

Original Article

Simplification of Multiplications using Vedic Mathematics Techniques

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Abstract - Vedic mathematics is one form of mathematics that has been used since the ancient period in India. From historical times, many saints and shankracharyas, with their amazing ideas and thoughts, contributed to this Vedic mathematics, including a large set of algorithms. Vedic mathematics is based on sixteen sutras. Vedic mathematics is not concerned with any religion; anyone from anywhere in the world can yield an advantage and can practice using this broad source of ancient knowledge. Vedic mathematics can enhance anyone's problem-solving speed, hence helping him to crack competition where time is the main constraint.

Keywords - Ancient Period, Vedic Mathematics, Divisibility, Complex Numbers, Multiplication, Square Roots.

1. Introduction

Vedic Mathematics" is so named because it is derived from the Vedas. More specifically, it originates from the fourth Veda, i.e., the Atharva Veda. The Atharva Veda is the Veda that deals with mathematics, Medicine, Engineering, Business and other kinds of sciences about which we are very familiar. Veda is a Sanskrit word derived from the root Vid, which means to know without limits. Vedic mathematics can simplify different arithmetic and algebraic operations, which have been accepted over the entire world. Thinkers and experts from the globe suggested that vedic mathematics could be a very useful technology for those who require to solve mathematical problems in a short span.

Indian Vedic Mathematics, derived from the ancient Sanskrit text Veda, presents a unique and efficient approach to numerical computations. Bharati Krishna Tirthaji [1] formalized this system in his book Vedic Mathematics, where he introduced sixteen sutras (mathematical aphorisms) and thirteen sub-sutras that simplify arithmetic and algebraic operations. Research suggests that Vedic methods, such as the "Ekadhikena Purvena" technique for squaring numbers ending in 5 and the "Nikhilam Navatashcaramam Dashatah" method for multiplication, significantly enhance speed and accuracy in mental calculations [2]. The simplicity and elegance of Vedic Mathematics continue to attract researchers exploring its integration into educational curricula, advanced mathematical algorithms, and computational applications [3].

In Vedic mathematics, complex problems can be answered very quickly using the Vedic method. By using these ancient techniques, which are very systematic and accurate, one can very quickly solve difficult problems that take extra time. It includes all mental calculations in mathematics and covers trigonometry and geometry. Vedic mathematics is a combination of sixteen sutras for mental calculations [4]. Anita Mandloi [5] presented the analysis of ancient time mathematics. Documents analysis also supports thematic analysis. Documents are reliable sources of data. Vaidya concluded that the Vedic Math approach has, time and again, proved to offer a huge advantage in preparation for these events as well as for an individual's holistic development [06]. T., Suyash, et al. [7] worked on division operations based on Vedic Mathematics. Kumar and Charishma [8] designed a high-speed Vedic multiplier using Vedic Mathematics techniques. The Vedic computing paradigm is a set of mathematical and computational ideas based on the ancient Indian scriptures known as the Vedas. It takes a comprehensive approach to problem-solving and computation, stressing simplicity, efficiency, and intuition [9, 10, & 11].

Vedic mathematics is very useful in ancient literature, which simplifies different mathematics operations like divisibility, complex numbers, multiplication, square roots, etc. Jyotish Shastra, one of the six parts of Vedangas, is formed by three parts



called Skandas. Because of the great efforts of Jagadguru Swami Bharathi Krishna Tirtha, this subject was largely revived. The Vedic mathematics consists of the 16 sutras. The ancient Hindu Rishis of Bharat, in sixteen Sutras and one hundred twenty words, laid down some easy steps for solving different mathematical problems in very few steps, in some cases with two or three steps.

Vedic mathematics is very useful for time management because by this, in two or three lines, problems like multiplication, complex numbers, cubing, differential equations, square roots, cube roots, partial equations, theorems, etc., can be solved very effectively. To compete in the very fast-moving world, how quickly you can answer a problem is the most important thing. In all the competitions, there is a race against time. Only those people with fast mental and analytical abilities will be able to succeed in the race. The time saved by these methods can be used to solve other problems. At the present time, by giving initial training in maths at the school level, students will be able to understand the logic of ancient Vedic mathematics after they reach the 8th standard. Vedic mathematics will become very interesting to everyone, especially to beginners and younger students who are keen to mark in examinations and competitive entrance exams. It would not be wrong if we said India's past will help them make it into today's world. This entire miracle is possible with the help of these sixteen Sutras and thirteen sub-sutras [12-16].

Why is it called 'Vedic'

'Vedic' comes from Vedas, which means the fountainhead of all knowledge. The sources of the Sutras were found in Ancient Vedic Texts. As per one definition, Vedic means 'time factor'. Vedic Maths is not concerned with one religion, which means anyone from any sphere of the world can take advantage of its results.

Advantages of Vedic Mathematics

Vedic mathematics helps people solve problems much faster, which saves time that can be used to answer more questions and reduces the burden of having to remember tables up to nine only. With Vedic maths, concentration level increases, and logical thinking level is enhanced. It is a kind of magical.

Among the four mathematical operations, multiplication is considered one of the most difficult. Some multiplication of larger digits takes a lot of time to get answered. Sometimes, it becomes difficult to remember tables, and students get scared of multiplication. By knowing only tables up to five, one can do multiplications of bigger numbers very easily in a very short span of time with the use of Vedic mathematics. These techniques enhance the problem-solving capacity of children and also encourage them to look at the properties of the problem so that they can understand and decide the optimum way to solve these problems. In this way, the mental and analytical ability of the child is enhanced. With these methods, the solving capacity of students gets charged and sharpens their minds to learn how new horizons of problems are simplified. In the modern era, students are dependent on modern technology like calculators, computers, etc. They are not giving importance to learning tables, due to which they are lagging in calculations and problem-solving techniques. In the present time, speed and accuracy play an important role. So parents/teachers must take it as a challenge and should give their child/student something that is faster, more reliable, and more accurate than a calculator. It is universally known that the more we use our minds, the more energetic and alert we will be [3]

2. Multiplication Techniques

Among the four mathematical operations, multiplication is measured as one of the most difficult operations. Some multiplication of larger digits takes a lot of time to get answered. Sometimes, it becomes difficult to remember tables because students get scared of multiplications. By knowing only tables up to five, one can do multiplications of bigger numbers very easily in a very short span of time with the use of Vedic mathematics. These techniques enhance the problem-solving capacity of children and also encourage them to look at the properties of the problem so that they can understand and decide the optimum way to solve these problems. In this way, the mental and analytical ability of a child is enhanced. With these methods, the problem-solving capacity of students gets charged and sharpens their minds to learn how new horizons of problems are simplified. In the modern era, students are dependent on modern technology, such as calculators, computers, etc. They are not giving importance to learning of tables due to which they are lagging in calculations and problem-solving techniques. In the present time, speed and accuracy play an important role. So parents/teachers must take it as a challenge and should give their child/student something as fast, reliable, and accurate as a calculator. It is universally known that the more we use our minds, the more energetic and alert we will be [3].

2.1. Base Method

Same base but less than the base

Example 1: 6×9

Step 1:- In this base is 10,

$$\begin{array}{rcl} 6 & -4 & (6 \text{ is } 4 \text{ deficient to be } 10) \\ \times 9 & -1 & (9 \text{ is } 1 \text{ deficient to be } 10) \end{array}$$

Step 2:- Subtract cross-wise to get first digit of the answer: $6 - 1 = 5$ or $9 - 4 = 5$, the difference of two are always same.

Step 3 : To get second part of the answer multiply vertically i.e. $-4 \times -1 = 4$.

$$\begin{array}{rcl} \text{So, } 6 & -4 & \\ 9 & -1 & \\ \hline 5 & / & 4 \\ \text{i.e. } 6 \times 9 = 54 & & \end{array}$$

2.2. Both have the Same Base

When the base of both the numbers is the same but exceeds the base, then the same sutra as discussed above method is used, i.e. extension of the above method and here we are applying for larger numbers.

Example 1: 11×12

Step 1: In this base is 10

$$\begin{array}{rcl} 11 & +1 & (11 \text{ is } 1 \text{ surplus than } 10) \\ 12 & +2 & (12 \text{ is } 2 \text{ surplus than } 10) \end{array}$$

Step 2: Add crosswise: $11 + 2 = 13$ or $12 + 1 = 13$, which gives first part of answer = 13

Step 3: Multiply vertically: $1 \times 2 = 2$

$$\begin{array}{rcl} \text{So, } 11 & +1 & \\ 12 & +2 & \\ \hline 13 & / & 2 \\ \text{So, } 11 \times 12 = 132 & & \end{array}$$

Example 2: 103×106

Step1:- In this base is 100

$$\begin{array}{rcl} 103 & +03 & (103 \text{ is } 3 \text{ surplus than } 100) \\ 106 & +06 & (106 \text{ is } 6 \text{ surplus than } 100) \end{array}$$

Here, the base is 100, so we have to write 03 in place of 3 and 06 in place of 6

Step 2:- Add crosswise: $103 + 6 = 109$ or $106 + 3 = 109$, which is the first part of the answer.

Step 3:- Multiply vertically: $03 \times 06 = 18$

Because the base is 100, in the second part of the answer, two digits are allowed.

$$\text{So, } 103 \times 106 = 10918$$

2.3. Both Numbers have Less Value but the same Base

When both the numbers have less but the same base, then the same sutra is applied to the greater number, which has the value of less but the same base.

Example1: 98×97

Step 1: The first step is to check the base; this base is 100, so we have two digits on the RHS.

$$\begin{array}{rcl} 98 & -02 & (2 \text{ deficient than } 100) \\ 97 & -03 & (3 \text{ deficient than } 100) \end{array}$$

Step 2: Subtract crosswise: $98 - 03 = 95 = 97 - 02$, so 95 is the first part of the answer.

Step3: Vertical multiplication $-02 \times -03 = 06$

Because the base is 100 therefore, in the second part of the answer, two digits are allowed

$$\text{So, } 98 \times 97 = 9506$$

2.4. Both Numbers have a Value more than the Base

Example 1:- 104×13

Step 1: The very first step is to check the base,

$$\begin{array}{rcl} 104 & +04 & (104 \text{ is } 04 \text{ surplus of base } 100) \\ 13 & +3 & (13 \text{ is } 3, \text{ surplus of the base is } 10) \end{array}$$

Because the digits in the lower base are one so, in the second part of the answer, only one digit is allowed

Step 2: Add crosswise:-

$$\begin{array}{r} 104 \\ +3 \\ \hline 134 \end{array}$$

With the care line, the numbers properly to get 134

So we can say 134 is the first part of the answer

Step 3: Multiply vertically: $-04 \times 3 = (1)2$

As only 1 digit is allowed to get the second part of the answer

Therefore, 1 is carried to the first part of the answer and added to 134 to get 135

$$104 \times 13 = 1352$$

2.5. If One Number is below and the other above the Base

Example1:- Multiply 103 and 98

Step 1:- First of all, check the base, in this base is 100

$$\begin{array}{rcl} 103 & + 03 & (03 \text{ surplus } 100) \\ 98 & - 02 & (02 \text{ deficient to } 100) \end{array}$$

Step 2:- First part of the answer maybe $103 - 2 = 101 = 98 + 03$

Step 3: The second part of the answer is

$$(+ 03) \times (- 02) = - 06$$

$$\text{Therefore, } 103 \times 98 = 10100 - 6 = 9994$$

2.6 Multiplication of any number with 11:

Example 1: Multiply 31 and 11

Step 1:- First of all, write the digit on the left-hand side of the number, i.e. 3 from the number 31 of the number first.

Step 2:- In between, write the addition of the two digits of the given number, i.e. $3 + 1 = 4$

Step 3: Now, on the extreme right-hand side, write the second digit of the number. Here, the digit is 1.

$$\text{So, } 31 \times 11 = 341$$

OR

$$31 \times 11 = 3 / 3+1 / 1 = 341$$

2.7. Multiplication of the given Number with 111

Example:- Multiply 127 and 111

Step 1:- First of all, mark the digits of the given number as the 1st, 2nd and last digits.

$$1\text{st digit} = 1, 2\text{nd digit} = 2, \text{last digit} = 7$$

Now, the first and last digits of the number 127 may form the first and last digits of the answer

Step 2:- From the left-hand side, add two digits of the given number to get the second digit. i.e. $1 + 2 = 3$

Step 3:- To get third digit, from left hand side add 1st, 2nd and last digits of the number i.e. $1 + 2 + 7 = 10$

Step 4: From left hand side add 2nd and last digit to get fourth digit, i.e. $2 + 7 = 9$

Because we know that one's place cannot have two digits so, shift 1 and add to the next digit on the left-hand side, i.e. $127 \times 111 = 14097$

OR

$$1/1 + 2/1 + 2 + 7/2 + 7/7$$

$$1/3/10/9/7$$

$$1/4/0/9/7$$

$$\text{So } 127 \times 111 = 14097$$

3. Another Technique of Multiplication

3.1. Multiplication of Two Digit Number

Upto the previous section, we have applied various techniques to multiply different numbers in which numbers have some special cases in which numbers have near base or complementary conditions, etc. But if the numbers are not near base conditions, it becomes a little bit lengthy to apply base conditions. For that, another general method is applied, which allows us to simplify the multiplication of any numbers easily. In this technique, vertical and crosswise sutra are used to multiply any numbers. This is very simple and easy to understand the multiplication of numbers which is very systematically way discussed in following different steps.

Example:- Multiply 22 and 24

Step1:- One at a time vertically

$$\begin{array}{cc} 2 & [2] \\ 2 & [4] \end{array} \quad \begin{array}{c} 2 \times 4 = 8 \\ \downarrow \end{array}$$

Step2:- Two at a time crosswise

$$\begin{array}{cc} 2 & 2 \\ 2 & 4 \end{array} \quad \begin{array}{c} \swarrow \searrow \\ (2 \times 4 + 2 \times 2) = 12 \end{array}$$

Step3:- One at a time vertically

$$\begin{array}{cc} [2] & 2 \\ [2] & 4 \end{array} \quad \begin{array}{c} 2 \times 2 = 4 \\ \downarrow \end{array}$$

So, $22 \times 24 = 528$

Multiplication of two numbers with carry

Example:- 42 X 25

Step1:- One at a time vertically

$$\begin{array}{cc} 4 & 2 \\ 2 & 5 \end{array} \quad \begin{array}{c} \downarrow \\ 2 \times 5 = 10 \end{array}$$

Step2:- Two at a time crosswise

$$\begin{array}{cc} 4 & 2 \\ 2 & 5 \end{array} \quad \begin{array}{c} \swarrow \searrow \\ 4 \times 5 + 2 \times 2 \\ 20 + 4 = 24 \end{array}$$

Step3:- One at a time vertically

$$\begin{array}{cc} 4 & 2 \\ 2 & 5 \end{array} \quad \begin{array}{c} \downarrow \\ 4 \times 2 = 8 \end{array}$$

So, $42 \times 25 = 1050$

Multiplication of three-digit numbers:

Example: Multiply 213 and 110

Step1:- One at a time vertically

2	1	3	↓	3×0
1	1	0	↓	$= 0$

Step2:- Two at a time crosswise

2	1	3	↘ ↗	$1 \times 0 + 3 \times 1$
1	1	0	↘ ↗	$= 0 + 3 = 3$

Step3: Three at a time vertically as well as crosswise

2	1	3	↘ ↗ ↘ ↗	$2 \times 0 + 1 \times 3 + 1 \times 1 = 0 + 3 + 1 = 4$
1	1	0	↘ ↗ ↘ ↗	

Step4:- Two at a time crosswise

2	1	3	↘ ↗	$2 \times 1 + 1 \times 1$
1	1	0	↘ ↗	$= 2 + 1 = 3$

Step 5:- One at a time vertically

2	1	3	↓	$2 \times 1 = 2$
1	1	0	↓	

So, $213 \times 110 = 23430$

Multiplication of three digits with carry

Example:- Multiply 816 and 223

$\begin{array}{c} 8 & 1 & 6 \\ \updownarrow & \updownarrow & \updownarrow \\ 2 & 2 & 3 \end{array}$	8×2 <hr/> 16	$8 \times 2 + 2 \times 1$ $= 16 + 2 =$ <hr/> $18 + 3$ $= \underline{21}$	$8 \times 3 + 6 \times 2 + 1 \times 2$ $= 24 + 12 + 2$ $= 38$ <hr/> $38 + 1$ $= \underline{39}$	$3 \times 1 + 2 \times 6$ $= 3 + 12 = 15$ <hr/> $15 + 1$ $= \underline{16}$	$6 \times 3 = 18$ <hr/> $\underline{18}$
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So $816 \times 223 = 181968$

In actual we can say that Vedic mathematics is very simple and precise techniques to simplify a lengthy problem in short span of time. With these techniques mental and analytical problem solving capacity get enhanced hence saves a lot of time which one can utilize to solve other problems. All these are possible with continuous use and practice of this ancient Vedic mathematics.

4. Conclusion

The Vedic mathematics is one form of mathematics that has been used from ancient period in India. Its not a new technique but from historic times many saints with their amazing ideas and thoughts contributed a lot to this ancient sutras. Now a day it is becoming so famous because of increasing competitions. Vedic mathematics is becoming very popular among students at various well-known professional institutions. Even in many schools this Vedic mathematics are teaching at junior level to make students aware about these fast problem solving techniques as well as to develop mental and analytical capacity of students to face lengthy problems with differ techniques with less time. With this revolutionary tool mental calculation ability of students enhances. These days many researchers in different area are being undertaken to evaluate the effects of Vedic Mathematics on school children of different standards. At last I would like to suggest my entire friend that we should use Vedic mathematics and also should apply it in our day to day life, this will help us to answer different problems with fast computations.

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