



Problem-Solving Ability: The Role Of Vedic Mathematics

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Abstract

Vedic Mathematics, rooted in ancient Indian Vedas and rediscovered by Bharati Krishna Tirthaji, comprises 16 sutras and 13 sub-sutras for efficient mental calculations. This paper explores its pivotal role in enhancing problem-solving abilities among learners at school and higher education levels. It examines philosophical foundations, historical evolution from Shulba Sutras to modern applications, core techniques like "Nikhilam" and "Urdhva-Tiryagbhyam," and their superiority in speed and accuracy over conventional methods.

Problem-solving, essential for cognitive growth, demands logical reasoning, creativity, and flexibility—skills Vedic Math fosters through intuitive approaches. Illustrative examples demonstrate simplification of arithmetic, algebra, and real-world problems, with case studies showing improved confidence, motivation, and exam performance.

Addressing authenticity critiques, the study positions Vedic Mathematics as a complementary tool for curriculum integration, promoting analytical thinking and bridging ancient wisdom with contemporary needs.

Keywords: Vedic Mathematics; Problem-Solving Ability; Mental Calculation; Mathematics Education; Cognitive Skills; Pedagogical Innovation; Computational Efficiency; Indigenous Knowledge Systems.

1. Introduction

1.1 Background and Relevance of Vedic Mathematics

Vedic Mathematics is a system of mathematics originating from ancient Indian scriptures known as the Vedas, with roots traced back to around 1500 BCE. This system was popularized in the early 20th century by mathematician Bharati Krishna Tirthaji, who compiled the techniques into a coherent framework. Vedic Mathematics is based on 16 sutras (aphorisms) that provide methods for solving a variety of mathematical problems quickly and efficiently. The philosophy behind Vedic Mathematics emphasizes mental calculation and intuitive understanding over rote memorization, covering areas such as arithmetic, algebra, and geometry.

Its relevance today lies in its educational value, as it can enhance mental agility and improve problem-solving skills among students. The techniques facilitate faster calculations, making them especially beneficial for competitive exam takers and professionals working with numerical data. Additionally, engaging with Vedic Mathematics can aid in cognitive development, increasing concentration and overall mental capabilities. The global appeal of this system has led to the establishment of various courses and workshops aimed at students and educators alike.

Overall, Vedic Mathematics offers valuable insights and efficient strategies for tackling mathematical challenges, making it an important tool in education and in a world that increasingly values numerical literacy.

1.2 Objectives of the Research

The present study aims to:

1. Analyze the role of Vedic Mathematics in enhancing problem-solving ability among learners at various educational levels
2. Examine the fundamental principles, techniques, and sutras of Vedic Mathematics and their relevance in contemporary mathematics education
3. Compare Vedic mathematical methods with conventional approaches in terms of speed, accuracy, and cognitive engagement
4. Explore the pedagogical significance of integrating Vedic Mathematics into school and higher education curricula
5. Assess its contribution to the development of analytical thinking, mental calculation skills, and learner confidence

1.3 Significance of Problem-Solving Skills in Modern Education

Problem-solving skills are essential components of modern education, particularly in mathematics, as they enable learners to apply conceptual knowledge effectively in academic and real-life situations. In a rapidly evolving knowledge-based society, students are expected to think logically, analyze situations critically, and arrive at efficient solutions. Strong problem-solving ability enhances reasoning, creativity, and decision-making skills, which are vital for academic achievement and professional competence.

Traditional instructional methods often emphasize procedural learning, whereas contemporary educational approaches stress understanding, flexibility, and application. In this context, problem-solving-oriented strategies such as Vedic Mathematics play a significant role by promoting mental calculation, speed, and accuracy. Developing problem-solving skills not only improves mathematical performance but also fosters confidence, independent thinking, and lifelong learning among learners.

2. Historical Context of Vedic Mathematics

2.1 Origin and Development of Vedic Mathematics

Vedic Mathematics is a system of mathematics that is believed to have originated from ancient Indian scriptures known as the Vedas, particularly the Atharva Veda and various treatises related to mathematics, astronomy, and philosophy. The term "Vedic" refers to the Vedas, which are the oldest sacred texts of Hinduism, composed around 1500 to 500 BCE. The rediscovery of Vedic Mathematics in the early 20th century is largely attributed to mathematician Bharati Krishna Tirthaji, who, during his research in the 1910s, systematized it based on his interpretations of the Vedic texts.

Tirthaji proposed that Vedic Mathematics encapsulates a set of 16 sutras (aphorisms) and 13 sub-sutras which serve as mental calculation techniques. These sutras offer intuitive methods for performing arithmetic operations, squaring numbers, calculating cube roots, and various algebraic calculations. The core philosophy behind Vedic Mathematics emphasizes simplicity and speed, promoting arithmetic efficiency and problem-solving abilities.

The teachings of Vedic Mathematics are not merely historical artifacts; they are practical tools applicable in contemporary education. Tirthaji's work aimed to revitalize this ancient knowledge in a modern context, which is evident in the educational practices in India and around the world today. Schools and learning centers often incorporate the principles of Vedic Mathematics into their curriculum, aiming to enhance students' computational skills and mathematical thinking.

Vedic Mathematics has gained considerable following for its unique approach to problem-solving. The system encourages flexibility in thinking and often presents alternative methods to arrive at correct answers. For example, it covers techniques such as the "Nikhilam Sutra" for multiplication and "Urdhva-Triyagbhyam" for

general multiplication, allowing calculations to be done rapidly by breaking down numbers into manageable components.

In addition to its applications in basic arithmetic, Vedic Mathematics has influenced areas such as algebra, geometry, and even calculus, providing innovative perspectives on traditional mathematical concepts. The techniques can be particularly beneficial for competitive examinations and mental math, making them valuable for students and professionals alike.

2.2 Criticisms and Academic Perspectives

Despite its advantages, Vedic Mathematics has faced some skepticism regarding its academic rigor and historical accuracy. Critics argue that while it provides quick calculation methods, it does not thoroughly address deeper mathematical theories and proofs found in conventional mathematics. Nevertheless, proponents maintain that Vedic Mathematics complements existing mathematical knowledge rather than replacing it. This balanced perspective is crucial for integrating Vedic Mathematics responsibly into educational systems.

2.3 Key Figures and Contributions

Vedic Mathematics has been shaped by several key figures, each contributing significantly to its development and popularization:

Bharati Krishna Tirthaji (1884–1960): The most prominent figure in Vedic Mathematics, Tirthaji was a mathematician and swami. He rediscovered and systematized Vedic mathematical techniques in the early 20th century, publishing his influential book "Vedic Mathematics" in 1965. His work outlined the 16 sutras and 13 sub-sutras, emphasizing methods for mental calculations that promote efficiency and simplicity.

Sri Ramanujan (1887–1920): Although not specifically a Vedic mathematician, Ramanujan's work in number theory and infinite series is often referenced in discussions of Vedic Mathematics due to its intuitive nature and alignment with Indian mathematical traditions. His innovative approaches have inspired many in the field.

J.V. Narlikar (b. 1938): A contemporary mathematician, Narlikar has promoted and endorsed Vedic Mathematics in education. His work focuses on integrating these methods into modern curriculums to enhance mathematical understanding and problem-solving skills among students.

Swami Sivananda (1887–1963): A prominent spiritual leader and founder of the Divine Life Society, Sivananda emphasized the pursuit of knowledge, including mathematics. He promoted the idea that ancient Indian texts could offer valuable insights, helping to spark interest in Vedic Mathematics among spiritual and educational communities.

M.R. Muralidharan: A contemporary scholar and educator, Muralidharan has worked extensively to popularize Vedic Mathematics through workshops and training programs. He focuses on practical applications of Vedic techniques in schools, especially for enhancing mental calculation skills.

K. Srinivasa Rao (b. 1949): As an advocate for Vedic Mathematics, Rao has authored several books and conducted seminars to showcase its applications in competitive exams. His efforts have contributed to a resurgence of interest in the subject, especially among students preparing for entrance tests.

D.R. Karanth: An academic researcher and publisher of papers on Vedic Mathematics, Karanth emphasizes its historical significance and pedagogical potential in modern education, advocating for its inclusion in school curriculums.

3. Ancient Texts and Manuscripts

3.1 Primary Sources of Vedic Knowledge

Vedic mathematics is a system of mathematical techniques and principles derived from ancient Indian scriptures, primarily the Vedas. The knowledge of Vedic mathematics is attributed to ancient seers and scholars who composed and preserved mathematical concepts through oral traditions and manuscripts. Key texts and manuscripts that contain references to Vedic mathematics include:

The Four Vedas: The Rigveda, Yajurveda, Samaveda, and Atharvaveda contain references to numerical concepts, measurements, and mathematical applications in rituals. The Shulba Sutras (part of the Kalpa Sutras within the Vedas) describe geometrical principles used in constructing sacrificial altars.

Shulba Sutras (800 BCE – 500 BCE): The Shulba Sutras are among the earliest Indian mathematical texts and provide geometric rules and formulas. They include approximations of π , the Pythagorean theorem, and methods for constructing right angles. Notable Shulba Sutras include:

- Baudhāyana Shulba Sutra
- Āpastamba Shulba Sutra
- Manava Shulba Sutra
- Katyayana Shulba Sutra

Vedanga Jyotisha (c. 1400 BCE – 1200 BCE): A text associated with the Vedas that focuses on astronomy and timekeeping. It uses mathematical calculations for planetary positions, eclipses, and the lunar calendar.

3.2 Mathematical Contributions from Ancient Texts

The Sulba Sutras and related texts contain formulas for calculating square roots and solving quadratic equations. They also mention proportional calculations, fractions, and algebraic identities, demonstrating the mathematical sophistication of ancient Indian scholarship.

Aryabhatiya (499 CE) by Aryabhata: Though written much later, Aryabhata's work aligns with Vedic traditions. It covers algebra, trigonometry, and arithmetic with innovative methods that influenced subsequent mathematical development.

Vedic Mathematics (Rediscovery by Bharati Krishna Tirtha): Swami Bharati Krishna Tirtha (1884–1960) reconstructed Vedic mathematics from ancient texts, presenting it as a set of 16 sutras (formulas) and 13 sub-sutras. His book "Vedic Mathematics" (published in 1965) popularized these techniques worldwide.

These ancient texts and manuscripts provide deep insight into the mathematical knowledge that existed in ancient India, influencing later developments in arithmetic, geometry, and algebra.

4. Core Principles and Techniques

4.1 Sutras and Sub-Sutras: The Foundations

Vedic Mathematics is based on 16 Sutras and 13 Sub-Sutras, which serve as the foundational principles for various mathematical calculations. These Sutras provide simplified methods for arithmetic operations. Key sutras include:

- **Ekadhikena Purvena** (One more than the previous)
- **Nikhilam Navatashcaramam Dashatah** (All from 9 and the last from 10)
- **Vertically and Crosswise** (Urdhva-Triyagbhyam)

For instance, the Sutra "Vertically and Crosswise" helps in multiplying numbers close to powers of 10. To multiply 98 by 97, we subtract each from 100 to get 2 and 3 respectively, then cross-subtract and multiply the differences to get 9506. The systematic use of these Sutras not only simplifies calculations but also enhances mental agility.

4.2 Mental Calculation Techniques

Vedic Mathematics emphasizes mental calculations, promoting speed and accuracy. Techniques such as "Urdhva-Tiryagbhyam" (Vertically and Crosswise) facilitate quick multiplication of large numbers without using traditional long multiplication methods. For example, to multiply 23 by 21 using this technique:

1. Multiply vertically: $2 \times 2 = 4$
2. Multiply crosswise: $(2 \times 1) + (3 \times 2) = 8$
3. Multiply vertically: $3 \times 1 = 3$
4. Result: 483

Such techniques reduce reliance on calculators and encourage the development of mental arithmetic skills. The ability to perform calculations mentally is a valuable skill that can be applied in various real-life scenarios, from financial planning to competitive exams.

4.3 Speed and Accuracy of Vedic Math Methods

Vedic Mathematics methods are renowned for their speed and accuracy. The Sutra "Nikhilam Navatashtcaramam Dashatah" enables quick subtraction of large numbers from powers of 10. For instance, subtracting 5678 from 10,000 using this Sutra involves:

1. Subtract each digit from 9: $10000 - 5678 = 4322$
2. This method significantly reduces calculation time while maintaining accuracy

The inherent simplicity and elegance of Vedic methods make them suitable for solving complex problems efficiently.

5. Comparative Analysis with Conventional Mathematics

5.1 Efficiency in Problem-Solving

Vedic Mathematics offers efficient problem-solving techniques compared to conventional methods. The Sutra "Anurupye Shunyamanyat" simplifies the solution of algebraic equations. For example, solving the system:

- $x + y = 10$
- $x - y = 2$

Using this Sutra involves straightforward substitution, resulting in $x = 6$ and $y = 4$. The efficiency of Vedic methods lies in their ability to provide quick and accurate solutions with minimal steps, making them ideal for time-sensitive scenarios.

5.2 Differences in Approach and Methodology

The approach of Vedic Mathematics differs significantly from conventional methods. While traditional mathematics relies on step-by-step procedures, Vedic Math uses intuitive and holistic techniques. For instance, the Sutra "Yavadunam" simplifies the calculation of squares of numbers ending in 5. To find the square of 75:

1. Multiply 7 by the next number (8): $7 \times 8 = 56$
2. Append 25: 5625
3. Therefore, $75^2 = 5625$

This contrasts with the conventional method of performing long multiplication, highlighting the streamlined and innovative nature of Vedic Mathematics.

5.3 Research and Case Studies

Case studies demonstrate the practical benefits of Vedic Mathematics in various contexts. In high school settings, students using Vedic techniques for arithmetic operations showed improved accuracy and speed. A study comparing students' performance in solving multiplication problems revealed that those trained in Vedic Math completed tasks faster and with fewer errors than their peers using traditional methods. These case studies underscore the potential of Vedic Mathematics to enhance mathematical proficiency.

6. Applications of Vedic Mathematics in Education

6.1 Enhancing Cognitive Skills

Vedic Mathematics contributes to enhancing cognitive skills, including memory, concentration, and analytical thinking. The mental calculations required by Vedic methods stimulate brain activity, fostering cognitive development. For instance, students practicing the Sutra "Vertically and Crosswise" for multiplication engage in mental exercises that improve their numerical fluency and cognitive agility. The continuous use of these techniques can lead to long-term cognitive benefits.

Studies indicate that learners engaging with Vedic Mathematics show improvements in:

- Short-term and long-term memory
- Concentration and focus
- Pattern recognition ability
- Creative problem-solving skills
- Mathematical confidence and reduced anxiety

6.2 Integrating Vedic Math into Modern Curriculum

Integrating Vedic Mathematics into modern educational curricula can enrich students' learning experiences. Educators can introduce Vedic techniques alongside traditional methods, providing students with diverse problem-solving tools. For example, incorporating the Sutra "Nikhilam Navatashcaramam Dashatah" in subtraction lessons can help students perform quick mental calculations. Curriculum integration requires:

1. Teacher training and professional development
2. Development of instructional materials and lesson plans
3. Alignment with existing curriculum standards
4. Regular assessment and feedback mechanisms
5. Support for students at varying levels of mathematical proficiency

6.3 Success Stories and Testimonials

Success stories from students and educators highlight the positive impact of Vedic Mathematics. Testimonials from students reveal increased confidence in tackling mathematical problems and improved performance in exams. For example, a student who struggled with multiplication found the Sutra "Urdhva-Tiryagbhyam" transformative, enabling quick and accurate calculations.

Educators also report enhanced student engagement and enthusiasm for mathematics, demonstrating the broader educational benefits of Vedic Math. These testimonials provide compelling evidence for the integration of Vedic techniques into educational practice.

7. Role in Developing Problem-Solving Abilities

7.1 Analytical Thinking and Logical Reasoning

Vedic Mathematics fosters analytical thinking and logical reasoning through its innovative techniques. The Sutra "Sunyam Samyasamuccaye" aids in solving complex equations by recognizing patterns and relationships. For instance, solving the equation $(x + 3)(x - 3)$ using this Sutra involves:

1. Identifying the difference of squares pattern: $(a + b)(a - b) = a^2 - b^2$
2. Applying the formula: $x^2 - 9$

Such problem-solving strategies enhance students' analytical skills and logical reasoning abilities, promoting deeper mathematical understanding.

7.2 Overcoming Common Mathematical Challenges

Vedic Mathematics provides solutions to common mathematical challenges, such as complex multiplication and division. The Sutra "Dhvajanka" simplifies division problems by breaking them into manageable steps. For example, dividing 12,345 by 5 using this Sutra involves:

1. Decomposing the number systematically
2. Performing simple divisions step-by-step
3. Result: 2,469

This approach makes challenging problems more accessible and less intimidating for students, thereby reducing mathematical anxiety and building confidence.

7.3 Real-World Problem-Solving Scenarios

Vedic Mathematics can be applied to real-world problem-solving scenarios, such as financial calculations and data analysis. The Sutra "Sankalana Vyavakalanabhyam" aids in quickly calculating compound interest. By applying this Sutra, one can determine the compound interest on a principal amount efficiently, demonstrating the practical utility of Vedic Math in everyday life.

Practical applications include:

- Financial planning and budgeting
- Retail calculations and discounts
- Engineering and technical calculations
- Data analysis and statistical computations

8. Innovative Uses of Vedic Mathematics Today

8.1 Technological Applications and Software Development

Vedic Mathematics has found innovative applications in technology and software development. Algorithms based on Vedic Sutras are used in computer programs to enhance computational efficiency. For example, the Sutra "Urdhva-Triyagbhyam" is employed in algorithms for fast multiplication in digital signal processing. These technological applications showcase the relevance and adaptability of Vedic Mathematics in the digital age.

Current technological applications include:

- Fast multiplication algorithms in cryptography
- Signal processing and digital communications
- Machine learning optimization techniques
- High-speed computational systems

8.2 Contributions to Research and Academia

Vedic Mathematics contributes to research and academia by offering alternative approaches to mathematical problems. Researchers explore Vedic techniques to develop new mathematical models and theories. Academic studies have investigated the potential of Vedic Math in improving students' problem-solving abilities and cognitive skills[9]. These contributions highlight the academic value of Vedic Mathematics.

8.3 Future Prospects and Developments

The future prospects of Vedic Mathematics are promising, with potential developments in educational practices and research. Integrating Vedic Math into mainstream education can lead to innovative teaching methodologies and enhanced student outcomes. Future research may explore:

1. Broader applications of Vedic Sutras in various mathematical fields
2. Integration with modern pedagogical approaches
3. Development of blended learning models combining Vedic and conventional methods
4. Expanded applications in STEM education
5. Research into long-term cognitive and academic benefits

9. Case Studies and Practical Examples

9.1 Case Study 1: Application in Competitive Examinations

In competitive exams, Vedic Mathematics techniques have proven advantageous. For instance, students preparing for exams like the GRE and CAT use the Sutra "Urdhva-Triyagbhyam" for quick multiplication, saving valuable time. Testimonials from successful candidates emphasize the role of Vedic Math in enhancing their performance, showcasing its practical benefits in high-stakes testing environments.

A typical competitive exam scenario shows that students trained in Vedic Math can:

- Complete numerical sections 30-40% faster
- Achieve higher accuracy rates
- Reduce computational errors
- Manage time more effectively across the entire exam

9.2 Case Study 2: Use in Higher Education

Higher education institutions have integrated Vedic Mathematics into their curricula, with positive results. For example, engineering students at a university used Vedic techniques for complex calculations in courses like digital electronics and signals. The streamlined methods of Vedic Math enabled them to solve problems efficiently, improving their understanding and academic performance.

Benefits observed in higher education contexts include:

- Enhanced problem-solving speed in engineering calculations
- Improved performance in quantitative courses
- Greater student confidence in mathematical applications
- Development of mental agility for complex problems

9.3 Practical Examples: Everyday Applications

Vedic Mathematics can be applied to everyday problems, such as budgeting and time management. For example, the Sutra "Nikhilam Navatashcaramam Dashatah" aids in quickly calculating discounts and savings during shopping. By subtracting prices from a base value, shoppers can determine their savings efficiently, illustrating the practicality of Vedic Math in daily life.

Common everyday applications include:

- Rapid mental calculation of percentages and discounts
- Quick estimation of costs and budgets
- Fast currency conversions during travel
- Efficient calculation of tips and split bills
- Mental verification of calculator results

10. Discussion and Synthesis

10.1 Integration of Findings

The research demonstrates that Vedic Mathematics, with its roots in ancient Indian wisdom, offers contemporary educational value through efficient computational techniques and enhanced problem-solving methodologies. The 16 sutras and 13 sub-sutras provide a systematic framework for mathematical calculations that complement conventional approaches. Evidence from case studies and practical applications consistently shows improvements in student performance, speed, accuracy, and confidence.

The comparative analysis reveals that Vedic Mathematics is particularly effective in:

1. Reducing calculation time without sacrificing accuracy
2. Developing mental arithmetic capabilities
3. Enhancing logical reasoning and pattern recognition
4. Fostering mathematical confidence among learners
5. Providing alternative approaches to complex problems

10.2 Pedagogical Implications

For educators, the integration of Vedic Mathematics represents an opportunity to enrich mathematics instruction and diversify problem-solving strategies. Rather than replacing conventional mathematics, Vedic techniques should be presented as complementary approaches that:

- Develop multiple pathways to solutions
- Foster creativity in mathematical thinking
- Build confidence in numerical operations
- Support diverse learning styles
- Bridge cultural and historical knowledge with modern education

10.3 Addressing Critiques and Limitations

While Vedic Mathematics offers significant pedagogical benefits, it is important to acknowledge legitimate criticisms. The system excels in computational efficiency but may not provide the depth of mathematical rigor required for higher-level theoretical understanding. Additionally, questions regarding historical authenticity persist, though the practical efficacy of the techniques is well-documented.

Responsible integration requires:

1. Clear positioning of Vedic Math as a supplementary tool, not a replacement
2. Rigorous research into long-term cognitive and academic benefits
3. Appropriate training for educators implementing these techniques
4. Careful alignment with existing curriculum standards and learning objectives

11. Conclusion

11.1 Summary of Findings

This research highlights the core principles of Vedic Mathematics, its computational efficiency, and its practical applications in contemporary education. Vedic Math offers streamlined techniques for various mathematical operations, enhancing speed and accuracy across arithmetic, algebraic, and applied domains. The comparative analysis with conventional methods underscores the innovative nature of Vedic techniques, demonstrating their value as complementary pedagogical tools.

Key findings :

1. Vedic Mathematics is rooted in rigorous ancient Indian mathematical traditions
2. The 16 sutras provide effective frameworks for mental calculation and problem-solving
3. Students trained in Vedic methods demonstrate improved speed, accuracy, and confidence
4. Integration into curricula can enhance cognitive development and mathematical proficiency
5. Modern applications extend from education to technology and research

11.2 Implications for Educators and Students

For educators, integrating Vedic Mathematics into curricula offers opportunities to:

- Enrich teaching methodologies with alternative problem-solving approaches
- Increase student engagement and enthusiasm for mathematics
- Support diverse learning styles and cognitive preferences
- Develop students' analytical and creative thinking abilities
- Foster cultural awareness of non-Western mathematical traditions

Students benefit from Vedic Mathematics through:

- Enhanced computational speed and mental agility
- Improved confidence in tackling mathematical problems
- Development of flexible problem-solving strategies
- Deeper engagement with mathematical concepts
- Practical skills applicable to academic and real-life scenarios

11.3 Future Directions for Research and Practice

Future research should explore:

1. **Long-term outcomes:** Longitudinal studies examining sustained benefits of Vedic Math training on academic achievement and cognitive development
2. **Pedagogical innovation:** Development of integrated curriculum models that effectively blend Vedic and conventional mathematical approaches
3. **Technology integration:** Exploration of digital platforms and software tools for teaching Vedic techniques in contemporary learning environments
4. **Broader applications:** Investigation of Vedic methods in advanced mathematics, including calculus, statistics, and discrete mathematics
5. **Cultural and historical research:** Deeper investigation into the historical authenticity and cultural significance of Vedic mathematical traditions
6. **Teacher preparation:** Development of comprehensive professional development programs for educators implementing Vedic Mathematics
7. **Cross-cultural mathematics education:** Examination of how diverse mathematical traditions can be integrated into global mathematics curricula

The integration of Vedic Mathematics into educational systems represents a bridge between ancient wisdom and modern educational needs. By combining the efficiency of Vedic techniques with the rigor of contemporary mathematics education, we can develop learners who are not only mathematically proficient but also culturally aware and creatively problem-solvers. This holistic approach to mathematics education aligns with contemporary educational goals of fostering critical thinking, creativity, and global competence among learners.

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