Vedic Mathematics-India's Opulent Benefaction

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Abstract *– Mathematics referred to as the queen of sciences reflects the "the active will and the reason for aesthetic perfection". Logic and mathematics are commutual. As per the reports, India is facing a huge Maths Crisis in which 26.1 per cent of children in Class V know division and only 44.1 per cent in Class VIII could solve a three digit by one digit division problem. In other words, abstract and logical reasoning is their hurdle. To overcome this, scholars have revived interest in Vedic Mathematics which was born in the Vedic Age, deciphered towards the beginning of the 20th century, by Swami Bharati Krishna Tirthaji. The Sanskrit word Veda is derived from the root Vid indicating deep acquaintance. The Sutras apply to almost every branch of Mathematics making calculations of large numbers easier that was nearly impossible in systems like those of the Greeks, Romans etc. In the vedic system complex problem or difficult sum or lengthy equations can often be solved immediately. It has striking and beautiful methods which beautifies and systematise mathematics. The Vedic system invented the zero, Aryabhata was followed by Brahmagupta who developed the use of zero, followed by Pythagoras' theorem which was discovered in India and gravity was explained in the Rig Veda, 2,400 years before Newton's apple injury. The debate has raised an uncomfortable question for Hindu nationalists on how India lost its mathematical advantages over the millennia. Thus, our desideratum lies in highlighting the significance and the vast usage of this branch of mathematics.*

Keywords – *Vedic Mathematics, Sutras, Vedic system, Vedas.*

1. INTRODUCTION

Square one of Vedic mathematics – Isn't the idea of solving mathematical problems just within the wink of an eye fascinating? Veritably, the brownie points here go to Vedic Mathematics inbred in the Vedic Age, deciphered towards the beginning of the 20th century, by Swami Bharati Krishna Tirthaji. Well, because mathematics, may it be Vedic or modern is not only about numbers and figures. Many western societies, math is a much dreaded school subject. Vedic math only has 16 rules, each of which is very simple. The Sutras apply to almost every branch of Mathematics making calculations of large numbers easier that was nearly impossible in systems like those of the Greeks, Romans etc. The Vedic system invented the zero, Aryabhata was followed by Brahmagupta who developed the use of zero, followed by Pythagoras' theorem which was discovered in India and gravity was explained in the Rig Veda, 2,400 years before Newton's apple injury. Vedic Mathematics was not known to the world but with an increase of interest in ancient Sanskrit text, the ancient Vedic Mathematics was rediscovered by Swami Bharati Krisna Tirthaji (the former Shankaracharya of Puri, India) in 1911, he was a great scholar of Sanskrit, Mathematics, History and Philosophy. His deep study and careful research had deciphered the great mathematical formulas known as Sutras that were completely ignored as no one could relate these to mathematics. Vedic Mathematics (1965) that is a pioneer work of Bharati Krishna Tirthaji has techniques of Vedic mathematics. It is considered as a first work towards Vedic Mathematics. In late 1960s a copy of his book reached London and from there Vedic Mathematics was reborn. The verses are guides to turn difficult sums into quick mental math using simple rules. The Nikhilam Navatashcaramam Dashatah - 'all from nine, last from ten' – for example, speeds the multiplication of large numbers by breaking them down to their common bases: To multiply 48 by 52, the numbers are broken into (50-2) and (50+2) and the square of the smaller sum (4) subtracted from the square of the larger (2,500) to reach the answer of 2,496.

Similarly, division is simplified by multiplying the denominator into a base ten number: 44/25 = 176/100 = 1.76. The successors of the Greeks in the history of mathematics were the Hindus. They produced original concepts and good procedures. They were the first to recognize zero as both a cardinal number and a place holder. Bhaskara supplied correct rules for operating with irrational numbers. The Hindus created the concept of negative numbers; the earliest known use of negative numbers was by Brahmagupta around A.D. 630. Aryabhata went beyond Diophantus in his use of continued fractions to solve indeterminate equations. After Aryabhata and Varahamihira, came Brahmagupta who was later assessed by Alberuni as the most distinguished mathematician of India. In Brahma-Sphuta-Siddhanta, Brahmagupta has dealt with algebra, arithmetic, geometry and astronomy. Brahmagupta for the first time dealt with zero and its operations but wrongly stated that zero divided by zero is also zero but is known for arriving at the solution of the

indeterminate equations of second degree in which he excelled Aryabhata. He is the first in the world to have used algebra effectively for astronomical calculations. His major achievements were in the field of algebra in which he carried forward the earlier work of Aryabhata. Medatithi, a seer of the Vedic times, is known to have stated very high numerals, e.g. 10 to the power 22 in a systematic way. His name is associated with hundreds of verses in the Rig-Veda, Atharvaveda and Yajur Veda. There is however, no evidence available to show that in Medhatithi's time, the large numerals were written as they were spoken. The earliest evidence of the use of the new system has been found in the Bakhshali manuscript, whose original composition is said to have been made around A.D. 200.Later Aryabhata in his Aryabhatiya, Varahamihira in his Pancha Siddhanta, Jainbhadra Gani and others used the place value system of writing numerals. In no other country was the decimal system of place value notation used so early as in India. The system of place value notation of writing numerals is an Indian contribution to the world of mathematics that is reckoned as one of the greatest inventions of all times. Aryabhata was one of the most scientific innovators of ancient India. He is the earliest known Hindus author to have worked on algebra. Aryabhata expressed high numbers by means of syllables. He indicated a method of arriving at a solution of the indeterminate equations of the first degree. He is also the first to give a concept of kuttakara or pulveriser which was later developed by others in India. He also quoted the Pythagorean theorem in one of his verses. Bhaskara anticipated many of the discoveries in the field of algebra so that his work could only be surpassed in the European countries after the 17^{th} and 18^{th} centuries. He was the last of the great mathematicians of ancient and medieval India. For the Indians of the Vedic times, the performance of a variety of sacrifices formed a major part of their religion. These sacrifices were performed at certain precalculated times, and in altars of particular sizes and shapes which led their builders to understand and deduce certain practical geometrical principles. Construction of these altars was handled by people well versed in it and the art of this is contained in scriptures known as sulba sutras. Baudhayana Sulba Sutra is the oldest and the biggest of them all. It belongs to Krishna of various altars and deals briefly with their shapes and sizes. He describes methods for construction of geometrical figures, combination and transformation of areas, measurement of volumes of areas, and squaring the circle. By 1800 mathematics rested upon two foundations, the number system and Euclidean geometry. The 17th centuries were the greatest periods of mathematics. What may be called the prehistory of zero was expressed in early Vedic by kha which refers to cavities of various sorts and occurs in the Upanishads in the sense of "space". The Rig-Veda made use of recursion and distinguished between cardinal and ordinal numbers. The word kha, which Indian mathematicians used later to denote zero, occurs in Vedic only in the senses of hole, opening vacancy or space. The three greatest landmarks in this area are the kuttaka, method of Aryabhata for solving the linear indeterminate equation ay-bx=c, the bhavana law of Brahmagupta, and the cakravala algorithm described by Jayadeva and Bhaskara 2 for solving quadratic indeterminate equation Dx2+1=y2.

2. OBJECTIVE

Objective of the study is the essential facts of Vedic Mathematics arousing awareness in the young generation about the importance of Indian culture through so that they feel proud to be a part of such a diversely rich society. This research bring into notice facts about the growing influence of Vedic mathematics in various fields in order to simplify complex calculations in order to remove the fear of mathematics in many students by citing examples of the great mathematicians given by India to the world. Thus, study aims to brim the rich heritage of India thereby bringing to the light the various discoveries done by Indian mathematicians and the various claims that India lost in the hands of others. Even the students at IITs, St James' School, London, have begun to teach the Vedic system successfully. Our motive is to throw light on claims like our scientists discovered the Pythagoras theorem but we gave its credit to the Greeks. Lastly, we want the students to learn simplified techniques for understanding math and improve their skills.

i) Pertinency of vedic mathematics:

Vedic Mathematics was taken up as a new alternative system of mathematics. British mathematicians got interested in Vedic mathematics. Many lectures on this were delivered which later on were collected in the book – Introductory Lectures on Vedic Mathematics. After the visit of Andrew Nicholas to India between 1981 and 1987, interest in Vedic maths started to develop in India. Vedic mathematics has given a new approach to mathematics. To do calculations quickly, the Indian Institute of Technology students are said to use Vedic Mathematics, St James' School, London and many other schools have started teaching Vedic maths to their students. In India also it is taught in many schools. Students of economics and MBA find it very useful. A Delhi-based forum known as International Research Foundation for Vedic Mathematics and Indian Heritage have been giving lectures on Vedic Mathematics since 1999 in most of the schools in Delhi. Without a doubt there are many advantages of learning Vedic Mathematics. Students develop problem solving ability and it also leads to the development of creative

intelligence. Students of Vedic Mathematics can not only do simple calculations of subtraction, addition, multiplication but also very complex calculations such as algebra, geometry, calculus and trigonometry. Our mind is at work with this mathematics so mental sharpness is associated with it. Vedic math is very effective and at the same time it is easy to learn. Only 16 Vedic sutras are used to solve the mathematical problem. Sutras are basically word formulae that describe normal way of solving mathematical problems. Instead of learning by repetition, Vedic Mathematics involves logic and understanding the fundamental concepts. One can do calculations much faster than done by using the conventional method that is taught in schools. It teaches the students to solve same problem in different ways. It should indeed be a spirited feeling to encourage the system being developed in our own motherland.

ii) Exemplification of vedic mathematics:

Perchance, the most striking feature of the Vedic system is its coherence. Instead of a mélange of unrelated techniques the whole system is bewitchingly interrelated and unified: the general multiplication method, for example, is easily reversed to allow one-line divisions and the simple squaring method can be reversed to give one-line square roots. And these are all easily understood. This unifying quality is hitting the spot making mathematics child's play and enjoyable. For example: Nikhilam is a special multiplication method which is illustrated as follows:

Eg: multiply 95 by 98 .note that95 is less than 100 5
and 98 is 2 less than 100.let us write the two numbers and their deviations from 100 with a line separating the two as follows:

95 05

98 02

Note that the deviation has 2 digits. The product of 95 and 98 is obtained by multiplying the numbers to the right of the line. Then a cross a cross subtraction is carried out diagonally, to give 93 which occupies the thousands and hundreds places, 9310 is the required product.

Another e.g. Indicating the nikhilam for numbers greater than the base;

For numbers close to some power of 10 eg: if we want to multiply 105 n 108 the we proceed as follows;

To the right of the number we write its difference from 100 with a positive sign. Now the numbers on the right are multiplied as before. The number on the left is obtained by diagonal cross addition:

105 +05

108 +08

113 40

The product is 11340.

The technique that is useful in all cases is based on the principle of udhvatiryaka and involves cross multiplication. This was developed in India before 8 century and is bases on a deep understanding of the place value system of representing numbers.

E.g. 534 with 463

We write down the first number as it is, n reverse the second number;

534

364

1

=12(4*3=12)

The first digit of the result is obtained by multiplying the vertically overlapping nos 4 and 3.The product is 12; the units digit 2 is written as the units digit of the result and 1 is carried over to the second digity.364 is then shifted left by a digit. The vertically overlapping numbers are multiplied and the products added. Any carry from the previous operation is added to this to obtain the hundreds digit of the result.

534

364

31

=42(3*3+4*6=33

33+1=34)

Thus the overlapping digits 3 and 3 as well as 4 and 6 are multiplied and the two products are added to give 33.The addition of carry 1 gives 4 as second digit of the result and as a carry of 3.The process is repeated by again shifting 364 to the left as shown:

534

364

531

=242(5*3+3*6+4*4=49

49+3=52)

Thus the overlapping are multiplied and added, we get 49, to which we add the carry over 3.The third digit of the product is therefore 2 and 5 is carried over to the fourth digit.

The number 364 is again shifted left and the same operation is repeated as shown:

534

364

4531

=7242(5*6+3*4=42)

(42+5=47)

The addition of the products of overlapping digits gives 42 and to this we add the carry 5 to give 7 as the fourth digit of the result, and as 4 as the carry. Again, 364 is shifted to the and repeat the operation.

534

364

4531

=247242

As only 5 and 4 are vertically overlapping their product yields 20.The carry 4 is added to give 24.The fifth digit of the result is thus 4,and 2 will be carried over to the sixth digit. Once again shifting 364 to the left by a digit results in no overlap and therefore the sixth digit of the result is only the carry 2.thus 534*463=247242.In modern teaching we usually have one way of doing a calculation.

iii) Leg –up:

The Vedic system has many special methods, when a calculation has some special characteristic that can be used to find the answer more easily. This flexibility adds to the fun and gives pupils the freedom to choose their own approach. This in turn leads to the development of creativity and intuition. The Vedic system does not insist on a purely analytic approach as many modern teaching methods do. This makes a vast difference to the attitude which students have towards mathematics. The ease and simplicity of Vedic Mathematics means that calculations can be carried out mentally. A flexible, mental system has leg up over the unpliable ones. Pupils can invent their own methods and are not limited to the one 'correct' method. This leads to more creative, interested and intelligent pupils. It also leads to improved memory and greater mental agility. All these features of Vedic math encourage students to be creative in doing their math. Being naturally creative students like to devise their own methods of solution. The Vedic system seeks to cultivate intuition, having a conscious proof or explanation of a method beforehand is not essential in the Vedic methodology. The Vedic system appears to be effective over all ability ranges: the able child loves the choice and freedom to experiment and the less able may prefer to stick to the general methods but loves the simple patterns they can use. Artistic types love the opportunity to invent and have their own unique input, while the analytic types enjoy the challenge and scope of multiple methods because the Vedic system uses these ultra-easy methods mental calculation is preferred and leads naturally to develop mental agility. And this in turn leads to growth in other subjects. In the Vedic system 'difficult' problems or huge sums can often be solved immediately. These striking methods are just a part of a complete system of mathematics which is far more systematic than the modern 'system'. Vedic Mathematics manifests the coherent and unified structure naturally inherent in mathematics and the methods are direct. Vedic mathematics, a set of supposedly ancient techniques that help even the most numerically challenged to conquer difficult sums, is surging in popularity as government ministers claim that they could hold the key to better education

iv) The field of vision:

The debate has raised an uncomfortable question for Hindu nationalists on how India lost its scientific and mathematical advantages over the following millennia. Dina Nath Batra said “Muslim invasions and British colonial rule were to blame. The ancient knowledge had been neglected because we’ve been slaves of the Mohammedans and the British for 2,000 years. Nalanda and other places of wisdom were destroyed”, he said. St James' School, London, and other schools began to teach the Vedic system, with notable success. Today this remarkable system is taught in many schools and institutes in India and abroad, and even to MBA and economics students. When in 1988, Maharishi Mahesh Yogi brought to light the marvels of Vedic math; Maharishi Schools around the world incorporated it in their syllabi. At the school in Skelmersdale, Lancashire, UK, a full course called "The Cosmic Computer" was written and tested on 11 to 14 year old pupils, and later published in 1998. According to Mahesh Yogi, "The *sutras* of Vedic Mathematics are the software for the cosmic computer that runs this universe."The difference created by Vedic mathematics is that it had developed the system of tens, hundreds, thousands, etc., and the basis of carrying the remainder of one column of numbers over to the next. This made for smooth sailing calculations of large numbers that was nearly impossible in other systems, as found with the Greeks, Romans, Egyptians and even Chinese. The rising popularity of Vedic maths is partly because of a renewed campaign by the nationalist Prime Minister,

Narendra Modi, to lay India's claim to the cornerstones of human knowledge. He marked India's successful mission to Mars last year by claiming its ancient Vedic scientists had conceived of air travel thousands of years before the Wright Brothers made their first flight. Not only is this, the techniques of Vedic mathematics used in the processors used in electronic devices. As proposed by the IEEE, we know that the ever increasing demand in enhancing the ability of processors to handle the complex and challenging processes has resulted in the integration of a number of processor cores into one chip. Still the load on the processor is not less in generic system. This load is reduced by supplementing the main processor with Co-Processors, which are designed to work upon specific type of functions like numeric computation, Signal Processing, Graphics etc. The speed of ALU depends greatly on the multiplier Vedic Mathematics as by employing these techniques in the computation algorithms of the coprocessor will reduce the complexity, execution time, area, power etc.

v) Anonymity between vedic mathematics and integration simplification:

One fresh thought, one new thought can change your life forever. Perception, simplicity and evaluation have led to the spurting out of a methodology that has its roots in the blend of pragmatism and idealism thereby refraining from complexity. The process of Integration simplification, in the light construction of reality, is based on the psychological concept of differentiation, assimilation, integration and accommodation. Disintegration refers to the misapplication of resources like time. Integration refers to harmonizing towards a common purpose. It is a pragmatic approach of solving a problem or preventing a problem in an interactive manner .Complexity means distracted effort whereas simplicity is a focused effort. Well, generalizing the concept of integration simplification, we thereby present a brusque collation between the technique of integration simplification and our topic of VEDIC MATHEMATICS in terms of simplicity and effective utilization of paramount resources like time. Just as the theory of integration simplification aims at providing the breaking up of complex problems into simple parts, in the same way the topic of Vedic mathematics also provides alternative ways of easy mathematical calculations which involve the use of common sense, an underlying principle of the above technique which saves a lot of time and energy.

3. CONCLUSION:

The essence of mathematics is not to make simple things complicated but to make complicated things simple. Mathematics possesses not only truth but supreme beauty-a beauty cold and austere, like that of sculpture. In our legwork, we have tried to bring into account the antiquity of mathematics and then of Vedic mathematics in an effort to create awareness about the rich culture of which we should be proud as Indians so that the Golden Bird is able to witness many more Aryabhatas and Bhaskaras in the upcoming years. With a presentation of the various views on the topic, we have reached to the conclusion that the methods of Vedic mathematics are quite simple and easy to understand but the views of various authors regarding the fact that there is no solid evidence to prove that these actually form a part of the Vedas. But, certainly, this method has gained popularity not only in solving high school mathematics problems but has emerged immense growth leading to the formation of actual multipliers and various other real life applications. Along with the above mentions pros and cons of the topic, we have tried to describe the simplicity of Vedic mathematics to the fullest by highlighting the closeness of Vedic mathematics with the theory of Integration Simplification. The two are similar in the aspect of saving precious resources like time and reducing complexity to make things more efficient. Vedic Mathematics is a branch of mathematics; nevertheless the applications of the two in their respective fields and the motives behind them are similar thereby leading to the involvement of the efficient and wise utilisation of resources and exhilaration of more efficacious techniques in the respective areas for their upliftment. Thus, by bringing to the brim, all the necessary facts regarding our topic ,we wrap us as proud Indians of a diverse Indian society and hope that India gets the acknowledgements of the future discoveries and we are able to witness much more inventiveness down the line.

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