Geometric Wisdom in Ancient India: A Study of the Pythagorean Theorem in Sanskrit Texts

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Abstract - *This paper explores the articulation of the Pythagorean Theorem in ancient Indian scriptures, particularly through verses from the Nāradapurāṇa and its interpretation in Bhāskarācārya's Līlāvatī. These Sanskrit texts present geometric relationships using poetic language and symbolic logic that align with the modern understanding of right-angled triangles. By examining the Sanskrit terminology-bhuj (base), koti (height), and karṇa (hypotenuse)-the paper uncovers how ancient Indian scholars engaged with advanced mathematical ideas. The analysis highlights the timeless relevance of these concepts in modern fields like geometry, engineering, computer science, and mathematics education.*

Keywords - *Pythagorean Theorem, Nāradapurāṇa, Līlāvatī, Geometry, Ancient Indian Mathematics, Bhāskarācārya, Sanskrit Mathematics, Trigonometry, Mathematical Heritage.*

INTRODUCTION

Ancient Indian scholars were pioneers in the fields of mathematics and geometry. Their contributions were often preserved in poetic Sanskrit verses and incorporated into religious or philosophical texts, which made them accessible and enduring. One of the most compelling examples is the early formulation of the Pythagorean Theorem-long before it was widely attributed to the Greek mathematician Pythagoras. This paper delves into the geometric insights presented in the Nāradapurāṇa and Līlāvatī, demonstrating how ancient Indian mathematicians conceptualized and applied the relationships within right-angled triangles.

RESEARCH OBJECTIVES

- To analyze the Sanskrit verses from the Nāradapurāṇa that describe the Pythagorean Theorem.
- To understand how Bhāskarācārya's Līlāvatī elaborates and explains these mathematical principles.
- To connect these ancient formulations with modern geometric and algebraic concepts.
- To highlight the relevance of ancient Indian mathematical thought in contemporary education and technology.

PYTHAGOREAN THEOREM IN SANSKRIT TEXTS

भुजकोटिकृतेर्योगमूलं कर्णश्च दोर्भवेत् ।
श्रुतिकोटिकृतेरन्तः पदं दोः कर्णवर्गयोः ॥ ४४ ॥
विवराद् यत्पदं कोटिः क्षेत्रे त्रिचतुरस्रके।
राश्योरन्तरवर्गेण द्विघ्ने घाते युते तयोः ॥ ४५ ॥

(Nāradapurāṇa, Pūrva Bhāga, Dvitīya Pāda, Adhyāya 54, Ślokas 44–45).

TRANSLATION AND MEANING

The square root of the sum of the squares of bhuj (base) and koti (height) gives the hypotenuse (karṇa).

The square root of the difference of the squares of karṇa and bhuj gives koti.

The square root of the difference of the squares of karṇa and koti gives bhuj.

These principles apply to right-angled triangles or quadrilaterals with a perpendicular.

This aligns directly with the Pythagorean Theorem: $karṇa^2 = bhuj^2 + koti^2$

Example

Given: koti = 4, bhuj = 3

Then: $4^2 + 3^2 = 16 + 9 = 25$

$\sqrt{25} = 5 \Rightarrow$ karṇa = 5

If karṇa = 5 and bhuj = 3: $25 - 9 = 16 \Rightarrow \sqrt{16} = 4 \Rightarrow$ koti = 4

If karṇa = 5 and koti = 4: $25 - 16 = 9 \Rightarrow \sqrt{9} = 3 \Rightarrow$ bhuj = 3

INTERPRETATION

- Foundations of Geometry and Trigonometry: These verses reflect the essence of the Pythagorean Theorem, a key pillar of modern geometry. Ancient Indian scholars intuitively understood spatial relationships and expressed them using elegant and precise language.
- Mathematical Literacy in Cultural Texts: Embedding mathematics in cultural and religious texts ensured their preservation and accessibility. This practice is being revived today in STEM education to enhance learning through cultural context.
- Analytical Reasoning and Algebraic Thinking: The problem-solving methods in Līlāvatī mirror modern algebraic approaches. Ancient Indian mathematicians used square roots and arithmetic operations to derive results.
- Application in Modern Technologies: The Pythagorean Theorem supports algorithms in fields like computer graphics, GPS, and machine learning. These ancient principles underpin modern computation and spatial reasoning.

CONCLUSIONS

The mathematical insights contained in the Nāradapurāṇa and explained further by Bhāskarācārya in Līlāvatī provide clear evidence that ancient Indian mathematics was both conceptually advanced and pedagogically effective. The continuity of thought from these texts to modern geometry not only highlights India's contribution to global mathematical knowledge but also serves as an inspiration for integrating heritage and innovation. Recognizing and honoring this legacy encourages a deeper engagement with mathematical learning and its historical context.

References

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