International Journal of Engineering Research and Science & Technology

www.ijerst.org

ISSN : 2319-5991

Vol. 22 No. 3 (2026)

ijerst.editor@gmail.com

editor@ijerst.com

ISSN 2319-5991 www.ijerst.com

Peer Reviewed, Referred & Indexed Journal

Research Paper

REIMAGINING MATHEMATICS EDUCATION THROUGH INDIAN KNOWLEDGE SYSTEMS: HERITAGE, INNOVATION AND NEP 2020

Dr. Seema Agarwal.
Associate Professor and Vice Principal
Ghanshyamdas Saraf College of Arts & Commerce (Autonomous), Mumbai, Maharashtra

ABSTRACT

The mathematical heritage of India in arithmetic, algebra, geometry, number theory, astronomy, measurement, computation and statistical reasoning is extremely rich due to centuries of intellectual research. This tradition is explained by Indian Knowledge System (IKS) and is integrated in the modern schooling. NEP 2020 aims at integrating Indian knowledge traditions into higher education for the promotion of holistic learning, critical thinking, creativity, interdisciplinary understanding and greater awareness of India's intellectual achievements. The present study investigates the possibility of incorporation of India's mathematical heritage in the modern mathematical education through NEP 2020. The discussion involves the works of Aryabhata, Brahmagupta, Bhaskara II, Srinivasa Ramanujan, P. C. Mahalanobis and C. R. Rao in mathematics, astronomy and statistics. The traditional methods of arithmetic and mental computation, selected features of Vedic Mathematics, and mathematical ideas in Indian astronomical traditions are also discussed along with their significance for conceptual understanding and mathematical reasoning. Integrating IKS into mathematics education can make meaningful connections to traditional knowledge and modern mathematical application. This method can be used to teach mathematicsfrom historical, cultural and multidisciplinary points of view to scholars, and to develop logic, problem-solving and computational thinking. The study examines the relation of India's mathematical background with data science, statistics, economics, finance, technology and AI. The study reveals that the meaningful integration of IKS with mathematics in NEP 2020 could make mathematics education more contextual, inclusive and culturally embedded. It can tell students about India's mathematical achievements and how to apply math to challenges and opportunities of the 21st century.

Keywords: Indian Knowledge Systems, Mathematics Education, NEP 2020, Indian Mathematical Heritage, Indian Mathematicians, Vedic Mathematics, Astronomy, Statistics, Interdisciplinary Learning, Mathematical Reasoning

1. INTRODUCTION.

'India has an extensive and distinguished tradition of intellectual inquiry. Indian scholars have contributed greatly to the development of mathematical knowledge from ancient mathematical texts and astronomical observations to developments involving algebra, number systems, statistics and modern mathematical research.

The Indian Knowledge System (IKS) is a treasure trove of knowledge evolved and propagated thru the various intellectual traditions of India. Mathematics, astronomy, medicine, philosophy, linguistics, arts, agriculture, architecture, metallurgy, environmental knowledge are some of the topics discussed. Numerical reasoning and mathematical methods were closely associated with astronomy, architecture, trade, calendars, measurement and everyday life and thus mathematics was a significant component of this knowledge tradition.

The NEP 2020 aims at transforming the education system through the promotion of

holistic, multi-disciplinary, experiential and competency-based learning. It acknowledges the importance of India's rich knowledge traditions and promotes their integration into education in a manner that is relevant to the needs of today.

By integrating IKS into mathematics education, the students are sensitized to the historical contributions of India, simultaneously nurturing modern mathematical competencies. Instead of seeing mathematics as a collection of formulas and procedures, students can be encouraged to understand the evolution of mathematical ideas, the reasons for their development, and how they continue to influence contemporary science and technology.

Thus the integration of IKS and Mathematics within the NEP 2020 framework can contribute to:

• Developing conceptual understanding of math concepts.
• Develop logical and analytical thinking.
• To introduce students to the mathematical heritage of India.
• Improvement of mental calculation and estimation skills.
• Creating connections between maths and astronomy, science, technology, economics and other subjects.
• Promoting problem solving and creative thinking.
• Fostering appreciation of India's contributions to world knowledge.
• Make the learning of mathematics more contextual and meaningful.

2. MATHS AND INDIAN KNOWLEDGE SYSTEMS:

Indian intellectual traditions have given importance to mathematics. The ancient Indian mathematical knowledge developed due to practical and theoretical needs such as astronomical calculations, calendar preparation, land measurement, commerce, architecture and religious and cultural practices.

Key developments in the Indian mathematical traditions include:

• Arithmetic and numerical calculation
• Geometry and measurement
• Algebraic - Number theory
• Trigonometry
• Mathematische Astronomy
• Combinatorics
• Series and sums to infinity
• Statistics and probability in modern period

The Indian contribution to mathematics is especially important in the development and systematic use of the decimal place-value system and the idea of zero. Eventually these ideas became the basis for modern mathematics and computing systems.

It can thus be used not only as historical content but also as a means of showing how mathematical thinking develops in response to real world problems. This approach can enable students to see mathematics as a living and breathing science.

3. ANCIENT INDIAN TRADITION IN MATHEMATICS AND ASTRONOMY:

Mathematics and astronomy grew up together in India. Observing the stars correctly demanded high mathematics to compute the positions and motions of the heavenly bodies , to measure time , to compile calendars , to forecast astronomical phenomena .

"Indian scholars contributed much to mathematical astronomy. The most prominent were Aryabhata, Brahmagupta and Bhaskara.

3.1 Aryabhata

Aryabhata , one of the most influential mathematicians and astronomers of ancient India , wrote the Aryabhatiya . His writings included discussions of arithmetic, algebra, trigonometry and astronomy. He estimated the value of π and devised mathematical techniques for astronomical calculations. Aryabhata's work shows how mathematical ideas were developed in relation to the observation and explanation of natural phenomena.

3.2 Brahmagupta

Brahmagupta made great advances in arithmetic and algebra. His treatment of zero and negative numbers was especially important. His work gave rules for carrying

out arithmetic operations with zero and negative quantities, and furthered the development of algebraic thinking.

3.3 Bhāskara

Bhaskara especially Bhaskara II made large contributions to algebra, arithmetic, geometry and astronomy. His writings show the advanced mathematical techniques used by Indian scholars for the solution of practical and theoretical problems.

3.4 Educational Implications Today

The historical relationship between mathematics and astronomy can be used in the classroom to:

• Mathematical modeling of motion of planets.
• A study of calendars and the measurement of time.
• Geometrical models of observations of the sky.
• Applications of Trigonometry.
• Numerical simulations of astronomical systems.
• Project learning based on observation and calculation.

Such activities can link historical knowledge to current scientific understanding.

4. CONTRIBUTIONS OF PROMINENT INDIAN MATHEMATICIANS AND STATISTICIANS:

India has an extensive mathematical heritage, from ancient scholars to contemporary mathematicians and statisticians. Their work demonstrates that mathematical knowledge has been evolving thru different historical periods.

4.1 Srinivasa Ramanujan (1887-1920)

Srinivasa Ramanujan is world renowned for his brilliant work in number theory, infinite series, continued fractions, mathematical analysis and partition theory. His work continues to influence research in mathematics today.

Ramanujan's life also demonstrates the value of curiosity, independent thinking, creativity and persistence in mathematical discovery.

4.2 P. C. Mahalanobis

The pioneer statistician was Prasanta Chandra Mahalanobis. His most famous contribution is the Mahalanobis distance, a powerful statistical measure used in multivariate analysis. He was also a key player in setting up statistical institutions and promoting statistics in national planning and development.

4.3 C. R. Rao

Calyampudi Radhakrishna Rao made fundamental contributions to mathematical statistics, statistical inference, estimation theory, and allied areas. His work has had a lasting effect on statistics and its use in science and society.

4.4 Other Indian Thinkers

India has a glorious tradition of outstanding scholars who have made their contributions to mathematics, statistics, probability, mathematical physics, differential equations and allied fields. Their contributions showcase the diversity of India's mathematical and scientific traditions.

By presenting students with these personalities, we can help them realize that mathematics is not only a theoretical subject but also a field of creativity, discovery, research and social application.

5. ARITHMETIC AND THE EARLY MATHEMATICAL PROCEDURES:

Arithmetic is one of the cornerstones of mathematics. Traditional Indian mathematical practices included efficient methods of numerical computation. They were often targeted at simplifying computations and improving mental agility.

When properly conceptualized, traditional techniques of mathematics can be complementary to modern methods within the framework of contemporary education.

Major areas are:

5.1 Arithmetic Operations

Students should have a good knowledge of:

• Addition
• Subtraction
• Multiplication
• Division
• Expressions of fractions
• Numbers in decimals
• percentages
• Ratios and proportions

5.2 Mental arithmetic

Mental calculation can foster numerical flexibility and estimation. Students can be encouraged to work out appropriate problems mentally before they are allowed to use calculators or digital devices.

5.3 Estimation and Approximating

Estimation is a very important mathematical skill used in everyday life, science, commerce, engineering and decision making. Students can be taught to judge the plausibility of a calculated answer.

5.4 Reasoning for Algebra

Arithmetic is the foundation of algebra. Students can progress from working with numerical patterns to working with variables, expressions, equations, and mathematical relationships.

5.5 Games and mathematical puzzles

Math is more fun when you play games, do puzzles, look for patterns, and do logic activities. All of these help you to develop reasoning and problem-solving skills.

The goal should not be to teach faster calculations but to develop number sense, reasoning, accuracy, flexibility and conceptual understanding.

6. VEDIC MATHEMATICS & LEARNING MATHEMATICS:

The term Vedic mathematics normally refers to a set of methods, allegedly mental tricks to aid rapid calculation, which have been popularized in modern times. They are especially linked to mental calculation and various methods of solving a certain kind of numerical problem. From the perspective of education in the IKS, these techniques can be studied as a part of the larger Indian mathematical heritage. But they must be accompanied by the standard mathematical methods and supported by conceptual understanding.

Vedic Maths and other calculation techniques can be useful for:

- Building mental arithmetic skills.
- More numerical flexibility.
- Enabling pattern recognition.
- Proposing alternative solutions to selected problems.
- Building confidence in math.
- Participation in numerical learning.

Teachers should ensure that students understand why the method works rather than just memorizing a shortcut for effective integration.

So, conventional mathematical methods can be used as pedagogical tools to supplement, not to replace, conceptual mathematics.

7. Mathematical Tools and Their Uses in the Sciences and Engineering

One of the important aims of modern mathematics education is to help students learn that mathematics is not an isolated phenomenon. Mathematical concepts and tools are used extensively in almost all educational and professional disciplines.

NEP 2020 is built on the principles of multidisciplinary and experiential learning, offering opportunities to demonstrate these linkages.

7.1 Math & Science

Mathematics is the language of representation and analysis of scientific phenomena. Mathematical models, measurements, equations, statistics and data interpretation find applications in physics, chemistry, biology, environmental science and other scientific fields.

7.2 Mathematics and Tech

Modern technologies are built on mathematical concepts. Mathematics is everyplace in computer science, information technology, engineering, cryptography, algorithms, computer graphics, computational modeling.

7.3 Economics & Mathematic

In economics, math is used to study demand and supply, growth, optimization, financial models, statistics, forecasting and economic data.

7.4 Mathematics and Finance

Financial literacy includes knowledge about percentages, interest, taxation, loans, investments, inflation, risk and data interpretation. Hence mathematical knowledge is important for responsible financial decision making.

7.5 Mathematics and Data Science

With the rise of digital technology, statistics, probability, visualization of data, mathematical modeling and computational techniques have become increasingly important. Students need to be mathematically and statistically literate to critically interpret information.

7.6 AI and Mathematics

Artificial intelligence and machine learning rely on mathematical concepts such as linear algebra and probability, statistics, optimization and calculus. This gives an important contemporary context for mathematics education.

7.7 Mathematics and Environmental Sustainability

Mathematical models can be used to understand climate patterns, population growth, resource consumption, pollution, water management, and other environmental issues.

7.8 Mathematics and Health Sciences

Statistics and mathematical modelling are widely used in epidemiology, medical research, public health, clinical studies, and the analysis of health-related data.

These examples demonstrate that mathematical knowledge is more meaningful when students can see its application outside the mathematics classroom.

8. IKS, NEP 2020 AND PEDAGOGICAL APPROACHES:

Teaching-learning methods suitable for integration of IKS with mathematics should be adopted NEP 2020 encourages education that is experiential, inquiry-based, competency-oriented, multidisciplinary,
and connected with real-life situations.

Some helpful strategies include:

8.1 Activity-Based Learning

Puzzles, calculations, the construction of geometrical figures, mathematical games and practical activities enable students to explore historical mathematical methods.

8.2 Learning by Projects

Some topics that projects may cover include:

• Contributions of Indian mathematical scholars.
• Historical development of zero.
• Astronomy in India.
• Conventional measurement methods.
• Mathematical patterns in Indian architecture.

Mathematics Applications in Indian Calendars.

• Mathematics in indigenous designs and crafts.

8.3 Learning from Experience

Students learn to develop mathematical concepts by observing, measuring, calculating, modeling and analyzing real-life situations.

8.4 Digital Education

Technology can be used to create interactive mathematical activities, virtual models, simulations and visualizations that connect historical mathematical knowledge with modern applications.

8.5 Cross-curricular learning

Math can be integrated with history and geography, science, economics, computer science, environmental studies, and other subjects.

Approaches such as these can turn mathematics from a subject based on formulas into an engaging and exploratory experience for learning.

9. ROLE OF TEACHERS IN INTEGRATION OF IKS WITHMATHEMATICS:

Teachers play a vital role in making sure that IKS integration is academically meaningful and pedagogically effective.

Teachers may:

• Introduce students to authentic historical sources of mathematics.
• Talk about the history of mathematical discoveries.
• Link ancient techniques to new mathematical concepts.
• Encourage students to compare different solutions of a problem.
• Encourage questioning, reasoning and discussion.
• Use of projects and activities related to Indian Mathematical Heritage
• Relate mathematical concepts to real-world applications.
• Encourage students to research on Indian mathematicians.

• Use technology to show mathematical and astronomical concepts.

The teacher should therefore move from being a transmitter of information to being a facilitator of exploration, analysis, interpretation and application.

10. ADVANTAGES OF INTEGRATING IKS AND MATHEMATICS EDUCATION :

There may be several benefits of the meaningful integration of IKS in mathematics education.

Benefits:

Intellectual Benefits

• Develops logical reasoning.

• Enhances problem-solving skills.

• Shows an interest in mathematics.

• Encourages analytical and critical thinking.

Cultural advantages

• Creates awareness of the intellectual heritage of India.

• Helps students learn about the historical evolution of mathematics.

• Develops respect for diverse knowledge traditions.

Benefits for Education

• Contextualizes mathematics.

• Fosters experiential and activity-based learning.

• Supports multi-disciplinary education.

• Provides opportunities for project-based learning.

Modern Benefits

• Links mathematics to technology and innovation.

- Fosters quantitative and data literacy.

• supports applications in science, finance , economics and artificial intelligence

• Equips students to solve difficult issues in real-world situations.

11. DIFFICULTIES AND ISSUES:

There are significant opportunities for integrating IKS into mathematics education, but this must be done carefully and in an academic manner.

First of all , historical claims about mathematics should be backed up by reliable scholarly sources . Students should be encouraged to differentiate between documented historical contributions and later interpretations.

Second, traditional methods should be used to complement, rather than replace, conceptual understanding. Mathematical education should continue to focus on reasoning, proof, modeling, problem solving and modern mathematical approaches.

Third, teachers need to be adequately trained and provided with learning resources to be able to effectively integrate IKS into mathematics classrooms.

Finally, IKS should be presented as a dynamic knowledge tradition open to critical study and linked to contemporary mathematics, rather than as a collection of historical facts.

12. THE WAY FORWARD:

Systematic academic initiatives may improve the integration of IKS and mathematics under NEP 2020. Educational institutions may:

1. Develop modules on history of Indian mathematics
2. Organize seminars and workshops on Indian mathematical heritage.
3. Support student projects on Indian mathematicians and Indian mathematical texts.
4. Create mathematical activities from traditional Indian knowledge
5. Include mathematical astronomy in interdisciplinary projects.
6. Digital instruments for visualizing historical mathematical concepts.
7. Stimulate research in Indian mathematical traditions.
8. Teacher training in relation to IKS, mathematics pedagogy.
9. Create math clubs based on puzzles, history, applications and innovation.
10. Integrate traditional math knowledge with modern STEM education.

Such initiatives can contribute to a balanced approach to education that respects India's heritage and prepares students for the challenges of the modern world.

13. SUMMARY:

Indian mathematics is an important part of the intellectual heritage of India. The contributions of great scholars like Aryabhata, Brahmagupta, Bhaskara, Ramanujan, Mahala Nobis, C. R. Rao show the continuity and diversity of mathematical thinking in India. NEP 2020 provides an important framework for integrating Indian knowledge traditions into contemporary education. In mathematics this is accomplished by integrating the historical knowledge with the contemporary mathematical concepts, applications, technology and interdisciplinary learning.

The purpose of the integration of IKS in mathematics should not be restricted to the celebration of past achievements. It should inspire students to question, explore, calculate, reason, model, discover and apply mathematical ideas.

Traditional mathematical techniques such as mental calculation methods and approaches associated with Vedic Mathematics can be used meaningfully in conjunction with conceptual understanding and contemporary mathematical pedagogy. Similarly, the study of Indian mathematical astronomy and Indian scholars' contributions can provide students with historical context and inspiration for further learning.

To summarize, the integration of IKS and mathematics can contribute to the vision of NEP 2020 in the development of learners who are mathematically competent, culturally aware, critical thinkers, innovative, and able to apply knowledge to real-world challenges. This approach can make mathematics education more holistic, relevant, inclusive and globally meaningful while reinforcing students' understanding of India's contribution to the progress of human knowledge.

REFERENCES

1. Ministry of Education, Government of India. **National Education Policy 2020**. Government of India.
2. Ministry of Education, Government of India. **Indian Knowledge Systems – IKS Division**. Government of India.
3. Ministry of Education, Government of India. **NEP 2020: Implementation and Achievements**. Government of India.
4. Research literature on **National Education Policy 2020 and School/Higher Education**, available through academic research databases.
5. Research literature on the **History of Indian Mathematics and Astronomy**, including studies of Aryabhata, Brahmagupta, Bhaskara, and other Indian scholars.
6. Research literature on **Srinivasa Ramanujan and his contributions to Number Theory**.
7. Research literature on **P. C. Mahalanobis and C. R. Rao and their contributions to Statistics**.