



Strat-O-Grams

A newsletter of research-based strategies for
Belton School District students, teachers and parents

Learning Strategies – Math Strategies for Solving Word Problems

Topics:

General tips
S.T.A.R. Strategy
Considerations when using math strategies
R.I.D.G.E.S. Strategy
QRQCQ Strategy
Web Resources

General Tips

Learning how to solve problems in mathematics is knowing what to look for. Math problems often require established procedures and knowing what and when to apply them. To identify procedures, you have to be familiar with the problem situation and be able to collect the appropriate information, identify a strategy or strategies and use the strategy appropriately.

1. Clues:

- Read the problem carefully.
 - Underline clue words.
 - Ask yourself if you've seen a problem similar to this one. If so, what is similar about it?
 - What did you need to do?
 - What facts are you given?
- What do you need to find out

2. Game Plan:

- Define your game plan.
- Have you seen a problem like this before?
- Identify what you did.
- Define your strategies to solve this problem.
- Try out your strategies. (Using formulas, simplifying, use sketches, guess and check, look for a pattern, etc.)

If your strategy doesn't work, it may lead you to an 'aha' moment and to a strategy that does work.

3. Solve:

Use your strategies to solve the problem

4. Reflect:

- This part is critical. Look over your solution.
- Does it seem probable?
- Did you answer the question?
- Are you sure?
- Did you answer using the language in the question?
- Same units?

S.T.A.R. Strategy

One effective approach to assisting middle school students in accessing challenging mathematical concepts is to provide strategy instruction. In their article, Mathematics Strategy Instruction (SI) for Middle School Students with Learning Disabilities, Paula Maccini and Joseph Gagnon (2006) define strategy instruction as “a plan that not only specifies the sequence of needed actions but also consists of critical guidelines and rules related to making effective decisions during a problem solving process”.

Some features that make strategies effective for students are:

- (a) Memory devices to help students remember the strategy (e.g., a *First Letter Mnemonic*, which is created by forming a word from the beginning letters of other words);
- (b) Strategy steps that use familiar words stated simply and concisely and begin with action verbs to facilitate student involvement (e.g., read the problem carefully);
- (c) Strategy steps that are sequenced appropriately (i.e., students are cued to read the word problem carefully prior to solving the problem) and lead to the desired outcome (i.e., successfully solving a math problem);
- (d) Strategy steps that use prompts to get students to use cognitive abilities (i.e., the critical steps needed in solving a problem); and
- (e) Metacognitive strategies that use prompts for monitoring problem solving performance (“Did I check my answer?”) (Lenz, Ellis, & Scanlon, 1996).

STAR is an example of an empirically validated (Maccini & Hughes, 2000; Maccini & Ruhl, 2000) first-letter mnemonic that can help students recall the sequential steps from familiar words used to help solve word problems involving integer numbers.

The steps for STAR include:

- (a) **S**earch the word problem;
- (b) **T**ranslate the problem;
- (c) **A**nswer the problem; and
- (d) **R**eview the solution (see Figure 1).

Teachers can use self-monitoring forms or structured worksheets to help students remember and organize important steps and substeps. For example, students can keep track of their problem solving performance by checking off (Ö) the steps they completed (e.g., “Did I check the reasonableness of my answer?” Ö).



Example of Strategy Instruction in Secondary Math:

The example below demonstrates a classroom lesson incorporating the first-letter mnemonic strategy, *STAR* (Maccini, 1998).

Prior to the lesson, the teacher should pretest students to make sure they have the prerequisite skills and vocabulary relevant to the appropriate math concept(s) and to make sure the strategy is needed. The teacher then introduces the strategy and describes what a strategy is, including the rationale for learning the specific instructional strategy and where and when to apply it. After an explanation, the teacher asks students to explain the purpose of the strategy, how it will help them solve word problems, and how to use the strategy. Students should memorize the steps of the mnemonic strategy and related substeps for ease of recall by using a rapid-fire rehearsal. This rehearsal technique involves first calling on individual students (or throwing a ball to students) and having them state a strategy step, then repeating the process with other students in the class. The rehearsal becomes faster as students become more fluent with the steps and rely less on teacher prompts or written prompts.

Figure 1: Instructional Steps for a Classroom Lesson

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| <p>1. Provide an Advance Organizer</p> | <p>The teacher provides an advance organizer of the strategy to help:</p> <ul style="list-style-type: none"> (a) relate previously mastered information to the new lesson; (b) state the new skill/information that is to be presented; and (c) provide a rationale for learning the new information. <p>Teacher: <i>“Yesterday, we used the problem solving strategy, STAR, with word problems involving integer numbers. We used our Algebra tiles to demonstrate the problem and our STAR worksheets to keep track of the steps. Today, we are going to use the strategy and draw pictures to demonstrate the problems on our worksheets. This will be useful because we will not always have the math tiles available to help us solve subtraction problems involving integer numbers. It is important to learn how to solve these problems in order to solve many real-world problems, including money and exchange problems, temperature differences, and keeping track of yardage lost or gained in a game.”</i></p> |
| <p>2. Provide Teacher Modeling of the Strategy Steps</p> | <p>The teacher first thinks aloud while modeling the use of the strategy with the target problems. Then the teacher checks off the steps and writes down the responses on an overhead version of the structured worksheet, while the students write their responses on individual structured worksheets. Next, the teacher models one or two more problems while gradually fading his or her assistance and prompts and involving the students via questions (e.g., “What do I do first?”) and written responses (i.e., having students write down the problems and answers on their structured worksheet).</p> <p>Teacher: <i>“Watch and listen as I solve the problem using the STAR strategy and the structured worksheet. The problem states, On a certain morning in College Park, Maryland, the low temperature was -8°F, and the temperature increased by 17°F by the afternoon. What was the temperature in the afternoon that day?”</i> (See Figure 2 for a copy of the structured worksheet).</p> |

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|---|---|
| | <p>S: Okay, so the first step in the STAR strategy is for me to search the word problem. That means I need to read the problem carefully, and write down what I know and what I need to find. In this problem, I know that I have two temperatures and I need to find the temperature by the afternoon.</p> <p>T: My next step is to translate the problem into picture form. First, I'll draw 8 tiles in the negative area and then I'll draw 17 tiles in the positive area.</p> <p>A: Then I need to answer the problem. I know one positive and one negative cancel each other. I can cancel -8 and $+8$, which results in $+9$ remaining. Therefore, the answer is $+9$.</p> <p>R: Finally, I need to check my answer. OK, I'll reread the word problem and check the reasonableness of my answer. Yes, my answer is $+9^{\circ}\text{F}$ and it is a reasonable answer.</p> |
| <p>3. Provide Guided Practice</p> | <p>The teacher provides many opportunities for the students to practice solving a variety of problems using their structured worksheets. Guidance is gradually faded until the students perform the task with few prompts from the teacher.</p> |
| <p>4. Provide Independent Student Practice</p> | <p>Students perform additional problems without teacher prompts or assistance, and the teacher monitors student performance.</p> |
| <p>5. Feedback and Correction</p> | <p>The teacher monitors student performance and provides both positive and corrective feedback using the following guidelines:</p> <ul style="list-style-type: none"> (a) documents student performance (percent correct); (b) checks for error patterns; (c) reteaches if necessary and provides additional problems for students to practice corrections; and (d) closes the session with positive feedback. |
| <p>6. Program for Generalization</p> | <p>The teacher provides a cumulative review of problems for maintenance over time (weekly, monthly) and provides opportunities for students to generalize the strategy to other problems (see Figure 3).</p> |

Promote individualization of strategy instruction (SI).

Students should be encouraged to individualize use of SI in math class via adapting a strategy learned in class. For example, as processes involved in the *STAR* strategy becomes more automatic for students, recalling the first step, “Search the word problem,” may prompt students to read the problem carefully and to initiate translation into mathematical form (i.e., translating words into an equation).

Program for generalization.

It is imperative that both special and general education math teachers program for both *near* (i.e., maintaining the same structure but using different story lines) and *far* generalization (i.e., incorporating more complex problems than the problems in the instructional set) of the SI math strategies in order to promote retention and application of strategy use. For example, for *near generalization*, different story lines can be incorporated for generalization (i.e., use of integer numbers with problems involving time zone changes, sea level, and age) in addition to the problems used in the instructional set. For *far generalization*, more complex problems are introduced than the problems initially taught in the instructional set (e.g., In a certain city, if the difference between the highest and lowest altitude is 155 m and the altitude of the highest point is 900 m above sea level, what is the altitude of the lowest point?). In addition to its application to problem solving involving integer numbers, the *STAR* strategy can be generalized across math topics (see **Figure 3** for an example involving area).

Search the word problem

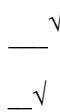
- (a) Read the problem carefully
- (b) Ask yourself questions: “What do I know? What do I need to find?”
- (c) Write down the facts

Translate the words into an equation in picture form

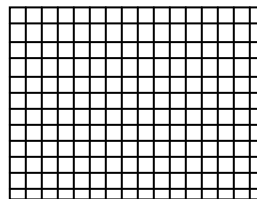
Answer the problem

Review the Solution

- (a) Reread the problem
- (b) Ask yourself questions: “Does the answer make sense? Why?”
- (c) Check the answer



Matt’s bedroom measures 12 ft x 16 ft, has \$40 to spend, the carpet costs \$2/yd², I need to first find the total area of the room...



I know that 3 ft = 1 yd, and (3ft)² = (1yd)² so 9ft² = 1 yd². I will ÷192 ft² by 9 to get yd² = 21.3 yd²

The carpet costs \$2/yd² so I will need \$2 x 21.3 yd² = \$42.60. Matt does not have enough money.



I checked my answer and it makes sense—Matt needs \$2.60 more in order to buy the carpet for his room.

Ridges Strategy

The RIDGES strategy is probably appropriate for upper elementary through secondary grade levels and can be used for math word problems to help a student formulate an appropriate plan to solve the problem.

RIDGES stands for:

Read the problem- If the problem is not understood it should be reread.

I know statement- List the information given in the problem. All information should be listed, relevant or not.

Draw a picture- Draw a picture of the information in the problem. This may help a student pick out the relevant information.

Goal statement- The student should express, in their own words, the question the problem is asking. (I.e. I know the field is six feet wide and ten feet long)

Equation development- The student will write an equation to the problem. (i.e. length + width + length + width = distance around the field)

Solve the equation- The given information is plugged into the equation. (i.e. $10+6+10+6$ =distance around the field)

Source:

Snyder, K. (1988) Ridges: A problem-solving math strategy. *Academic Therapy*, 230), 261-263.

SQRQCQ Strategy to Solve Math Problems

This strategy provides a structured approach to solve word problems by guiding students to find important elements and determine how they should be solved in a logical order. It includes built-in self-questioning to encourage students to find and correct their own mistakes. The strategy involves planning an attack on the problem systematically, making the best use of all the information that the problem offers, and make sense of the answers. "SQRQCQ" is a six step strategy that follows a logical order allowing the students to have a checklist making sure their answer is correct. "SQRQCQ" is an acronym for Survey, Question, Re-read, Question, Compute, and Question.

Survey the Math Problem: Read the problem to get a general idea of its general nature.

Talk with your student about the problem and discuss what parts are most important.

Determine if there are any "red herrings" in the problem that serve no purpose in solving it. Have the student offer guesses about what the problem wants him to do.

Ask Yourself Questions about the Problem: Reflect on the reading to determine what the problem is asking you to do. Is the question asking you to estimate, calculate area, multiply, or other operation? Talk about it with your student.

Read the Problem: Read the question again. This time, focus on the specific details of the problem. What parts of the problem relate to each other? Consider what form your answer should be. Should the answer be in inches, miles, liters, time units, or some other form? Discuss this with your student.

4. **Question Yourself About the Operations Involved:** Reflect again. This time, determine the specific math operations the problem is asking you to perform, and list them on paper in the order they are to be performed.

5. **Calculate the Problems:** Perform each operation in the order you listed it. Check off each step as you finish it.

Question Yourself About the Steps You Took: Review each step you took. Determine if your answer seems reasonable. If possible, check your answer against the book's answers or have a teacher look at your work to determine if you are on the right track. Check your answers at each step of the operation. Were they correct? If not, make those corrections.

Tips:

Scan through the text of the word problems you will be solving to identify any words you do not recognize. List them and determine their meanings before solving the problems. Write brief definitions of the terms for your reference during problem solving.

For students with basic math learning disabilities, consider allowing the use of a calculator as they are learning how to work with word problems. This will allow them to focus on problem solving skills without their calculation disabilities getting in the way.

Word Problems Solving Strategies Resources

<http://www.mathstories.com/strategies.htm>

<http://library.thinkquest.org/4471/learn.htm>

http://homepages.wmich.edu/~whitten/champaign_project/math.html

<http://www.nzmaths.co.nz/PS/Info/PSSstrategies.aspx>

<http://www.rhlschool.com/math.htm>

References

Afflerbach, P., & Meuwissen, K. (2005). Metacognition In Literacy Learning: Theory, Assessment, Instruction, and Professional Development. In S. E. Israel, C. C. Block, K.L.

Bauserman, & K.K. Welsch (ED.). Teaching and Learning Self Assessment Strategies in Middle School (pp. 157-160). New Jersey: Lawrence Erlbaum Associates, Inc.

Gagnon, J. C., & Maccini, P. (2008). Teacher use of empirically-validated and standards-based instructional approaches in secondary mathematics. Remedial & Special Education.

Maccini, P., Gagnon, J. (2006). Mathematics Strategy Instruction (SI) for Middle School Students with Learning Disabilities. Available for download from:

<http://www.k8accesscenter.org/index.php>