Access to Algebra for Students with Disabilities: Research and Strategies

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Research

Goal: Identify empirical studies in either the general or special education literature that investigated algebra instructional methods/strategies.
Search Strategies

- Computerized search using ERIC and PsychINFO
- Used the following descriptors
  - Algebra
  - Disability
  - Learning disability
  - Mental disability
  - Strategies
  - Exceptionality
  - Middle school
  - High school
- Ancestral search of article references
- Manual search of mathematics and special education journals

Inclusion Criteria

- Examine the effects of instructional interventions and/or strategies on student performance in algebra
- Used an experimental design, quasi-experimental, or single-subject design
- Because of the small numbers, stringent evaluation of research design was not applied
Results

• 14 Studies
• Studies were grouped according to the student population that served as the primary focus for the intervention
  – Students with disabilities (n=9)
  – Students at risk (n=1)
  – General education students (n=4)
• Highly variable quality in research design particularly for studies focused on general education students

Special Education

• 9 studies of students with disabilities
  – Sample sizes ranged from 3 to 68 students with learning disabilities
  – Focus on middle school, high school, and postsecondary settings
• Algebra content included algebraic word problems, integers, roots, exponents, problem representation, and solution, single and multiple variables, relational and proportional problems
• Strategies that resulted in improved student performance
  – Cognitive Strategy Instruction (Hutchinson, 1993; Hutchinson & Hemingway, 1987)
  – STAR Strategy (Maccini & Hughes, 2000; Maccini & Ruhl, 2000)
  – Videodisc instruction (Kitz & Thorpe, 1995)
  – Co-teaching (Rosman, 1994)
At-Risk

- 1 study of students at risk for failure in mathematics (Allsopp, 1997)
  - Included 262 eighth grade students between 12 and 15 years
    - 99 students identified at-risk for failure in mathematics
    - 163 math-competent peers
- Algebra content included basic algebra equation and word problem-solving
- Classwide Peer Tutoring Intervention
- Key findings
  - Math competent students scored significantly higher on pretest than at risk students
  - Math competent students were significantly higher than at risk students at pretest, but treatment gains resulted in no significant differences between groups at post test and maintenance
  - Significant overall improvement from pre- to post test indicated that both groups benefited from problem-solving instruction

General Education

- 4 studies of general education students
  - Sample sizes ranged from 47 to 228 students
  - Focus on middle school and high school settings
- Algebra content included functions; variable expressions and equations; problem representation; polynomials, and problem solving
- Key findings
  - Reform-oriented instruction produces gains in problem representation skills (Brenner et al., 1995)
  - Problem solving approaches to teaching Algebra I content produce greater achievement gains than traditional lecture-demonstration (Wilkins, 1993)
  - Use of manipulatives in a limited context does not result in increased achievement (McClung, 1989)
  - Use of a computer-based integrated learning system for teaching Algebra I does not result in increased achievement (Carter & Smith, 2000)
Strategies

**Goal:** Summarize instructional strategies that have evidence supporting their effectiveness.

**Tip sheets available with more detailed descriptions.**

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**Gold Medal Winner**

Concrete-Semi-concrete-Abstract Instruction (CSA)

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Concrete-Representational-Abstract Instruction (CRA)

Emphasizes teaching students to understand algebraic concepts before memorizing facts, algorithms, and operations. Instruction begins at the concrete level, moves to the semi-concrete or representational level, and then to the abstract level of instruction.
Studies Using CSA


An Example of CSA/CRA Instruction

Concrete Instruction

❖ Instruction begins with students using manipulatives to display and solve math problems.
❖ Example: 

Semi-concrete or Representational Instruction

❖ Once students have a concrete understanding of the concept, they move to pictorial representations.
❖ Example: 

Abstract Instruction

❖ Students solve problems using the formal symbol systems of mathematics.
❖ Example: 

Silver Medal Winner

Cognitive Strategy Instruction (CSI)

Students are taught to use self-instructional strategies which include reading the problem, making a drawing, developing a plan, and solving the problem. Cognitive Strategy Instructional methods include prompt cards, self-questioning, modeling, guided practice, and independent practice.

Strategies Using CSI


STAR Strategy

Search the word problem
(i.e., read the problem, record the known and unknown facts)

Translate the words into an equation in picture form
(i.e., choose a variable, identify operation, represent the problem concretely or semi-concretely)

Answer the problem

Review the solution
(i.e., reread the problem, check answer)

Identified Studies


Identified Studies


For More Information on Algebra and Students with Disabilities

- **Contact:**

  Project AAIMS
  Algebra Assessment and Instruction: Meeting Standards
  Funded by the U.S. Department of Education, Office of Special Education Programs (Award #H324C030060A)

- **Website coming soon:**

  www.educ.iastate.edu/aaims