epiSTEME 9 submission no. 27

IDENTIFYING GAPS IN STUDENTS' UNDERSTANDING OF ALGEBRAIC IDENTITIES: TOOLS FROM INDIC KNOWLEDGE SYSTEMS

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WHY THIS STUDY?

topics.

INTRODUCTION

3 strands to be achieved through Math education as stated in NAS 2021:

1. **Application of concepts** in straightforward problems,

Mr. Snake

 Analysing, interpreting, connecting the dots, integrating different pieces of information for problem solving, and
 Creative skills like generalisation, handling complex information and intelligent manipulations in problem

T.

Blue lines represent equal distances traveled by both of them to reach the 'killing point'

solving.

Mr. Peacock

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BACKGROUND

Identities, Pythagorean Theorem and Linear equations in one variable are taught in 3 different chapters in grade 8 but problems that integrate all 3 are missing.

This study aspires to see how students respond to problems that involve combining concepts from different

If distance travelled by both the monkeys is equal,

find the height of the vertical jump (vertical blue line)

NAS 2021

SAMPLE PROBLEMS

BRAHMAGUPTA'S TRIPLETS
a) Use Brahmagupta's expressions:
a² + b², a² - b², 2ab
to generate Pythagorean Triplets (PT).
b) Find the value of a & b that would generate that PT (57, 176, 185).

DEEPER UNDERSTANDING

c) In how many ways can you write 35 as a difference of two squares?
d) When we add two numbers in the PT generated using the above expressions, we get a perfect square. Why?

GEOMETRY+ALGEBRA IN LILAVATI

e) Find length of the altitude to the base 14 in triangle whose sides are 13, 14 15.



WORD PROBLEMS IN LILAVATI

f) A lotus stood straight 52 feet above the bottom of a pond. When the wind blew, the tip of the lotus submerged in water at a distance of 48 feet from the original position. What was the depth of the water?

QUALITATIVE ANALYSES

- Knowing the three algebraic identities did not ensure that students were able to get its deeper understanding & application.
- The element of exploration, observing patterns in PT was highly rewarding both in terms of achieving Strands 2&3 of NAS 2021 as well as making Math more enjoyable.

m	n	m² - n²	2mn	$m^2 + n^2$	Triplet
8	1	63	16	65	16,63,65
5	2				
7	4				
9	3				
10	4				

3. In the above table, take every triplet and add the number in the green column with the number in the yellow column. What do you get in every case? Do you observe something? If so, what is it? Why do you think it is happening?

- Problems that demanded 'reverse thinking' encouraged students to develop heuristics and problem solving strategies.
- Students were able to construct knowledge required to solve linear equations in two variables that they
 would be otherwise taught in grade 10.
- Problems from Indic Knowledge Systems (IKS) that involved algebraic treatment to geometry problems
 was challenging to many but given a rough figure, some were able to solve it using heuristics.
- Word problems from *Lilavati* were the most challenging to students as they had to visualise and create a rough figure before forming equations and solving them. These problems demand the highest skills mentioned in the Revised Bloom's Taxonomy.

QUANTITATIVE ANALYSES

	Count	Mean	Sd	Q1	Median	Q3	Min	Max
Assignment scores	27	61.439	18.902	44.643	65.909	73.684	30.460	100
School assessment	27	68.000	17.856	57.000	68.000	84.000	32.000	99
Assignments count	27	5.148	2.365	4.000	5.000	7.000	1.000	9
Love for Math	27	4.185	0.786	4.000	4.000	5.000	3.000	5
Responsiveness	27	2.111	0.934	1.000	2.000	3.000	1.000	3

Table 1: Table of scores, assignments submissions, love for math and responsiveness

TABLE #1

- No outliers
- Love for Math was independent of scores
- Distribution of students is not skewed

TABLE #2

Significant difference at 5% significance level between: two groups, assignment count, and 10% significance level in their responsiveness.

Students who did well in assignments did well in school and others though motivated found it hard to achieve strands 1 & 2 of NAS 2021.

	Low school performance (N=14)		High school performance (N=13)		
	Mean	SE	Mean	SE	Diff. in mean
Course performance score	0.533	0.049	0.702	0.044	0.169**
No. of assignments turned in	4.286	0.597	6.077	0.615	1.791**
Love for Math	4.071	0.221	4.308	0.208	0.237
Responsiveness	1.786	0.261	2.462	0.215	0.676*

*** indicates p<0.01, ** indicates p<0.05, * indicates p<0.1

CONCLUSIONS

- 1. Students learn identities but the deeper understanding and application is often shallow. There's a need to assess this gap in understanding.
- 2. Exploration of Triplets can help bridge the gap in understanding algebraic concepts and symbolism. It also motivated students to explore and thereby achieve the Strands #2 & #3 of NAS 2021.
- 3. HOTS like reverse thinking could be achieved using the topic of Pythagorean Triplets.
- 4. Word problems from IKS give opportunities to integrate various topics like Pythagorean Theorem, Linear Equations in one variable and Algebraic Identities.

DO YOU HAVE ANY QUESTIONS?

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CREDITS: This presentation template was created by **Slidesgo**, including icons by **Flaticon**, infographics & images by **Freepik**

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