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Retrospection of Vedic Mathematics in Indian Knowledge System

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***Abstract*-- The education system of ancient India remained as a reflection of the intellectual heritage and wonderful period of India since time immemorial. It was rooted in ancient texts, philosophical treatises, and cultural ethos that made up the basis of knowledge in various subjects like mathematics, astronomy, medicine, philosophy, literature, and spirituality et.al. Mark Twain had expressed India as the cradle of the human race, the birthplace of human speech, the mother of history, the grandmother of legend, and the great grandmother of tradition. This paper has focus on Vedic Mathematics in the Indian Knowledge System. Mathematics and the Indian Knowledge System (IKS) are deeply immersed with each other. Indian mathematicians have brought laurels to the country in the field of mathematics from olden times. The Indian Knowledge System, a holistic structure involving philosophy, science, literature, and arts et.al. views mathematics not in seclusion but as an integral part of understanding the universe and life itself. Vedic Mathematics, a system of mathematical tools deduced from the ancient Indian scriptures called as the Vedas, keeps profound meaning within the broader framework of Indian Knowledge Systems (IKS). This abstract explores how Vedic Mathematics, with its elegant and intuitive sutras (aphorisms), not only offers efficient computational methods but also embodies a holistic approach to knowledge rooted in ancient Indian philosophical and spiritual traditions. Its relevance extends beyond mere arithmetic, fostering mental agility, creativity, and an appreciation for the interconnectedness of various disciplines within IKS, including astronomy, astrology, and philosophy. This paper will delve into its historical context, core principles, practical applications, and its role in re-establishing a contemporary understanding of India's rich intellectual heritage. Lancelot Hogben (English Mathematician) said that there had been no more revolutionary contribution than the one which the Hindus (Indians) had made when they invented zero.**

***Keywords*-- Holistic approach. Indian Knowledge System, Mathematics, Mathematical techniques, Vedic mathematics,**

I. Introduction

Indian Knowledge System (IKS) represents a vast repository of scientific, philosophical, artistic, and spiritual wisdom accumulated over millennia on the Indian subcontinent. From the sophisticated metallurgical techniques of the Iron Age to the intricate grammatical rules of Panini, IKS encompasses a diverse array of disciplines that have profoundly influenced global thought.

Within this expansive landscape, mathematics has always occupied a central position, not merely as a tool for calculation but as a pathway to understanding the cosmos and the divine. **Stan Gudder** (Mathematician) said that the essence of maths is not to make simple things complicated, but to make complicated things simple. Vedic Mathematics, often attributed to the work of Swami Bharati Krishna Tirtha in the early 20th century, presents a unique perspective on this ancient mathematical tradition. It is presented as a compilation of sixteen *sutras* (formulae) and thirteen *sub-sutras* (sub-formulae) derived from the Atharvaveda, offering remarkably simple and efficient methods for arithmetic, algebra, geometry, and even calculus. The significance of Vedic Mathematics in IKS lies not just in its computational prowess but in its embodiment of the underlying principles of ancient Indian thought: unity, coherence, and the pursuit of knowledge as a means of liberation. This document will explore the multifaceted importance of Vedic Mathematics, highlighting its historical roots, methodological elegance, educational potential, and its role in revitalizing a holistic understanding of IKS.

II. Historical Context

While Swami Bharati Krishna Tirtha codified and popularized "Vedic Mathematics" in the 20th century, the roots of these mathematical principles are deeply embedded in ancient Indian texts. The term "Vedic" refers to the Vedas, the earliest known scriptures of Hinduism, dating back to 1500-500 BCE. These texts contain hymns, philosophical treatises, and rituals, and interspersed within them are references to mathematical concepts, particularly in the *Sulbasutras*, which detail the geometrical constructions for Vedic altars. These texts demonstrate an advanced understanding of geometry, including the Pythagorean triples, long before their formal articulation in other civilizations.

The principles underlying Vedic Mathematics, such as working from left to right, using complements, and breaking down complex problems into simpler ones, are found in various forms throughout Indian mathematical history.

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Scholars like Aryabhata, Brahmagupta, Bhaskara I and II, and Madhava of Sangamagrama, all contributed significantly to the development of Indian mathematics, including the decimal place value system, the concept of zero, trigonometry, and calculus. Vedic Mathematics, therefore, can be seen as a synthesis and simplification of these ancient mathematical insights, presented in a concise and accessible format. Its "rediscovery" by Tirtha brought these often-esoteric methods to a wider audience, positioning them as a bridge between ancient wisdom and modern computational needs. **Dr. Sarvepalli Radhakrishnan** (Former President of India) expressed his views that it was the intense spirituality of India, and not any great political structure or social organization that it had developed, that had enabled it to resist the ravages of time and the accidents of history."

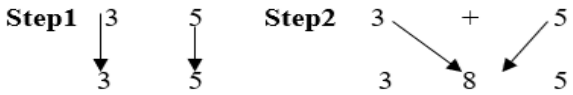
III. Core Principles And Sutras

The essence of Vedic Mathematics exists in its sixteen *sutras* (aphorisms) and thirteen *sub-sutras*. These short, memorable phrases encapsulate entire mathematical operations, allowing for rapid and often mental calculations. Some of the most prominent sutras include:

- *Nikhilam Navatashcaramam Dashatah (All from 9 and the last from 10):* Multiplication of numbers near to powers of 10 are performed with the use of this sutra, and it is helpful for subtraction also. It makes calculations by focusing on complements to a base.
- *Urdhva Tiryagbhyam (Vertically and Crosswise):* It is a general sutra to multiply, applicable to any number of digits. It involves a systematic cross-multiplication pattern that is highly efficient.
- *Ekadhikena Purvena (By One More than the Previous One):* This is particularly supportive for squaring numbers ending in 5, and for multiplying numbers where the last digits sum to 10 and the preceding digits are the same.
- *Vyastisamastih (Transpose and Apply):* Applicable for solving linear equations, this sutra simplifies the process by transposing terms.
- *Paravartya Yojayet (Transpose and Adjust):* Another powerful sutra for division, especially when the divisor is close to a power of 10.

Let us proceed further from simple question to some complex questions of multiplication by **Nikhilam** and **Urdhva-tiryakbyham** sutra.

Multiply: 35 x11



Ans: 385

Simpify: 85 x 11 = 8 $_1$ 35 = 935

Base 10

Simplify: 9 x 7

9 -1 (i) 9 is 1 less than 10 and
7 is 3 less than 10

x 7 -3 (ii) -1 x -3 = 3 and
either 9-3 or 7-1

6 / 3

Ans: 63

Multiply: 15 x 14

15 +5(i)15 is 5 more than 10,
14 is 4 more than 10

x 14 +4(ii) +5 x 4 =20 ,
either 15+4 or 14 + 5

19/ 20

Ans: 19 / 20 =19 / $_2$0 = 210

Base 100

Multiply : 97x96

97-03 (1) 97 is 3 less than100,
96 is 4 less than100

x 96-04 (2) Multiply -03x-04 and
either 97-04 or 96-03

93 / 12

Ans: 9312

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(Base 1000)

998 -002 998 is 2 less than1000,

997 is 3 less than1000

x 997 -003 Multiply -002x-003,

either 998-003 or 997-002

995 / 006

Ans: 995006

Simplify: 93 x 96 x 98

93 x 96 x 98

= 93 – 4 – 2 / (- 7) x (-4) +(-4) x (-2) +

(-2) x (– 7) / (- 7) x (– 4)x (- 2)

= 87 / 28+8+14 / -56 = 87 / 50 / -56

= 87 / 50-1 / 100-56 = 87 / 49 / 44

= **874944**

Simplify: 108 x 106 x 105

108 x 106 x 105 =

108 + 6 + 5 / 8 x 6 +6 x 5 +5 x 8 / 8 x 6 x 5

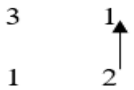
=119 / 48 + 30 + 40 / 240

=119 / 118 / 240 =119 / $_1$18 / $_2$40

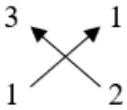
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Urdhva-tiryakbyham (Vertically and Crosswise)

Multiply: 31 x12



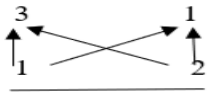
1x2=2



1 x 1+2 x 3 =7



3 x 1=3



3 7 2 Ans : 372

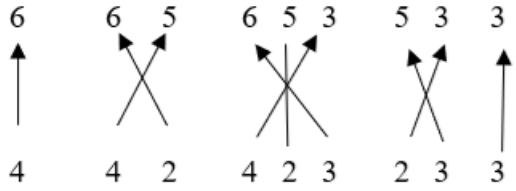
Simplify: 12x34



4x1+3x2=1 0, 1 Carry

4 0 8

Simplify: 653 x 423



=6 x 4 / 6 x 2+ 4 x 5 / 6 x 3 + 4 x 3+ 5 x 2

/ 5 x 3 + 2 x 3 / 3 x 3

=24 / 12 +20 / 18+12+10 / 15+6 /9

=24 / 32 / 40 /21 / 9

= 24 / $_3$2 / $_4$0 /$_2$1 / 9 **=276219**

Example by using

EKĀDHIKENAPŪRVEṆA (by one more than the previous one)

Have a number whose unit's digit is 5. For example **35^2**.

We have to solve the square of 35 whose last digit is 5 and the 'previous' digit is 3. Now, one more than the previous one, i.e. 3+1=4. The Sutra, in this , gives the procedure 'to multiply the previous digit 3 by one more than itself, i.e. 3 x 4 = 12. And 5^2, i.e. 5x5=, 25.

Hence the required answer is

35^2 = 3 x 4 / 25 = 12/ 25 =1225

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These sutras are not merely tricks; they represent underlying mathematical principles and algebraic identities. Their beauty lies in their generality and their ability to simplify complex calculations, often converting what would be multi-step processes in conventional mathematics into a single, elegant step. This approach encourages mental calculation and a deeper understanding of number relationships, fostering mathematical intuition.

IV. Practical Applications And Pedagogical Value

The practical applications of Vedic Mathematics are far-reaching that are mentioned here as:

- *Arithmetic:* Rapid multiplication, division, addition, and subtraction.
- *Algebra:* Solving linear and quadratic equations, factorization, and polynomial division.
- *Geometry:* Calculating areas and volumes, and understanding geometric relationships.
- *Calculus:* Though less directly articulated, some principles can be extended to understand series and progressions.

Beyond its computational efficiency, Vedic Mathematics holds significant pedagogical value. Its intuitive nature can make mathematics less intimidating and more enjoyable for students. It motivates:

- *Mental Calculation:* Reducing reliance on calculators and strengthening mental agility.
- *Problem-Solving Skills:* By offering multiple approaches to a problem, it promotes creative thinking.
- *Conceptual Understanding:* The sutras are not rote procedures but embody underlying mathematical principles, leading to deeper comprehension.
- *Reduced Math Anxiety:* The simplicity and elegance of the methods can build confidence in students who struggle with conventional mathematics.

In an educational context, incorporating Vedic Mathematics can provide a fresh perspective on mathematical concepts, complement existing curricula, and bridge the gap between traditional learning and modern needs.

V. Discussion

The significance of Vedic Mathematics in IKS extends beyond its utility as a computational tool. It serves as a powerful validation to the sophistication and holism of ancient Indian thought.

A. Embodiment of Holistic IKS Principles

Vedic Mathematics is not an isolated discipline but is deeply interwoven with other aspects of IKS. Its principles resonate with the philosophical basis of unity and interconnectedness. The concise nature of the sutras reflects the aphoristic style prevalent in ancient Indian texts, where profound wisdom was encapsulated in brief, memorable statements. The emphasis on mental calculation and intuition aligns with the yogic and meditative traditions that aim to refine the mind. Furthermore, the historical links to astronomy and astrology in ancient India highlight how mathematics was viewed as an essential tool for understanding the cosmic order. The very structure of the universe was believed to be mathematically expressible, and Vedic Mathematics provided a means to decode these patterns.

B. Bridging Ancient Wisdom and Modern Relevance

In an age of Artificial Intelligence/Machine learning, one might question the relevance of mental arithmetic. However, Vedic Mathematics offers more than just speed. It cultivates a deeper appreciation for the elegance and beauty of numbers. It demonstrates that complex problems can have simple solutions, fostering a mindset of resourcefulness and innovation. For contemporary India, re-engaging with Vedic Mathematics is a way of reclaiming and celebrating its intellectual heritage. It challenges the notion that scientific and mathematical progress originated solely in the West, reasserting India's historical contributions. It provides a unique educational framework that can complement modern pedagogical approaches, offering a culturally relevant and intellectually stimulating alternative.

C. Challenges and Future Directions

In spite of its merits, the integration of Vedic Mathematics into mainstream education faces challenges also. Some of challenges mentioned here are:

- The primary one is often the perception that it is a "religious" or "spiritual" subject rather than a purely mathematical one, due to its "Vedic" appellation. It is crucial to emphasize its mathematical principles, independent of any religious interpretations, to ensure its acceptance in secular educational settings.
- Another challenge exists in developing standardized curricula and training for educators to effectively teach these methods. Research is also ongoing to further explore the historical accuracy of Swami Bharati Krishna Tirtha's derivations and to ascertain the precise connections between his work and the original Vedic texts.

However, the advancing interest in IKS, coupled with the proven efficacy of Vedic Mathematics in improving computational skills and cultivating mathematical intuition, suggests a promising future. Further research, curriculum development, and teacher training can unlock its full potential, making it a valuable asset in modern education and a vibrant component of India's intellectual renaissance.

VI. Conclusion

Vedic Mathematics supports a profound testament to the ingenuity and intellectual depth of ancient Indian civilization, suggesting far more than just quick computational tricks. Within the expansive framework of Indian Knowledge Systems, it represents a harmonious blend of mathematical precision, philosophical insight, and pedagogical elegance. Its simple yet powerful sutras provide intuitive and efficient methods for a wide range of mathematical operations, fostering mental agility, creativity, and a deeper understanding of numerical relationships.

Beyond its practical applications, Vedic Mathematics embodies the holistic and interconnected nature of IKS, linking arithmetic to cosmology, philosophy, and the pursuit of knowledge. By demonstrating the profound mathematical wisdom embedded in ancient Indian texts, it plays a crucial role in revitalizing a contemporary appreciation for India's rich intellectual heritage. While challenges remain in its wider integration into modern education, its pedagogical benefits and its ability to make mathematics accessible and enjoyable are undeniable. As we increasingly recognize the value of diverse knowledge traditions, Vedic Mathematics serves as a powerful reminder of India's enduring contributions to global thought, offering a unique and valuable routeway to mathematical enlightenment and a deeper connection to the roots of IKS.

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