

Pre-service teachers' solution strategies in addition and subtraction tasks

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Background

- Teachers' mathematical knowledge is crucial for students' learning
- Focus on **Specialized Content Knowledge (SCK)**
- Importance of:
 - **Flexibility** (using multiple strategies)
 - **Adaptivity** (choosing appropriate strategies)

Problem Statement

- Pre-service teachers often rely on algorithms
- Limited variation in strategies
- Challenges with:
 - Negative numbers
 - Mathematical representations

Research question:

Which solution strategies do pre-service teachers use?

Theoretical Framework

- Ball et al. (2008): MKT model
- SCK → explaining, representing, and varying solutions
- Hickendorff et al. (2019): Strategy classification

Types of Strategies

Number-based strategies:

- Sequential (number line)
- Decomposition
- Varying (compensation)
- Column-based

Digit-based strategies:

- Standard algorithms

Number Line

- Central in the Norwegian curriculum (LK20)
- Supports understanding of:
 - Magnitude
 - Relationships
 - Negative numbers

Method

- 22 pre-service teachers (first semester)
- Test with 22 tasks
- Qualitative thematic analysis (Braun & Clarke)
- Coding based on Hickendorff framework

Example Tasks

- $-20 + 15 = ?$
- $2 - (-3) = ?$
- $\underline{\quad} + (-9) = -16$

Focus:

- Negative numbers
- Unknown values

Main Findings

- Strong dominance of algorithm-based strategies
- Limited use of number-based strategies
- Number line strategies almost absent

Results (Overview)

- 68–77% used algorithms in several tasks
- Sequential strategies ~ 0%
- Very few varying strategies

Tasks	1	2	3	4
1	18,18 %	0	54,54 %	22,27 %
2	13,63 %	0	63,63 %	18,18 %
3	9,10 %	4,54 %	59,1 %	18,18 %
4	68,18 %	0	13,63 %	4,54 %
5	63,63 %	0	22,72 %	9,1 %
6	50 %	0	18,18 %	18,18 %
7	40,9 %	0	27,27 %	18,18 %
8	40,9 %	0	18,18 %	22,27 %
9	59,1 %	0	18,18 %	9,1 %
10	31,81 %	0	13,63 %	27,27 %
11	45,45 %	0	13,63 %	18,18 %
12	27,27 %	0	4,54 %	50 %
13	4,54 %	9,1 %	45,45 %	31,81 %
14	4,54 %	18,18 %	40,9 %	31,81 %
15	9,1 %	0	22,27 %	45,45 %
16	9,1 %	0	22,27 %	45,45 %
17	13,63 %	0	4,54 %	77,27 %
18	13,63 %	0	4,54 %	77,27 %
19	18,18 %	0	0	77,27 %
20	13,63 %	4,54 %	4,54 %	68,18 %
21	13,63 %	4,54 %	4,54 %	68,18 %
22	9,1 %	9,1 %	0	68,18 %

response rate to the different tasks

Strategy Use

- Same strategy used across tasks
- Very little variation within individuals

→ Low flexibility and adaptivity

Number Line (Findings)

- Almost never used
 - Even in tasks where it would be appropriate
- Not part of students' natural reasoning

Negative Numbers

- High rate of non-response
- Especially in tasks involving negative numbers

→ Indicates conceptual difficulties

Interpretation

- Strong procedural knowledge
- Weak conceptual understanding

→ Instrumental vs relational understanding (Skemp)

Implications

- Need to strengthen:
 - Representational competence
 - Strategy diversity
 - Use of number line

What Should Be Developed?

- Flexibility (multiple strategies)
- Adaptivity (choosing strategies)
- Conceptual understanding of operations

Conclusion

- Algorithm dominance
- Low flexibility
- Underuse of number line

→ Need to strengthen SCK early in teacher education

Future Research

- Effects of teaching interventions
- Development over time in teacher education