Erasmus+ Cultural connections : Enhancing EU heritage, Social Inclusion and Digital Literacy through our Pupils' hearts
Scientific and Creative Thinking Workshop
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ACTIVITY 4.6

Divergent tasks: Maths

1. Quick Introductory Task: "Number Puzzle"

Objective:
To foster students' creative thinking through unexpected and open-ended tasks in lessons.

Activity Structure

Quick Introductory Task: "Number Puzzle"

Each group is given a simple task, for example:

> "Place the numbers 1–9 into a 3×3 square so that the sum of each row, column, and diagonal is the same."

Autonomy:
Teachers may experiment with different solution methods (pencil and paper, cards, digital board).

Task:
Place the numbers 1–9 into a 3×3 grid so that each row, column, and diagonal has the same sum.

Solution

This is the classic **3×3 magic square**.

Magic sum:

$$\frac{1+2+3+4+5+6+7+8+9}{3} = 15$$

One valid solution:

8 1 6
3 5 7
4 9 2

All rows, columns, and diagonals sum to **15**.

Alternative Solution Strategies

- Trial and error with physical number cards
- Logical reasoning: placing **5 in the center** (it balances all directions)
- Symmetry and rotation (this square has 8 equivalent solutions via rotations/reflections)

1. Trial and Error with Physical Number Cards

What This Looks Like in Practice

Students are given **nine cards** labeled 1 through 9 and a **blank 3×3 grid**.

They physically place, move, and rearrange the cards while checking sums.

Step-by-Step Trial-and-Error Process

1. Students begin by placing numbers randomly.
2. They calculate the sum of each row, column, and diagonal.
3. When sums do not match, students **physically move cards** to test new arrangements.
4. Over time, patterns emerge:
    - Large numbers placed together cause sums to exceed the target.
    - Small numbers grouped together cause sums to fall short.

Why This Strategy Is Valuable

- Encourages **hands-on exploration**
- Reduces fear of making mistakes
- Supports **SEN learners** and younger students
- Makes abstract constraints visible and tangible

Teacher Prompt Examples

- “What happens if you swap these two numbers?”
- “Which row is too large? Which number might be causing that?”
- “How could you balance a big number with a small one?”

Expected Learning Outcome

Students discover that **balanced placement**, not randomness, is required.

2. Logical Reasoning: Why 5 Must Be in the Center

Mathematical Insight

The sum of numbers 1–9 is:

$$1 + 2 + \cdots + 9 = 45$$

Since there are **3 rows**, each row must sum to:

$$45 \div 3 = 15$$

Why the Center Is Special

- The center number belongs to:
  - 1 row
  - 1 column
  - 2 diagonals

Total: **4 lines**

To balance all four lines equally, the center must be the **average** of all numbers.

Why 5 Is the Only Possible Choice

- The average of numbers 1–9 is:

$$\frac{1 + 9}{2} = 5$$

- If any number other than 5 is placed in the center:
  - Some lines become too large

    - Others become too small
- No rearrangement can fix this imbalance.

Classroom Explanation (Student-Friendly)

> "The center touches the most lines.
> If we want all lines to be fair, the center must be the most 'neutral' number."

Expected Learning Outcome

Students understand **constraint-based placement** rather than guessing.

3. Symmetry and Rotation: Why There Are 8 Equivalent Solutions

Base Magic Square

One valid magic square is:

8 1 6
3 5 7
4 9 2

Rotations (4 Solutions)

The square can be rotated:

0° (original) / 90° / 180° /270°

Each rotation preserves:

1. Row sums
2. Column sums
3. Diagonal sums

Reflections (4 More Solutions)

Each rotated square can also be:

- Reflected horizontally
- Reflected vertically

This creates **8 total distinct arrangements**.

Why These Are Not New Solutions

Although they look different:

- The relative positions of numbers stay consistent
- The structure is unchanged

Mathematically, these are **equivalent under symmetry transformations**.

Classroom Activity Idea

1. Ask students to rotate the grid physically or on paper.
2. Count how many “different-looking” but valid solutions exist.
3. Discuss why they are essentially the same.

Expected Learning Outcome

Students learn:

1. The concept of **symmetry in mathematics**
2. That some solutions are **structurally identical**
3. How geometry and arithmetic connect

Pedagogical Summary

Strategy	Skill Developed
Trial and error	Exploration, persistence
Logical placement	Deductive reasoning
Symmetry	Structural thinking

Key Teaching Insight

> “A problem that seems like guessing becomes logical once we understand the structure.”

Magic Square Visual Worksheets (3×3)

Worksheet 1: Trial and Error Exploration

Cut out numbers 1–9 and place them in the grid. Try different positions until all rows, columns, and diagonals have the same sum.

Target sum for each line: _____

Worksheet 2: Logical Reasoning – The Center Number

1. Add numbers from 1 to 9: _____ 2. Divide the total by 3: _____ 3. Which number should go in the center? _____ Explain why:

Worksheet 3: Symmetry and Rotation

Below is one completed magic square. Rotate or reflect it to find other valid solutions. How many different-looking solutions can you find?

8	1	6
3	5	7
4	9	2

Number of solutions found: _____