriculum integration and teacher education.
- Challenges and future opportunities.

The findings from these themes were interpreted in relation to the objectives of the study to develop a comprehensive understanding of the contribution of Vedic Mathematics to contemporary education.

4.4 Scope of Study

The study focuses on the educational role of Vedic Mathematics within the context of NEP 2020 and Indian Knowledge Systems. It discusses curriculum development, teaching-learning processes, teacher preparation, research, and policy implementation. The study does not attempt to validate the mathematical origin of the Vedic Sutras or compare Vedic methods with conventional mathematical algorithms experimentally.

4.5 Limitation of the Study

The study is limited to qualitative analysis of secondary data. Since no primary survey or experimental investigation was conducted, the findings are interpretative in nature. Future studies may employ quantitative, experimental, or mixed-method approaches to evaluate the impact of Vedic Mathematics on students' achievement, computational skills, mathematical creativity, and classroom engagement.

5. Role of Vedic Mathematics in NEP 2020

The National Education Policy (2020) envisions an education system that is holistic, multidisciplinary, flexible, inclusive, and deeply rooted in India's cultural and intellectual traditions. One of the policy's major objectives is to integrate Indian Knowledge Systems into mainstream education so that learners develop both global competencies and an appreciation of India's rich knowledge heritage. Vedic Mathematics aligns closely with this vision by providing innovative approaches to mathematical thinking and problem-solving.

Vedic Mathematics supports experiential and activity-based learning, which is a central feature of NEP 2020. Instead of relying solely on memorization and lengthy procedures, Vedic techniques encourage students to explore multiple methods for solving mathematical problems. This learner-centred approach enhances conceptual understanding and active classroom participation.

Another important objective of NEP 2020 is the development of critical thinking, creativity, and problem-solving abilities. The sixteen Sutras and thirteen Sub-Sutras of Vedic Mathematics offer flexible computational strategies that allow students to analyse numerical patterns, identify relationships, and solve problems efficiently. Such practices promote mathematical reasoning rather than mechanical computation. The policy also emphasizes competency-based education. Vedic Mathematics contributes to competency development by strengthening mental calculation, computational fluency, numerical confidence, and logical reasoning. These competencies are essential not only in mathematics but also in science, technology, commerce, and competitive examinations.

NEP 2020 further recommends the integration of Indian Knowledge Systems into teacher education and curriculum design. Vedic Mathematics provides an excellent opportunity for curriculum enrichment through value-added courses, elective papers, workshops, bridge programmes, and teacher training initiatives. Its inclusion can make mathematics classrooms more engaging while promoting awareness of India's intellectual heritage.

The multidisciplinary approach advocated by NEP 2020 also supports research on Vedic Mathematics in collaboration with education, psychology, cognitive science, history of mathematics, artificial intelligence, and educational technology. Such interdisciplinary research can generate evidence regarding the effectiveness of Vedic techniques in improving learning outcomes and computational skills.

Thus, Vedic Mathematics serves as an effective educational resource that complements the objectives of NEP 2020 by promoting quality education, innovation, cultural awareness, and competency-based learning.

NEP 2020 advocates experiential learning, competency-based education, and the integration of Indian Knowledge Systems across all educational levels [1]. Vedic Mathematics aligns with these objectives by encouraging multiple solution strategies, logical reasoning, and computational efficiency [3].

The policy also emphasizes critical thinking, creativity, and interdisciplinary learning, which are strengthened through flexible mathematical approaches [1, 4].

6. Vedic Mathematics as an Integral Component of Indian Knowledge Systems (IKS)

Indian Knowledge Systems (IKS) encompass the rich intellectual traditions of India in diverse disciplines such as mathematics, astronomy, medicine, philosophy, linguistics, architecture, agriculture, and environmental science. The National Education Policy (NEP) 2020 recognizes the importance of preserving, promoting, and integrating these knowledge traditions into contemporary education. Within this broader framework, Vedic Mathematics has emerged as a significant educational resource that connects India's mathematical heritage with modern pedagogical practices.

Vedic Mathematics represents an innovative approach to mathematical computation based on sixteen Sutras (aphorisms) and thirteen Sub-Sutras compiled and interpreted by Jagadguru Bharati Krishna Tirthaji. Although the historical origins of these Sutras continue to be discussed by scholars, their educational value has been widely acknowledged in mathematics education. The methods encourage flexibility in thinking, mental computation, pattern recognition, estimation, and creative problem-solving, making mathematics more accessible and enjoyable for learners.

Indian Knowledge Systems aim to preserve and disseminate India's rich intellectual traditions while promoting innovation in education [2]. Vedic Mathematics represents an important component of this heritage because it integrates numerical reasoning with culturally contextualized learning [10, 11].

Teacher education and faculty development are essential for effective implementation of IKS in higher education [1, 9].

One of the primary objectives of IKS is to promote contextual and culturally relevant learning. Vedic Mathematics enables students to appreciate India's intellectual contributions while developing essential mathematical competencies. Learning mathematical concepts through indigenous techniques fosters cultural confidence and encourages students to view mathematics not merely as a collection of formulas but as a discipline rooted in logical reasoning and systematic thinking.

The multidisciplinary philosophy of NEP 2020 further strengthens the relevance of Vedic Mathematics. Its principles can be integrated with cognitive science, educational psychology, computer science, artificial

intelligence, financial literacy, and data science. Mental calculation strategies derived from Vedic Mathematics support algorithmic thinking, numerical reasoning, and computational efficiency, which are valuable skills in the digital era.

Teacher education plays a crucial role in the successful implementation of Indian Knowledge Systems. Faculty development programmes, orientation courses, workshops, and curriculum enrichment initiatives can equip teachers with the pedagogical knowledge required to integrate Vedic Mathematics into classroom instruction. Well-trained teachers can employ Vedic techniques as supplementary instructional strategies that improve classroom engagement, encourage active participation, and reduce mathematics anxiety among students.

The integration of Vedic Mathematics into higher education also creates opportunities for interdisciplinary research. Researchers may investigate its impact on computational skills, mathematical achievement, cognitive development, creativity, mathematical anxiety, and problem-solving ability across different educational levels. Evidence generated through empirical studies will contribute to informed policy decisions regarding curriculum design and educational innovation.

Furthermore, digital technologies offer new possibilities for promoting Vedic Mathematics within the IKS framework [1, 9]. Interactive mobile applications, online learning platforms, virtual laboratories, artificial intelligence-based tutoring systems, and gamified learning environments can make Vedic Mathematics accessible to diverse groups of learners. Such innovations align with NEP 2020's vision of technology-enabled education while preserving India's intellectual heritage.

Therefore, Vedic Mathematics should not be viewed solely as a collection of rapid calculation techniques. Rather, it represents an important component of Indian Knowledge Systems that supports holistic education, promotes mathematical thinking, strengthens cultural identity, and contributes to the development of globally competent learners rooted in Indian values.

7. Educational Implications

Research indicates that active learning strategies improve mathematical understanding and problem-solving abilities [12, 13]. Vedic Mathematics encourages mental computation, learner engagement, and mathematical creativity, making it an effective supplementary teaching strategy [3, 4].

The integration of Vedic Mathematics into educational practice has several important implications. First, it promotes learner-centred pedagogy by encouraging students to explore multiple solution strategies instead of relying on a single algorithm. Second, it strengthens computational fluency and mental arithmetic, enabling students to perform calculations with greater confidence and efficiency.

Vedic Mathematics also contributes to the development of higher-order thinking skills, including logical reasoning, analytical thinking, creativity, and decision-making. These competencies are essential for success in science, technology, engineering, and mathematics (STEM) education as well as in competitive examinations.

Another significant implication is its potential to reduce mathematics anxiety. Many students perceive mathematics as a difficult and abstract subject. The simplified techniques and engaging nature of Vedic Mathematics make learning more enjoyable, thereby increasing motivation and classroom participation. From the perspective of teacher education, structured training programmes can prepare teachers to integrate Vedic Mathematics appropriately with the prescribed curriculum. Rather than replacing conventional methods, Vedic techniques should be used as complementary pedagogical tools that enrich classroom teaching and support competency-based education.

Finally, the inclusion of Vedic Mathematics in curriculum enrichment programmes, certificate courses, value-added courses, and research projects can strengthen the implementation of NEP 2020 and contribute to the broader objectives of Indian Knowledge Systems by preserving India's mathematical heritage while fostering innovation in education.

8. Challenges and Recommendations

8.1 Challenges

Despite the increasing recognition of Vedic Mathematics within the framework of the National Education Policy (NEP) 2020 and Indian Knowledge Systems (IKS), several challenges hinder its effective implementation in educational institutions.

- **Limited Teacher Preparedness:** Many mathematics teachers have not received formal training in Vedic Mathematics. Consequently, they may lack the pedagogical knowledge required to integrate Vedic techniques with the prescribed curriculum.
- **Lack of Standardized Curriculum:** There is no nationally standardized curriculum specifying the scope, sequence, and learning outcomes of Vedic Mathematics across different educational levels. This often results in inconsistent classroom practices.
- **Insufficient Empirical Research:** Although Vedic Mathematics is widely promoted, rigorous empirical studies examining its impact on mathematical achievement, computational fluency, conceptual understanding, creativity, and mathematics anxiety remain limited. More evidence-based research is required to establish its educational effectiveness.
- **Misconceptions and Historical Debates:** Discussions regarding the historical origins and interpretation of the Sutras sometimes overshadow the pedagogical value of Vedic Mathematics. Academic discourse should distinguish between historical inquiry and educational usefulness.
- **Resource Constraints:** Many institutions lack appropriate textbooks, digital learning resources, teacher manuals, and instructional materials for systematic implementation.

8.2 Recommendations

To realize the vision of NEP 2020 and strengthen Indian Knowledge Systems, the following recommendations are proposed:

- Introduce Vedic Mathematics as a value-added or elective course in schools and higher education institutions rather than as a replacement for the existing mathematics curriculum.
- Organize Faculty Development Programmes (FDPs), orientation courses, workshops, and refresher programmes to train teachers in effective pedagogical applications of Vedic Mathematics.
- Encourage universities to undertake interdisciplinary research on Vedic Mathematics involving mathematics education, psychology, cognitive science, artificial intelligence, and educational technology.
- Develop standardized curriculum frameworks, textbooks, digital content, and assessment tools aligned with competency-based education and learning outcomes.
- Promote technology-enabled learning through mobile applications, virtual classrooms, interactive software, and AI-supported learning platforms for teaching Vedic Mathematics.
- Encourage collaborative projects among universities, the Indian Knowledge Systems (IKS) Division, NCERT, SCERTs, and teacher education institutions for curriculum development and capacity building.

- Support experimental and longitudinal studies to evaluate the impact of Vedic Mathematics on computational skills, logical reasoning, mathematical creativity, academic achievement, and students' attitudes towards mathematics.

The successful implementation of Vedic Mathematics requires curriculum reforms, teacher training, and evidence-based educational research [1, 7]. Universities should promote interdisciplinary research and develop standardized instructional materials aligned with the objectives of NEP 2020 [2].

9. Conclusion

The National Education Policy 2020 has created new opportunities for integrating India's rich intellectual heritage into contemporary education through the promotion of Indian Knowledge Systems. Vedic Mathematics represents one of the most promising components of this initiative because it combines cultural relevance with educational effectiveness. Its emphasis on mental computation, logical reasoning, flexibility in problem-solving, and mathematical creativity aligns closely with the objectives of competency-based and experiential learning advocated by NEP 2020.

Rather than replacing conventional mathematics, Vedic Mathematics should be viewed as a complementary pedagogical approach that enriches mathematics teaching and learning. Its integration into curricula, teacher education, research, and digital learning environments can improve students' computational fluency, confidence, and analytical thinking while strengthening awareness of India's mathematical heritage.

Successful implementation, however, requires systematic teacher training, standardized curriculum frameworks, high-quality instructional resources, and robust empirical research. Educational institutions, policymakers, researchers, and teachers must work collaboratively to develop evidence-based practices that maximize the educational benefits of Vedic Mathematics.

In conclusion, the thoughtful integration of Vedic Mathematics within the framework of Indian Knowledge Systems has the potential to contribute significantly to the realization of NEP 2020 by fostering holistic education, promoting innovation, preserving cultural knowledge, and preparing learners with the competencies required for the twenty-first century.

The integration of Vedic Mathematics within the framework of Indian Knowledge Systems supports the vision of NEP 2020 by promoting competency-based education, cultural awareness, mathematical creativity, and holistic learning [1, 2, 3].

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