

Vedic Maths in Education

Gurunathan Sankaranarayanan & Anuradha Subramaniam

Abstract

Mathematics is fundamental to advances in Science, Engineering and Philosophy. Everything in the universe appears to involve mathematics in some way. Mathematics has a long history of more than 5000 years. Various aspects of the subject were developed by different cultures, often independently of each other. Ancient India has contributed a great deal to the world's mathematical heritage. The Vedas are exhaustive Indian scriptures which were revealed and chanted several thousand years ago.

Vedic Mathematics is the name given to an ancient Indian system of mathematics that was rediscovered in the early twentieth century from the Vedas. What we observe today in the modern era of mathematics is the synthesis of fruitful concepts inherited from the ancient medieval period. Modern mathematics has been moving toward increasing generalization and abstraction, with the elements and operations of systems being defined so broadly that their interpretations connect such areas such as Algebra, Geometry, and Topology

This paper provides examples of some of the positive qualities of Vedic mathematics, and why its use has relevance today. It also aims to provide a plan for how Vedic Mathematics education can be implemented to benefit future generations.

The Importance of Mathematics in Everyday Life

Mathematics is the “Cradle of all Creations”, without which the world cannot function. It is everywhere – in the nature all around us as well as in technology. It is very difficult for a person to advance in the modern world without learning how to count and calculate, be it a cook or a farmer, a carpenter or a mechanic, a shopkeeper, a doctor, an engineer, and so on. Everyone needs mathematics in their day-to-day living. Mathematics is the language of science and engineering, describing our understanding of all we observe. It may be broadly described as the science of space, time, measurement, quantities, shapes and numbers and their relationships with each other and how these relate and are applied in the world around us.

Ancient India and Mathematics

It is well said that the history of mathematics is the history of civilization. The mathematical heritage of the Indian sub-continent has long been recognized as extraordinarily rich. The Vedas are considered the oldest Hindu texts. There are four Vedas namely Rig, Yajur, Sama and Atharvana. There are also two important bodies of supplementary literature related closely to the Vedas themselves, namely the Vedangas and UpaVedas. The Vedangas are the limbs of the Vedas. There are six of them. Just like the limbs of the body, they perform various supportive and augmenting functions in the study, preservation and protection of the Vedas and Vedic traditions. The six Vedangas are Siksha (sounds and pronunciation), Chhanda (rhyme and metre), Vyakarana (word and sentence structure), Nirukta (complex words and phrases), Jyothisa (Astronomy, Astrology, Mathematics and Geometry) and Kalpa (ritual details). These subjects were an integral and essential part of the ancient Vedic educational system. It is said that in ancient India no science ever attained an independent existence or was cultivated for its own sake. Any science found in Vedic India is supposed to have originated from one or the other of the six Vedangas.

The Upavedas (usually considered Smriti) deal with the four traditional Arts and Sciences. They are Ayurveda (Medicine), Gandharva Veda (Music and Dance), Dhanurveda (Warfare), and ShilpaVeda (Architecture). All the Vedangas and Upavedas contain a significant wealth of mathematics. Mantras from the early Vedic period (before 1000 BCE) invoke powers of ten from a hundred all the way up to a trillion, and provide evidence of the use of arithmetic operations such as addition, subtraction, multiplication, fractions, squares, cubes and roots.

Further mathematical work is found in the Sulbasutras of the later Vedic period, the earliest of which is thought to have been written around 800 BC and the last around 200 BC. Although the usage of mathematics at this time was clearly not for its own sake, but for the purposes of religion and astronomy, it is important not to ignore the fact that it was indeed applied in medicine, architecture and music, besides being of use in everyday life.

Overview of Vedic Mathematics

Vedic mathematics was rediscovered from the Vedas and their supplementary Vedangas between 1911 and 1918 by Sri Bharati Krishna Tirthaji, a scholar of Sanskrit, mathematics, history and philosophy. He studied these ancient texts for years, and after careful investigation, was able to reconstruct a series of mathematical formulae called sutras. Vedic mathematics is based on 16 sutras and their corollaries or sub-sutras. The word sutra describes an aphorism or a formula. The word upa-sutra means sub-sutra or sub-formula or a corollary. A single sutra generally encompasses a varied and wide range of particular applications. It is a mental tool for calculation that encourages the development and use of intuition and innovation.

The word Veda means “Knowledge” and is considered the encyclopaedia of mankind by Hindus. In the present day, Vedas are mainly used for Hindu rituals and the core values of the Vedas are often not understood. It is proposed that Vedic mathematics may prove to be an effective system of education to help regain some of these lost values, and to impart knowledge to our future generations in an easy and effective way. Vedic or ancient Indian mathematics is currently gaining recognition. This reflects a mindset change that can be further developed by incorporating Vedic mathematics into the prevailing educational system.

Benefits of Vedic Mathematics

Along with multi-dimensional thinking, holistic development of the human brain can occur by practising Vedic mathematics. It encourages mental calculations. Hence it plays an important role in increasing concentration as well as improving confidence. It keeps the mind alert because of the element of choice and flexibility. The system also provides a set of checking procedures for independent cross-checking of whatever is being calculated. It promotes creativity in intelligent students, while helping the slow-learners to grasp the basic concepts. It enriches our understanding of mathematics, and enables us to see links and continuity between different branches of the subject. Vedic mathematics may even help develop spiritual insight.

Attention - Vedic Mathematics enables students to process calculations mentally, often using a variety of methods to solve a problem. Since it emphasises mental working, students need to be very aware of details in the problem: they need to stay focussed in order to choose the most suitable method of solution. This process improves the students’ ability to concentrate.

Visual - Vedic Mathematics encourages students to figure out any special pattern of a mathematics question through visualization of information. This helps to train their visual skill.

Memory - Vedic Mathematics involves doing mathematics mentally. It enhances students' short, medium and long-term memory. It enhances short term memory because numbers are held in the mind while they are being processed, and it enhances medium and long term memory because number properties and results are used repeatedly on different occasions, and so have to be recalled.

Logical reasoning – The Vedic system is designed to help students - even from a young age - understand mathematical operations and rules. Students can easily identify patterns, and thus solve problems with logical thinking.

Processing speed - It is natural to prefer the most efficient (and therefore fastest) solution to a problem, and the Vedic system helps students explore the various options, and thus discover the best method for them personally. This helps them to think and process the information faster.

Principles and Practices of Mathematics using Vedic Mathematics

The areas of mathematics in our current education system across the world include Foundation, Arithmetic, Algebra, Calculus/Analysis, Combinations, Geometry, Applied Mathematics, Probability and Statistics, Computational Sciences, Physical Sciences and Mathematical Sciences. Vedic mathematics, with its sutras and sub-sutras, can be implemented within all these branches of mathematics. Its implementation can help create a unified education system.

Foundational multiplication techniques such as Nikhilam and Vertically and Crosswise can be introduced in primary education to enhance the confidence of the students in multiplication. Gradually, this can be extended to the combined multiplication techniques. All the arithmetic operations using Nikhilam, Vinculum, Squares, and so forth, can be introduced in primary education. The authors have taught these foundation arithmetic techniques to children studying in western countries like Australia. These children were excited by the new approach, and now use it as their norm for multiplication.

The historical development of algebra occurred in three stages: rhetorical or prose algebra, syncopated or abbreviated algebra and symbolic algebra, known as "School Algebra". Symbolic algebra appears to be deeply rooted in Vedic philosophy. The Hindus applied algebra freely, creating formulas that simplified calculations. Algebra is an extension of arithmetic with symbolic letters. An example of applying Vedic sutras in algebra is "Shunyam Saamyasamuchaye" the fifth sutra of Vedic mathematics. Its corollary is Vestanam. The meaning of this sutra is "When the sum is the same that sum is zero". This sutra can be used for solving some quadratic equations.

For example, in $(x + a)(x + b) = (x + c)(x + d)$

If $ab = cd$ then $x = 0$.

The Vedic Indians developed extensive knowledge of Geometry due to the need for practical calculations related to their rituals, and much of the knowledge is still evident in the text named the Sulba sutras. For example, the Bodhayana Sutras (800-600 BC) contain a general statement of the Pythagorean theorem. The Bodhayana version of the Pythagorean theorem is

"The rope which is stretched across the diagonal of a square produces an area double the size of the original square". This in turn introduced the irrational number due to the fact that square roots are generated in this calculation. The achievement of geometrical constructs in Indian mathematics reached its peak later, when the construction of Sriyantra was arrived at: This is a complicated diagram, consisting of nine interwoven isosceles triangles, four pointing upwards and four pointing downwards. The triangles are arranged in such a way that they produce 43 subsidiary triangles, at the centre of the smallest of which there is a big dot called the Bindu. These examples serve as only a very small sample of Vedic mathematics. The current system and branches of mathematics can be well-aligned using Vedic mathematics to help simplify the transition from mathematical concepts based on procedural learning, to fast and creative learning methods.

Approaches to Implementation of Vedic Mathematics

The goal of mathematics education should not be to turn students into robotic calculators: it should be to teach people how to think.

On the global level, Singapore ranks top in mathematics education, and has implemented a successful mathematical framework. Singapore's education system has followed a survival-driven phase, an efficiency-driven phase, and, thereafter, an ability-based phase, working towards an aspiration-driven phase. Currently, mathematical societies across the world are still in the efficiency-driven phase. They might well reach the aspiration-driven phase (and beyond) by incorporating a good framework involving Vedic mathematics.

Problem-solving is central to mathematical learning. The development of problem-solving ability is dependent on five inter-related components, namely concepts, skills, processes, attitudes and metacognition. These involve the acquisition and application of mathematical concepts and skills in a wide range of situations, including non-routine, open-ended and real-life problems. By applying the type of framework offered by Vedic mathematics techniques, mathematical education globally can be taken to the next level.

This implementation requires a forward-looking and integrated educational planning system, support from the government and national policies of a particular country, together with a general commitment and strong focus on mathematics education - accompanied by an attitude of continuous improvement. To help implement such a high-quality mathematical system specifically using Vedic Mathematics the following aspects are required:

- a) Vision and leadership to take Vedic mathematics to international educational systems
- b) Alignment of mathematics education with Vedic mathematics principles and practices
- c) Clear goals and rigorous standards
- d) Curriculum, instruction and assessment mapping to the Vedic mathematics system
- e) High-quality teaching of Vedic mathematics
- f) Implementing proven practices of Vedic mathematics systems.

Vedic Mathematics in the Digital Era

While the benefits of ancient Indian Mathematics are clearly understood, the question arises whether it is fit for use in the digital era in which we live. Consider two students who are given mathematics homework. One student completes it by striving to solve complex mathematical problems. The other student does the work using technology then plays a video

game on his/her smart phone. This scenario emphasises the stark contrast between the worlds of past and current mathematics education at school and the world in which many of our students live.

If one considers mathematics to be a fixed body of knowledge to be learned, then the role of technology in this process would be primarily that of an efficiency tool, that is, in helping the learner to do the mathematics more quickly. However, if we consider the technological tools as providing access to new understandings of relations, processes, and purposes, then the role of technology relates to a conceptual construction kit. In this context, Vedic mathematics can be promoted as a medium of education using the latest technologies through which the new generation can benefit. Technology is an innovation that requires exhaustive application of mathematics. We can use the advantages of technologies to spread Vedic Mathematics education.

Vedic Mathematics Education Awareness Program

The Institute for Advancement of Vedic Mathematics (IAVM) is a great start for the promotion of Vedic mathematics awareness and education. The awareness of Vedic mathematics can be improved through fun-filled games for students in primary education. Vedic mathematics teachers in all parts of the world can meet regularly to spread a uniform message and accumulate a common content of knowledge. Conventional mathematics and Vedic mathematics can be compared, and a resultant common curriculum with a Vedic mathematics slant can be developed for all school ages. This can then be enhanced for university education.

Once a baseline of a common curriculum is established, local schools in any part of the world can be contacted to bring awareness of Vedic mathematics and to teach its simple techniques. As this process matures, the advantages of Vedic mathematics can be demonstrated to the education departments of different countries, with the final goal to incorporate Vedic mathematics in the curriculum, based on the educational standards and framework of the respective country.

In the meantime, certificate programs can be started for all age-groups, with the aid of the common curriculum developed. Regular meetings of all interested students via online conferences can be arranged and an annual day of celebration can be conducted with competitions and the distribution of certificates and awards. Furthermore, Vedic mathematics mobile apps can be created. Similar to current online mathematics websites e.g. “Matheletics” - primarily used in Australian schools - Vedic mathematics websites can be developed, or the Vedic mathematics community can work with current mathematics websites and schools.

Conclusion

There are many advantages to using the flexible, refined and efficient mental system of Vedic mathematics in educational systems world-wide. Its general benefits need to be shared with the general public. The current generation should be able to enjoy the rich heritage and wealth of knowledge that is given by our ancestors.