TeachME Professional Development

Teaching Strategies for Improving Algebra Knowledge: 2019 Update

Introduction

1. Algebra is often the first mathematics subject that requires extensive abstract thinking, and it also calls for proficiency with multiple representations, including symbols, equations, and graphs, as well as the ability to reason logically, both of which play crucial roles in advanced mathematics courses.

A. True
B. False

Overarching Themes

2. The three general themes that experts highlight for improving the teaching and learning of algebra include developing a deeper understanding of algebra, encouraging precise communication, and promoting:

A. Abstract reasoning
B. Strategic processing
C. Flexible and cooperative learning
D. Process-oriented thinking

Summary of Supporting Research

3. While procedural knowledge includes understanding algebraic ideas, operations and notation, conceptual knowledge includes choosing operations and methods to solve algebra problems as well as applying operations and methods to arrive at the correct solution to problems.

A. True
B. False

Recommendation 1

4. Each of the following is an accurate statement about using solved problems to engage students in analyzing algebraic reasoning and strategies EXCEPT:

A. Compared to elementary mathematics work like arithmetic, solving algebra problems often requires students to think more abstractly and to process multiple pieces of complex information simultaneously
B. Solved problems can minimize the burden of abstract reasoning by allowing students to see the problem and many solution steps at once
C. The use of incomplete solved problems during this step is not recommended as this tends to interfere with critical thinking
D. Analyzing and discussing solved problems can help students develop a deeper understanding of the logical processes used to solve algebra problems

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Summary of Evidence: Minimal Evidence

5. Evidence suggests that, compared to asking students to solve practice problems alone, studying solved problems can:

A. Improve achievement
B. Encourage inquisition
C. Facilitate success
D. Promote progress

Example 1.5. One Way to Introduce Incorrect Solved Problems

6. When introducing incorrect solved problems, the first question the teacher should ask is, 'What is the error, and how can you tell it's incorrect?'

A. True
B. False

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7. As sample problems are presented, experts recommend that correct and incorrect examples be clearly labeled as not to confuse accurate and inaccurate strategies.

A. True
B. False

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8. A computational error is one that occurs when faulty strategies or incorrect reasoning are used to solve problems.

A. True
B. False

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9. Which of the following is NOT one of the methods suggested to introduce, elaborate on, and practice working with solved problems?

A. Use whole class working discussions
B. Have students practice in small groups
C. Develop a wrap-around instruction plan
D. Assign independent practice activities

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10. One strategy for incorporating solved problems into independent practice activities is alternating solved problems with unsolved problems that are similar to the solved problems in terms of problem structure or solution strategy.

A. True
B. False

Potential Roadblocks and Suggested Approaches-Roadblock 1.1

11. In order to engage students with solved problems during whole class instruction, teachers can foster discussion and analysis by using

A. Open-ended questions
B. Think-aloud questions
C. Questions with multiple answers
D. Follow-up questions

Recommendation 2

12. Structure refers to an algebraic representation's underlying mathematical features and relationships such as each of the following EXCEPT:

A. The number type and position of qualities including variables and the number, type, and position of operations
B. The presence of an equality or inequality and the relationships between quantities, operations, and equalities or inequalities
C. The range of complexity among expressions, with simpler expressions nested inside more complex ones
D. The sequence of steps that are intended to be executed in a particular order

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13. Recognizing structure helps students understand the characteristics of algebraic expressions and problems that are presented in symbolic, numeric, verbal, or graphic forms.

A. True

B. False

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14. Research has consistently shown that using language that reflects mathematical structure has positive effects on procedural and conceptual knowledge.

A. True
B. False

How to Carry Out The Recommendation

15. Which of the following is NOT recommended to promote the use of language that reflects mathematical structure:

A. Use questions that require evidence and reasoning to justify mathematical problem solving
B. When talking to students, phrase algebra solution steps in precise mathematical language to communicate the logical meaning of a problem's structure, operations, solution steps, and strategies
C. Use precise mathematical language to help students analyze and verbally describe the specific features that make up the structure of algebraic representations
D. When introducing a new topic or concept, use and model precise mathematic language to encourage students to describe the structure of algebra problems with accurate and appropriate terms

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16. When students use subjective questioning, they are encouraged to think about the structure of the problem and the potential strategies they could use to solve the problem.

A. True
B. False

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17. By identifying the similarities and differences of equations that are presented in various forms, students can better understand the relationship among algebraic representations.

A. True
B. False

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18. Diagrams are useful to help students visualize the structure of a problem, organize and document the solution steps of the problem, and translate the problem into another representation.

A. True
B. False

Example 2.8-Multiple Algebraic Representations

19. When analyzing several representations of a problem, students should be encouraged to move in a linear fashion from one representation to the next, in order to clearly see that different representations based on the same problem can display the information differently.

A. True
B. False

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20. While precise mathematical language is not necessarily more complicated than simple language, it is generally more:

A. Detailed
B. Intricate
C. Accurate
D. Objective

Example 2.10-Examples of Cooperative Learning Strategies

21. In the "partner coaching/trade" cooperative learning strategy, students are arranged in groups, assigned different problems, and collaborate with members from other groups to discuss ideas and strategies.

A. True
B. False

Recommendation 3

22. Unlike an algorithm which contains a sequence of steps that are intended to be executed in a particular order, a strategy may require students to make choices based on the specifics of the problem as well as their:

A. Understanding of concepts
B. Problem-solving goals
C. Conceptual knowledge
D. Reasoning skills

Summary of Evidence: Moderate Evidence

23. Research indicates that teaching alternative algebraic strategies can improve achievement, especially procedural flexibility, once students have developed some procedural knowledge of algebra.

A. True
B. False

How to Carry Out The Recommendation

24. When providing students examples to solve problems using multiple algebraic strategies, students can observe that such strategies vary in their effectiveness and:

A. Degree of difficulty
B. Adaptability
C. Validity
D. Efficiency

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25. Although teachers may be inclined to only introduce one or two solution strategies at a time, experts have found that introducing multiple strategies initially enables students to develop skills for selecting the most desirable strategy.

A. True
B. False

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26. Students should be encouraged to articulate the reasoning behind their choice of strategy, while analyzing the problem structure, selecting the strategy, solving a problem, and analyzing another student's solution.

A. True
B. False

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27. When presenting pairs of solved problems to communicate a particular instructional goal to students, solved problems that are very different from each other should be represented, as this helps students focus on the underlying solution structure of each problem.

A. True
B. False

Potential Roadblocks and Suggested Approaches

28. Each of the following is an accurate statement about helping special education students solve algebraic problems EXCEPT:

A. Is important to distinguish between providing explicit instruction and teaching only a single solution strategy and asking students to memorize the steps of that strategy

B. Special education students are better served if they come to view mathematics as a game where they associate a problem with a specific method
C. Teachers can help special education students understand alternative strategies by being explicit about the steps of a strategy
D. The underlying rationale of using a particular strategy should be taught including how, what, when and why it is applicable or useful for particular problems

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