RAM Maths Circle

August 24, 2025

Nagpur

Introduction

In this mathematics session, we explored the essentials of logical implication, proof by contradiction, and contrapositive reasoning. Through relatable examples, interactive puzzles, and truth tables, the class made these abstract topics clear and engaging. The activities encouraged everyone to participate, think critically, and apply logical concepts with confidence.

Concepts Covered

The session introduced students to key principles of mathematical logic, with emphasis on reasoning techniques and structured problem-solving. Three central concepts were discussed:

1. **Logical Implication:** Students explored the meaning of implication through everyday examples. Truth tables were used to analyze when an implication is true or false, along with related concepts such as converse and contrapositive.

2. **Proof by Contradiction:** This method was explained as a process of assuming the negation of a statement and demonstrating that it leads to a logical inconsistency. Illustrative puzzles were employed to make the technique more engaging.

3. **Contrapositive Proofs:** The session highlighted how certain statements can be more easily proved through their contrapositive form. Applications included the Wason 4-card selection task, mathematical examples, and simple geometric properties.

Questions Discussed

Logical Implication Examples

- "If it is raining, then the ground is wet."

- "If the professor is in his office, the light is on."
- Completion of truth tables for propositions P and Q.

Puzzle (Proof by Contradiction): The Crystal Problem

Each student ate a different elemental crystal. The puzzle asked to determine who ate which crystal, based on the following statements:

- **Sumi:** "Rikku ate the water crystal."
- **Rikku:** "Bella ate the fire crystal."
- **Bella:** "Jonah ate the air crystal."
- **Jonah:** "Sumi did *not* eat the earth crystal."

The rules of the puzzle were:

- The **earth** and **water** crystals force their owners to tell the truth.
- The **fire** and **air** crystals force their owners to lie.

Wason 4-Card Selection Task

- Verification of the rule: *"If a card has a vowel on one side, then it has an even number on the other."*
- Cards shown: A, K, 4, 7.

Further Mathematical and Geometric Examples

- "If a number is prime, then it has exactly two factors."
- "If n is even, then n^2 is even."
- Statements involving triangle angle properties.

Summary

The session provided a structured introduction to logical implication, proof by contradiction, and contrapositive reasoning. Through truth tables, puzzles, and mathematical problems, students developed a deeper understanding of formal logic and systematic problem-solving.