



Journal of INDIAN KNOWLEDGE STUDIES (JIKS)

Ancient Wisdom, Modern Mathematics: Exploring the Relevance of IKS in Contemporary Mathematical Thought

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ABSTRACT

Mathematics has always been a key part of human civilization. Many mathematical ideas we use today can be traced back to ancient cultures, especially in India. The Indian Knowledge System (IKS) greatly contributed to mathematics through concepts like the decimal number system, zero, algebra, geometry, trigonometry, and calculation techniques. Ancient Indian scholars developed math methods for trade, architecture, astronomy, medicine, and everyday life. Their work still shapes modern mathematics and computational sciences.

This paper looks at the links between ancient mathematical wisdom and today's mathematics. It highlights the contributions of famous Indian mathematicians like Aryabhata, Brahmagupta, Bhaskara II, and the Kerala School of Mathematics. The paper also explains how ancient math principles are used in modern fields such as computer science, artificial intelligence, cryptography, engineering, and math education. It stresses the importance of incorporating traditional mathematical knowledge into current teaching practices to promote logical thinking, creativity, and cultural awareness. The study concludes that ancient math knowledge is not just a historical achievement, but a valuable resource that continues to inspire innovation today. Integrating this wisdom into modern math education can enhance learning and foster a greater appreciation of India's scientific heritage.

KEYWORDS

Indian Knowledge System, Ancient Mathematics, Zero, Decimal System, Aryabhata, Modern Mathematics, Mathematics Education.

ARTICLE HISTORY

Received: 02 July 2026

Revised: 15 July 2026

Accepted: 04 August 2026

Published: 05 September 2026

CITATION

Singh, C., (2026) Ancient Wisdom, Modern Mathematics: Exploring the Relevance of IKS in Contemporary Mathematical Thought. *Journal of Indian Knowledge Studies (J. Indian Knowl. Stud.)*, 1(1), 26-30. <https://doi.org/>

INTRODUCTION

Mathematics is often called the language of science because it helps us recognize patterns, solve problems, and explain the natural world. Every scientific and technological advance relies on math principles. While mathematics is always evolving, many of its basic ideas started thousands of years ago. Ancient civilizations like India, Egypt, Greece, and China made major contributions to math knowledge. India holds a unique position since many important mathematical concepts were developed by Indian scholars.

The Indian Knowledge System (IKS) includes the traditional wisdom developed in India over many centuries. It covers knowledge related to mathematics,

astronomy, medicine, philosophy, architecture, agriculture, and education. Ancient Indian mathematics was closely tied to practical life. Calculations were necessary for building temples, measuring land, creating calendars, conducting trade, and observing astronomical events. Thus, Indian mathematicians developed highly accurate and innovative calculation methods. One of India's greatest contributions is the idea of zero as a number. Before this, complex calculations were tough to perform. The introduction of zero, along with the decimal place value system, completely changed mathematics. Today, these concepts are the foundation of arithmetic, algebra, computer science, and digital technology. Indian mathematicians also made

significant contributions to algebra, geometry, trigonometry, and numerical analysis.

Aryabhata introduced key trigonometric ideas and calculated the value of π with great accuracy. Brahmagupta created mathematical rules for zero and negative numbers, while Bhaskara II expanded algebra and calculus-like concepts. The Kerala School later introduced infinite series that resemble concepts developed in Europe much later. In today's digital age, mathematics plays a vital role in artificial intelligence, data science, machine learning, cryptography, engineering, finance, and space research. Many modern applications depend on mathematical foundations rooted in ancient discoveries. Thus, studying ancient mathematical wisdom is important not only for understanding history but also for appreciating its ongoing importance in addressing modern challenges.

This paper examines the key contributions of ancient Indian mathematics and explains how these ideas still influence today's mathematical thinking. It also emphasizes the educational value of incorporating Indian mathematical heritage into modern teaching and learning methods.

2. ANCIENT INDIAN MATHEMATICAL WISDOM

Ancient India has a rich mathematical tradition that dates back over two thousand years. Mathematics was not studied as a standalone subject but was linked to astronomy, architecture, trade, agriculture, and religious practices. Indian scholars viewed math as essential for understanding both nature and human life, developing methods that were practical, logical, and remarkably accurate.

One of the earliest mathematical texts is the Sulba Sutras (around 800–500 BCE). These texts provided rules for building Vedic altars with precise specifications. They included geometric principles, calculations of squares and rectangles, and methods similar to the Pythagorean Theorem. This indicates that Indian scholars had advanced geometric knowledge long before many later civilizations. Another major achievement was the decimal place value system. Unlike earlier number systems that were hard to use, the Indian system assigned value based on the position of a digit. This innovation made arithmetic calculations much simpler and more efficient.

The decimal system is now used worldwide and underpins modern mathematics. Perhaps the most revolutionary contribution was the creation of zero as both a numeral and a mathematical concept. Zero simplified calculations and allowed for efficient

representation of very large numbers. Without zero, modern computers, digital communication, and advanced mathematical calculations would not exist.

3. CONTRIBUTIONS OF GREAT INDIAN MATHEMATICIANS

3.1 Aryabhata (476–550 CE)

Aryabhata is recognized as one of India's greatest mathematicians and astronomers. His famous work, *Aryabhatiya*, introduced several significant mathematical ideas that are still influential today. Aryabhata provided a highly accurate approximation of π (pi), which is about 3.1416. He also established the use of trigonometric functions like sine, which are now essential in engineering, physics, astronomy, and navigation.

Additionally, Aryabhata proposed methods for solving linear equations and performing astronomical calculations accurately. His work demonstrated that mathematics could explain natural phenomena scientifically.

3.2 Brahmagupta (598–668 CE)

Brahmagupta made significant contributions to mathematics by developing clear rules for calculations involving zero and negative numbers. His book, *Brahmasphutasiddhanta*, explained how these numbers could be added, subtracted, multiplied, and used in equations. He also created methods for solving quadratic equations, contributing to algebra and geometry.

Many of his ideas later spread to the Arab world and eventually reached Europe, influencing the growth of modern mathematics.

Brahmagupta's work set a solid foundation for algebra and numerical calculations that are still used today.

3.3 Bhaskara II (1114–1185 CE)

Bhaskara II, also known as Bhaskaracharya, wrote the well-known book *Siddhanta Shiromani*, which has four sections covering arithmetic, algebra, planetary motion, and spherical astronomy.

He introduced advanced methods for solving algebraic equations and discussed concepts related to instantaneous change, reminiscent of the differential calculus ideas that developed centuries later in Europe. Bhaskara II also illustrated mathematical problems with practical examples, making complex concepts more accessible. His teaching approach continues to inspire mathematics educators today.

3.4 The Kerala School of Mathematics

Between the 14th and 16th centuries, the Kerala School

achieved remarkable advancements in mathematics and astronomy. Scholars like Madhava of Sangamagrama developed an infinite series for trigonometric functions and approximations of π . These discoveries mathematically resembled concepts later included in calculus. Though their work went largely unnoticed outside India for years, historians now recognize the Kerala School as a key contributor to mathematics history. Their achievements highlight that mathematical innovation occurred globally, not just in Europe.

4. SIGNIFICANCE OF ANCIENT MATHEMATICAL KNOWLEDGE

The contributions of ancient Indian mathematicians still shape modern mathematical thinking in several ways:

- The decimal number system is the standard numerical system used worldwide.
- Zero is fundamental to arithmetic, algebra, computer programming, and digital technology.
- Aryabhata's trigonometric ideas find wide applications in engineering, architecture, navigation, and satellite communication.
- The algebraic methods developed by Brahmagupta and Bhaskara II remain critical in higher mathematics.
- The Kerala School's work on infinite series contributed to ideas closely related to modern calculus.

These accomplishments show that ancient mathematical wisdom is not just a part of history; it still plays a vital role in addressing today's scientific and technological challenges.

5. Connection Between Ancient Wisdom and Modern Mathematics

Modern mathematics forms the basis of science and technology. We use mathematical ideas in everything from smartphones and computers to artificial intelligence and space exploration. Many of these concepts link back to ideas created by ancient Indian scholars. This connection shows that traditional knowledge still matters today.

One significant example is the decimal place value system and the concept of zero. Every computer stores and processes information using numbers. Binary numbers, which are 0 and 1, programming languages, and digital calculations all depend on the idea of zero. Without this invention, modern computing would not exist as it does today.

Ancient Indian methods also stressed logical thinking and systematic problem-solving. These skills are crucial in modern mathematics, engineering, and scientific

research. Even with all the changes in technology, the mathematical reasoning behind it is based on the same essential principles.

6. APPLICATIONS IN MODERN FIELDS

6.1 Computer Science and Artificial Intelligence

Computer science relies on mathematical logic, algebra, number systems, and algorithms. Developments in ancient Indian mathematics, especially the decimal system and arithmetic methods, laid the groundwork for modern computing.

Artificial Intelligence (AI) employs mathematical models to analyze data, identify patterns, and make decisions. Concepts like matrices, probability, calculus, and optimization have evolved over the years, but they trace back to centuries of mathematical growth. Ancient mathematical traditions supported logical reasoning, which continues to shape AI research today.

6.2 Cryptography and Cybersecurity

Today's communication requires safe methods to protect information.

Cryptography uses number theory, modular arithmetic, and algebra to encrypt data.

Although modern encryption algorithms are complex, they depend on mathematical principles established over many centuries. Ancient Indian scholars played a significant role in developing number theory and arithmetic, forming a solid base for later mathematical advancements.

6.3 Engineering and Architecture

Engineering employs geometry, trigonometry, and measurement to design buildings, bridges, roads, and machines. Ancient Indian temple architecture shows a deep understanding of symmetry, proportions, and geometric patterns.

Similarly, current civil, mechanical, and aerospace engineering still rely on these same mathematical principles for precise design and construction.

6.4 Astronomy and Space Science

Indian mathematicians explored planetary motion, eclipses, and celestial calculations through mathematical models. Aryabhata accurately explained numerous astronomical phenomena using math.

Today, organizations involved in space exploration use trigonometry, calculus, and algebra for satellite positioning, rocket trajectories, and orbital calculations. These modern practices highlight the lasting importance of the mathematical knowledge developed centuries ago.

6.5 Mathematics Education

Ancient Indian mathematics focused on grasping traditional teaching methods encouraged students to solve problems mentally and think creatively.

Incorporating Indian mathematical heritage into classrooms can:

- Improve logical reasoning.
- Increase students' interest in mathematics.
- Connect mathematical concepts with history and culture.
- Promote critical thinking and problem-solving skills.

This approach supports the aims of the National Education Policy (NEP) 2020, which encourages integrating the Indian Knowledge System into education.

7. DISCUSSION

Studying ancient mathematical wisdom shows that mathematics is a continuously evolving field. Each generation builds on the discoveries of the past. Ancient Indian mathematicians made contributions that changed our understanding of numbers, equations, geometry, and astronomy. Their work still impacts modern scientific

8. CONCLUSION

Ancient Indian mathematics stands as one of the most significant accomplishments in the history of science. The development of the decimal place value system, the invention of zero, and advances in algebra, geometry, trigonometry, and astronomical calculations showcase the intellectual brilliance of Indian scholars. Notable mathematicians like Aryabhata, Brahmagupta, Bhaskara II, and the scholars of the Kerala School laid a strong mathematical foundation that continues to affect the modern world.

Today, mathematics plays a vital role in computer science, artificial intelligence, engineering, finance, cryptography, and space technology. Many of these areas depend on ideas that emerged from mathematical concepts developed centuries ago. This demonstrates that ancient wisdom is not just a thing of the past but still fuels scientific progress and technological advancement.

The Indian Knowledge System offers important lessons in logical reasoning, creativity, and practical problem-solving. Integrating this knowledge into modern math

concepts rather than just memorizing formulas. Many research and technological development.

However, many students are unaware of India's contributions to mathematics. Educational programs often focus on modern progress while giving limited attention to historical roots. Including Indian mathematical heritage in textbooks can inspire students and enhance their appreciation for the country's scientific legacy.

Nonetheless, ancient mathematical knowledge should not replace modern mathematics. Instead, it should complement contemporary education, providing historical context and fostering a deeper understanding of concepts. Combining traditional wisdom with modern research can create a more balanced and meaningful approach to math education.

Additionally, interdisciplinary research connecting Indian Knowledge Systems with mathematics, computer science, engineering, and artificial intelligence can lead to new opportunities for innovation. Ancient knowledge still offers valuable insights that remain relevant in addressing today's challenges.

education can deepen students' understanding of mathematical concepts while fostering respect for India's rich scientific heritage. This approach also aligns with the vision of the National Education Policy (NEP) 2020, which emphasizes incorporating traditional knowledge into education.

At the same time, ancient mathematical ideas should be examined with a scientific, evidence-based perspective. Their value lies not only in their historical significance but also in their potential to inspire new research and encourage interdisciplinary learning. Merging traditional knowledge with modern mathematical methods can lead to innovative solutions for upcoming scientific and technological challenges.

Ultimately, the connection between ancient wisdom and modern mathematics shows that knowledge grows through ongoing learning and discovery. By preserving and studying India's mathematical heritage, researchers, educators, and students can deepen their understanding of mathematics while fostering innovation for future generations.

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