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ORIGINAL ARTICLE

Comparative Study of Aryabhata (Vedic) Method vs Modern Method for Solving Linear Equations

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Abstract

Objectives: The research problem included the determination of the efficacy of the Vedic problem-solving technique (created on the ideas of Aryabhata and Swami Bharati Krishna Tirthaji) among 8th-grade students of the state of Gujarat, as against the current system of teaching how to solve linear equations. An activity review was conducted concerning comparing how these two aspects of time (period) and the involvement of the students in each of the ways are compared with the vision of the National Education Policy (NEP) 2020. **Methods:** In the study, the efficiency of the Vedic method and the modern mathematics instructions for solving a linear equation, particularly for the students of 8th grade in the state of Gujarat, will be compared. All the methods were used, and the time and accuracy were noted. Student opinion was also reported in the form of questionnaires. **Findings:** The participants of the research were 90 students in M.M. Vasa Primary School who were introduced to the two approaches. Pre- and post-tests, accuracy, time, and involvement levels of the students were used to evaluate their work. The findings revealed that the Vedic approach generated an effective reaction among the students, who solved the problems faster and were interested in it. **Novelty:** The research will involve exceptional experimental work on Vedic and modern mathematical processes using a real laboratory environment. Thus, the usefulness of incorporating ancient Indian methods in mathematics learning will be the point of focus in this type of research. It allows the NEP 2020 to focus on the relevance of culture and skill-building in teaching and instruction, which can finally offer a customised curriculum in teaching arithmetic.

Keywords: Aryabhata; Vedic Mathematics; Swami Bharati Krishna Tirthaji; Vedic method; Modern Mathematics; Linear Equations; Paravartya Yojayet; Vilokanam; NEP-2020; Indian Knowledge Systems (IKS); Mental Calculation

1 Introduction

Linear equations are part of the basic elements of mathematics and, hence, education. Traditional algebraic solutions may be time-consuming, thus leading to a loss of concentration by the students. Very similar is the Vedic Mathematics, ancient Indian art of speedy mental mathematics first discovered in the writings of Aryabhata [1] and later perfected by Swami Bharati Krishna Tirthaji in the sutras therein called Paravartya Yojayet and Vilokanam [2]. Current studies show that the teaching methodologies in Vedic have proven to reduce the time needed to solve the arithmetic problems and at the same time increase the computational fluidity. This is empirically substantiated and demonstrates that using the Vedic Sutra, the time would be reduced dramatically in doing arithmetic calculations by Singh and Yadav (2025) [3]. In addition to this, a study by Khare and Gangele (2022) [4] revealed that there were significant changes in the performance of the students in geometry through the use of Vedic mathematical methodologies. Such strategies are in line with the Indian Knowledge Systems (IKS) and the National Education Policy (NEP) 2020. Sinha [5] talks of the broader vision of the application of indigenous knowledge systems through education, and Saini [6] focuses on the contributions of Aryabhata that show how indigenous knowledge panned out to be used in teaching mathematics. This study tries to fill the gap by testing the effectiveness and involvement of the students of both of these methods, which can help the vision of NEP 2020 of the induction of culturally relevant study in the study of mathematics.

1.1 Research Gap

The Vedic method gained popularity due to its speed and cognitive benefits that individuals experience while teaching it. It still also lacks empirical data that is capable of comparing them with existing algebraic methods in working classes, actually under real conditions, especially for linear equations. The current research has focused more on arithmetic and conic sections, without systematic research on application in solving linear algebra problems with a controlled student experiment.

1.2 Problem Statement

The effectiveness of contemporary stepwise algebraic techniques in concept formation may not be the most efficient and entertaining one, at least in terms of working with more pupils and young students, especially in cases when quicker techniques of mental arithmetic are not being popularised. The relevant related question in education is whether the ancient techniques, in this case, the Vedic method procedures, can provide a more time-saving and entertaining teaching pathway for school students. It is different from the modern approach of solving linear equations.

2 Methodology

2.1 Study Design

It is a comparative experimental study, a time-based study, which will contribute to identifying the effectiveness of the two approaches. The Vedic method and the modern method of algebra are used to find the solutions to the linear equations. This will be comparing and trying out the time and mental strength required to solve problems using the two approaches.

The study involved 90 Grade 8 students of M. M. Vasa Primary School, Koba, Gujarat. The concept of linear equations was introduced to the students. The modern algebraic technique sets off a transpositional process step by step, whereas the Vedic one was based on a direct calculation in the mind with the help of sutras. Every student had two problems to be solved in both the modern and Vedic methods. A stopwatch would be used to time the time it takes to solve each issue, and the accuracy of answers was also confirmed.

2.2 Data Collection

The primary statistics were acquired with the help of time tests and observations made by students. The secondary sources of statistics were gathered in relevant literature along with academic articles on an ancient Indian book on mathematics called Aryabhatiya by Aryabhata and Vedic Mathematics by Swami Bharti Krishna Tirthaji.

2.3 Theoretical Framework

2.3.1. Modern Mathematical Approach

Solving linear equations has a modern approach, which seeks the variable by using introductory algebra, that is, by doing the opposite of the mathematical operation. This method aims to make the steps clear and is now used in most classrooms.

2.3.2. Aryabhata's Method

From Aryabhaṭiya of Aryabhaṭa, chapter: Ganita Pada: Stanza 30 provides a method for solving linear equations, as follows:

Translation:

"Divide the difference between the rupakas of the two persons by the difference between their gulikas. The quotient is the value of one gulika if the properties of the two persons are of equal value." Two people are equally rich. Of them, one of them has a gulikas and b rupakas (coins), and the other has 'c' gulikas and d rupakas. The rule shared here is to find the value of one gulika in terms of rupakas.

$$x = \frac{d-b}{a-c}$$

Where a and c represent the number of gulikas, and b and d represent rupakas (coins) for two individuals with equal total wealth.

This method is logical and adheres to mental calculating techniques.

2.3.3. Vedic Mathematics Sutras Paravartya Yojayet and Vilokanam

Vedic Mathematics is an entirely coherent system of being mentally mathematical, an ancient Indian system. It was encoded and rewritten by Swami Bharati Krishna Tirthaji at the start of the 20th century through his deep study of the Vedas. It is a system of synthesis of mathematical rules into one system, thereby enabling the computation to be performed in the fastest time ever with the least effort. Vedic Mathematics is based on sixteen major Sutras and thirteen sub-sutras (corollaries). The sutras are fundamental concepts in math and may apply to every part of math, i.e., arithmetic, algebra, geometry, trigonometry, and even calculus.

The problem of solving linear equations can also be solved by a good way of accomplishing the same, by the Paravartya Yojayet sutra, with which Swami Bharati Krishna Tirthaji introduced a sutra in his book Vedic Mathematics (Chapter Eleven). It enables us to make quick figures in our heads, and we leave out all the tedious steps in the algebra. This sutra is strongly related to the problem-solving method present in the Aryabhata method and is closely related to the ancient Indian mathematical tradition.

Also, the Vilokanam sutra, also referred to as mere observation, is utilised to sharpen the intuitive knowledge. The method enables the students to mentally solve the problem by finding a pattern or relationship in equations. It gives confidence, precision, and intellectual interest, and the learning process becomes both practical and pleasurable.

3 Results and Discussion

The results of the present work were achieved after comparing two various methods used to solve linear equations in a time-bound manner, which were the Modern Algebraic Method and the Vedic (Aryabhata's principles-based) Method. 90 Grade 8 students were involved, and each of them was asked to solve two equivalent linear equations using both methods. It was also recorded how long it took and how correctly, how the students went out qualitatively, and how they felt about the experience.

3.1 Efficiency of time

The Vedic system contributed much to solving linear equations more quickly by bringing in several simplifications. The comparative values of the average time of the experiment are presented as follows.

- The current techniques need 1.55 minutes of computing time to produce solutions to linear equations.
- The Vedic/Aryabhata method needed to solve the linear equation in 1.18 minutes.

3.2 Accuracy

The two methods were equally good when the students were prepared. Nonetheless, the number of students using the Vedic method to solve problems mentally was greater.

Performance Indicator: Number of Students (out of 90)

- Solved faster using Vedic Method: 68
- Using Vilokanam Sutras, solved mentally (without writing steps): 53

3.3 Student's preference

The structured questionnaire was used to obtain students' feedback as follows:

- Eighty-one students claimed that Vedic was exciting since it was quick and direct.
- Sixty-seven learners have further stated that they would like to know more about Vedic math techniques if they were to become part of the regular school syllabus.

3.4 Key Takeaways

- The Vedic method was more effective and time-consuming.
- The contemporary approach provided a better understanding to newbies.
- A hybrid system that incorporates the two techniques can be used to improve learning outcomes because the NEP 2020 vision allows one to combine traditional knowledge systems with modern education.

Student work:

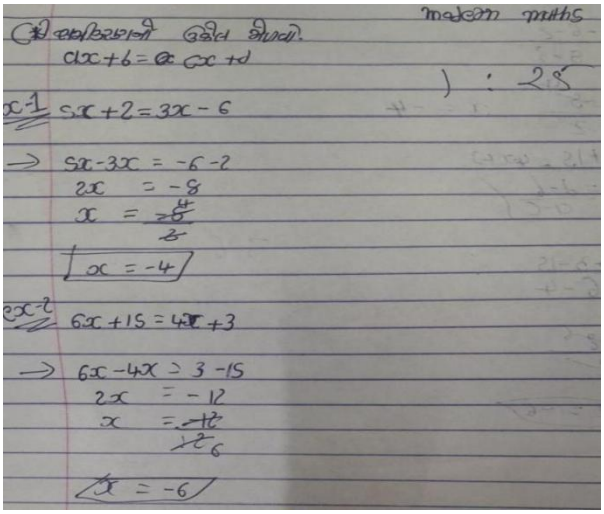

Fig 1. Student 1 applying the Modern method. Time taken: 1.25 minutes

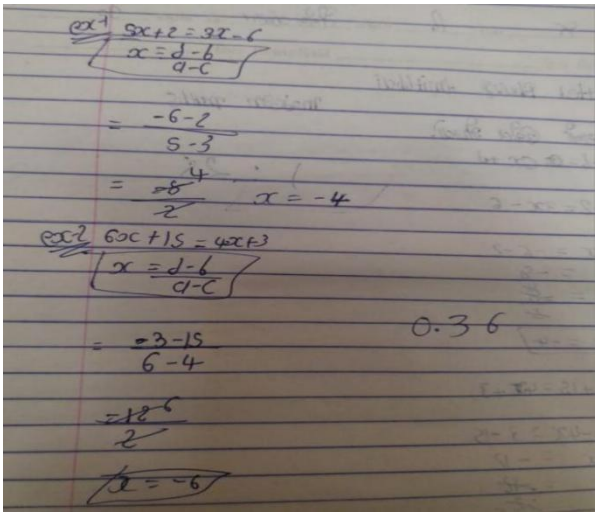

Fig 2. Student 1 applying the Aryabhata (Vedic) method. Time taken: 0.36 minutes

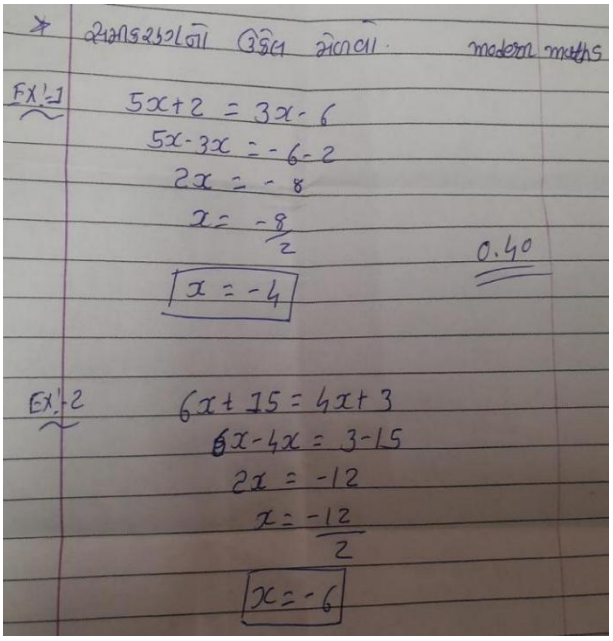

Fig 3. Student 2 applying the Modern method. Time taken: 0.40 minutes

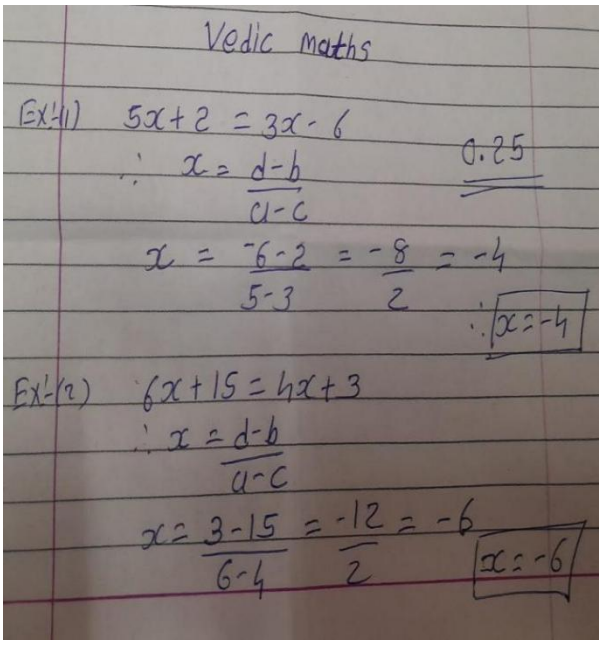

Fig 4. Student 2 applying the Aryabhata (Vedic) method. Time taken: 0.25 minutes

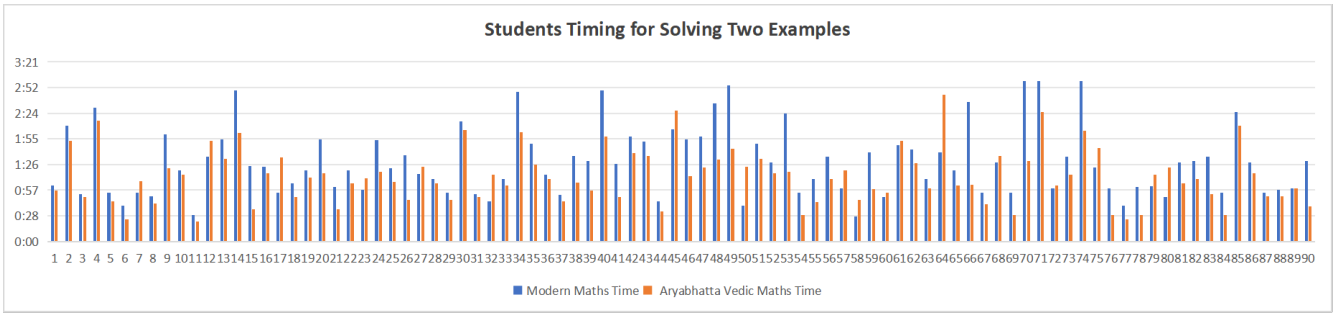

Fig 5. Problem-solving times for all 90 students using the modern method vs. the Aryabhata (Vedic) method

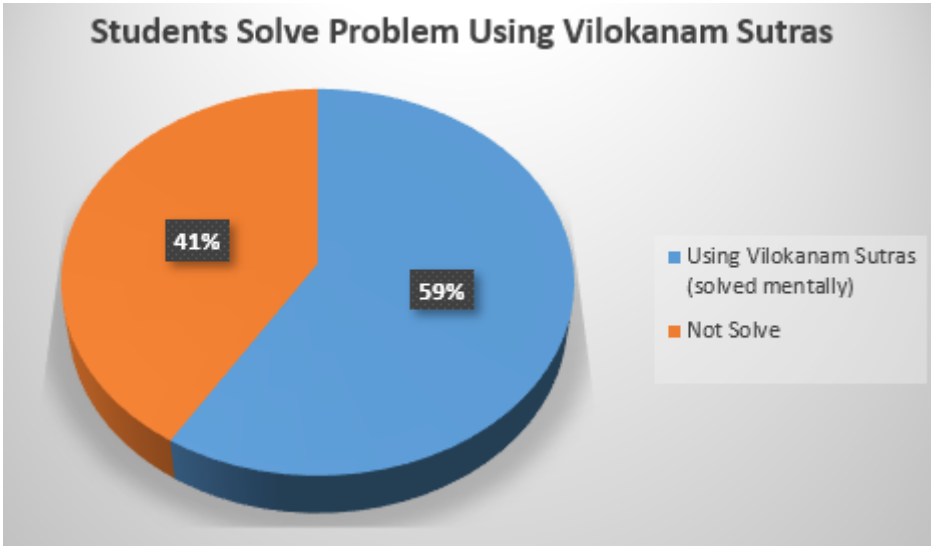

Fig 6. Problem-solving using Vilokanam Sutras

3.5 Comparative Discussion

The comparison explains that the Vedic way of solving a problem (with the principles followed by Aryabhata and Swami Bharti Krishna Tirthaji) is far quicker than the modern way of solving an algebraic problem, while maintaining accuracy. Nevertheless, unlike other authors, in the works in which mainly the conceptual and theoretical cleanness of the methods of Vedic arithmetic took place (Khare & Gangele, 2022; Singh & Yadav, 2025), the given research proposes empirical, classroom-based evidence, which is supported by measurable statistics. The fact that the Vedic method depends on the computations of the mind, after promoting explicit computation, also encourages the heavy participation of the students. Most of them felt this approach was quicker, easier to learn, and much more enjoyable. An interesting fact is that Vedic techniques would increase the speed and interest of students. In comparison to contemporary methods, they would be given more down-to-earth knowledge. Through this, it would play a significant role in offering solutions to higher levels of algebraic problems. The two approaches should therefore be related and not competing. Both are beneficial, but a combination of both in a so-called hybrid teaching model can be swift and correct, interesting, and conceptual. It also validated the National Education Policy (NEP) 2020 since the outcome proved that the Indian Knowledge Systems (IKS) were successfully integrated into the mathematics curriculum.

3.6 Limitations

- The sample size is narrow, as it covers exceptional children in grade 8 in one school in Gujarat, and this could limit the generalisation of the study to other parts of India and different age groups as well.
- Simple linear equations are the only ones that have been practised; the effects on more complex or multipartite algebraic measurements have not been explored.

- There was nothing monitored in the outcome relating to the long-term recall, the transfer to other fields of mathematics, and a more in-depth understanding.
- The qualitative opinion expressed in the study is founded on the short-term exposure to the Vedic methods; this aspect can change upon their long-term implementation.

3.7 Future Work

In the future, the studies would be conducive to:

- In the future, the study population can be increased to cover a larger span of students (regarding their demographics) across schools and regions in India, and the generalisability of the outcomes will be greater, as can be done by the researchers.
- To find answers to the question on the scalability of the Vedic method, it is possible to run it through the problem resolution of some higher-order algebraic tasks and examine its applicability in higher mathematics education.
- It should be examined to find out the effects and consequences of prolonged exposure to Vedic mathematics through further studies.
- Training and evaluation of hybrid teaching strategies incorporating both contemporary algebraic methods and Vedic mathematics may be considered and developed to provide a better understanding, time efficiency, and student interest in the process of mathematics instruction.

4 Conclusion

It is almost a comparative work that not only establishes conclusively the excellence of the Vedic method (based on the principles of Aryabhata and Swami Bharati Krishna Tirthaji) over the modern method of algebra for solving linear equations, but also in terms of time and student interest. The quantitative outcome of the study confirmed that the average time used with the help of the Vedic method was 1.18 min, which was substantially less than that demanded by the modern method, 1.55 min. Notably, 68 students out of 90 (or approximately 75 per cent) took less time to solve problems with the Vedic system than with the Western system, and 53 students (59%) managed to solve problems mentally without writing explanations. In addition, 81 students (90%) stated that the Vedic approach was more interesting, which favoured pedagogical relevance.

When compared to other studies or practices, it is unique because it provides an experiential learning approach in the classroom, drawing on ancient Indian methods in language teaching practices. This fills the gap between the ancient form of Vedic practice and the classroom requirement in the current era. The study forms part of the National Education Policy (NEP) 2020 and the vision of incorporating Indian Knowledge Systems (IKS) in modern education to enhance the learning experience due to its engagement, skill aggregate, and culturally centred nature.

In the current study, a unique contribution was made to the body of knowledge in mathematics education. It empirically presents an argument in support of incorporating culturally important ancient methods that could be used to modernise the existing approach to teaching mathematics and enrich it as well.Non-Cited References [7], [8], [9]

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