Self-Explanation as a Tool for Discovering Early Algebra Procedures: The Importance of Working Memory Capacity

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How can self-explanation help students develop math skills?

To develop new problem-solving approaches, students must integrate new information with relevant prior knowledge (Chi et al., 1989). Self-explanation is one learning technique that can support such knowledge integration during learning (Abelson et al., 2002).

Self-explanation is often elicited by showing students a correct answer and asking them to explain the underlying rationale.

However, self-explanation does not always help (e.g., Matthews & Rittle-Johnson, 2009; Mwangi & Sweller, 1998).

Method

N=115 2nd-4th grade students at a suburban public school

Pretest → Individual Tutoring Session → Immediate Posttest → 2-Week Retention Test

4 Tutoring Conditions: 2 (Order of Instruction) x 2 (Problem Solving Condition)

Order of Instruction: Students received instructional explanations about the equal sign either before problem solving (Instruct→Solve) or after (Solve→Instruct).

Problem Solving Condition: During problem solving, students either self-explained or completed additional practice (to control for time on task).

Solved 6 equations (+6 additional in practice condition)

Assessments

Near Transfer: Solve 7 Equations
Far Transfer (retention only)

Working Memory Measure: Backwards Digit Span (Wechsler, 2003)

Retention Test Results

Order x Condition interaction: Near Transfer, B=-3.23; Far Transfer, B=6.37, p<.01

Condition x WM interaction: Near Transfer, B=17.74, p<.05; Far Transfer, B=9.86, p<.05

No Condition x WM interactions: Near Transfer, B=17.74; Far Transfer, B=9.86

Conclusion

• Self-explanation prompts only helped when children learned by discovery and were high in working memory capacity. This was true for near and far transfer problems on a 2-week retention test.

• The benefits of discovery learning may be heightened for students higher in working memory capacity, if guided by a self-explanation activity that draws attention to relevant information.

• When designing optimal learning environments, it is important to consider learners’ cognitive abilities.

References


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