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 (Atkinson et al., 2000). Self-explanation may be especially beneficial when used as a discovery tool, prior to instruction.

When students solve problems prior to receiving instructions, they must discover what information is most relevant.

Self-explanation may help guide students in selecting relevant information and integrating this information with their prior knowledge during discovery learning.

Students who are higher in working memory capacity may be best equipped for such guided discovery learning through self-explanation.

Working memory capacity enables students to actively select and retrieve relevant information in the face of interfering information (Rosen & Engle, 1997).

Current Study
We tested these ideas by tutoring children about mathematical equivalence (that quantities on both sides of the equal sign equal the same value), a critical concept for learning algebra (Carpenter et al., 2003; Knuth et al., 2006).

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) × 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 × Condition × WM interactions: Near Transfer, ß=2.37; Far Transfer, ß=9.95, ns

Instruction→Solve Condition
No Condition × WM interactions: Near Transfer, ß<.10; Far Transfer, ß<.03, one-tailed

Self-explaining after instruction did not impact learning differently than practice alone (for students higher or lower in working memory).

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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