CRISS Applications to Mathematics Instruction

By Joseph Harvey and Lynn Havens

Teaching lessons rich in CRISS principles and strategies is an important factor to students' success in the classroom. Sometimes finding ways to incorporate these in the mathematics classroom can be a challenge. In this article are a number of tried and true strategies suggested by Joseph Harvey, elaborated upon by Lynn Havens, and successfully used by both!

We have organized the math applications into the two strategy sections of our CRISS Strategic Learning Plan, *Preparing for Understanding* and *Engaging Students with Content and Transforming Information.*

PREPARING FOR UNDERSTANDING

Students who know the Author's Craft of mathematics materials will more readily succeed in learning from those materials. Mathematics texts are similar to most textbooks in that they have titles, headings, and subheadings. Vocabulary usually is listed using boldface and italicized words. Mathematical procedures are often "showcased" by using shaded areas or boxes. In many of the newer textbooks, main ideas are placed at the beginning of units and chapters and, in addition, most sections within a chapter begin by listing the main ideas. An example from Glencoe McGraw-Hill *Pre-Algebra* is at the end of this article. Note the main idea list in the left-hand margin. Typically, the section elaborates on the main ideas using explanations or definitions followed by several examples or sample problems with solutions, which are often annotated to help the student understand each step.

Teachers can use **Pattern Puzzles** *(see pages 44-45 of the CRISS training manual, 3rd edition)* for teaching text organization. Divide a section of a chapter into paragraphs and math examples. Have students put the section back together so it makes sense to them. Then have the students compare their organization with that of the author. Discuss with the students the pros and cons of their arrangement compared to the author's organization of information. Finally, you can have students create posters which list or illustrate the organizational features of the book and chapters. Keep these posted in the room to guide students, and refer to them often to help students "own" the organizational plan.

In addition to discovering the author's craft of their textbooks, encourage students to look at how word or "story" problems are crafted. For example, in most problems, the last sentence indicates what the students are supposed to determine. In dealing with these problems, students may find it helpful to read that sentence first, then read the rest of the problem looking for the "story" and for the facts they will need to solve the problem—where are the facts located? Students may find that different types of problems have different types of organization. To solve a problem, students need to identify the organization first, before jumping into the calculation.

Background Knowledge

When a mathematics teacher prepares a lesson, she must consider several components. One of these, background knowledge, is essential to learning mathematics. Students must have number sense and be able to compute using subsets of the real number system, such as whole numbers, integers, and rational numbers. They need this to proceed from algebra I to geometry to algebra II and beyond. In calculus, students seem to be able to carry out derivatives and integral techniques, but get lost in the algebra. Once again, background knowledge is key. CRISS will guide this effectively.

So how does a mathematics teacher incorporate background knowledge into her classroom? Let's say she is teaching *percents*. The teacher can create a pre-test using questions, such as: What is a percent? How do you express percents as fractions and decimals? How do you apply percents as a smart consumer? How does the media use percents? These questions may be developed by the teacher or, better yet, get students to list questions they have about percents. Then use those questions to guide a discussion or for journal prompts.

Another way to bring out background knowledge is through the use of an **Anticipation Guide** *(see pages 90-92, 3rd ed.)*, which is a collection of true and false statements. Students read through the statements and check whether they agree or disagree with the information provided. Choose statements that relate to information about what your students might have misconceptions. Always remember to revisit the Anticipation Guide at the end of a section so students can correct their initial misconceptions. Sample statements based on a percent unit might be:

1. Percent means one hundred
2. 5% is the same as .5;
3. A smart consumer knows that 30% off the regular price is the same as 70% of the regular price.

Both the pre-test and Anticipation Guide (and most of the strategies listed in this article) may be incorporated into one of the **Foldable®** formats to add some fun and creativity to the activity. A Foldable, originally developed by Dinah Zike, <http://www.dinah.com/>, is created by cutting and folding pieces of paper to create interesting two- or three-dimensional formats for note taking.

ENGAGING STUDENTS WITH CONTENT AND TRANSFORMING INFORMATION

Writing

Question-Answer Relationships (QARs) *(see pages 70-74—especially page 74, math adaptation of QARs, 3rd ed.)* are an excellent way to incorporate writing (and discussion) into a lesson. Have student teams create and answer each of the four types of questions based on the information in their text or mathematics materials. Following are some sample questions/answers (using the adaptations shown on page 74) developed using examples from Glencoe McGraw-Hill *Pre-Algebra,* 2008.

- ***Right There:*** What is a percent? *Answer:* A percent is a ratio that compares a number to 100.
- ***Think and Search*** *(the question is just like the example, only using different numbers)**:*** Change 15% to a fraction. *Answer:* 15% = 15/100 = 3/20
- ***Author and You*** *(put new information together with info previously learned)**:*** Change 15% to a decimal. *Answer:* 15% = 15/100 = 0.15 (Note: Changing a fraction to a decimal was previously learned.)
- ***On My Own:*** Give an example in the real world of a percent greater than 100%. *Answer:* When I got 100% on my math test, plus two extra credit problems correct, the grade at the top of my test was 110%!

Help students get engaged in their texts by using sticky notes (see **Sticky-Note Discussions,** *pages 61-62, 3rd ed.)*. They can write out explanations and examples. They can summarize a procedure in their own words. If they have problems with the text, they should put the sticky note in the exact spot where they lost meaning and explain what they don't understand—a term, the process, the symbols being used, or the example. These written sticky notes can stimulate both small group and whole group discussions.

Have students create their own word problems. To write a good word problem, students will have to understand the *Authors Craft* for word problems. (See the preceding section, "Preparing for Understanding.") Encourage them to be creative, to include people, places, and situations with which they are familiar. Model how to include both hints (words that signal processes) and unnecessary details (to challenge the problem solvers).

Discussion

A successful strategy to engage students throughout the math lesson is **Read-and-Say-Something** *(pages 58-59, 3rd ed.)*. The group interaction will enrich and enlighten the learning in a safe, cooperative group setting. You can use this strategy when students are reading or doing a hands-on activity. For the "say something" part, they can ask questions about a process or term, give "real world" examples, create a similar problem, relate to earlier information in the text, etc. The same process can be used with a lecture. Just stop and let the students say something. Since they can't go back and "re-read" your lecture, provide time for them to ask other students or you the questions that originated during the say-something time.

Another lecture processing strategy is the **Three-Minute Pause** *(page 57, 3rd ed.),* which allows students time to check for understanding along the way. Remember, during the three minutes, the students summarize what they heard, identify something interesting that caught their attention, and ask questions about confusing parts. Three-Minute Pause and Read-and-Say-Something are great ways to keep students engaged, active learners during a lecture.

Carousel Brainstorming *(pages 62-63, 3rd ed.)* works well when combined with learning stations—a concept where the students are organized in groups and rotate from one activity station to another, often with a common theme. Systems of equations work well with this. For example, you could give each group of students a selection of problems to solve. As they rotate through the "solving" stations, they are required to solve their equations using substitution, subtraction, guessing, and graphing. Great discussions will occur at each station, as well as at the conclusion of the activity when students have to select the BEST way to solve a system of equations.

Organization

Mathematics is no longer a series of computations. Important real-world connections must be made. High stakes tests are usually in the form of multilevel, real-world questions that require background knowledge, synthesis, and evaluation. Students need to justify their answers and explain their processes. The CRISS problem solving formats (**Process Notes**, *pages 137-140,* and **Problem-Solving Organizer**, *pages 142-143,3rd ed.*) can be very helpful with this.

The **Semantic Feature Analysis** *(pages 211-215, 3rd ed.)* is an excellent tool for the mathematics teacher and student. It enables one to link key vocabulary words to specific features or traits. For example, use the SFA to link the math terms, such as "increase," "quotient," and "per" to the four basic operations—addition, subtraction, multiplication, and division. As students work with word problems throughout the year, have them add to the list of terms. Frequently, they will notice that one term, in different types of problems, may have more than one "feature." For example, most students would acknowledge that "increase" relates to *addition*, e.g., "If Stella's weight increases by 3 pounds how much does she weigh?" (Add 3 lbs. to her current weight.) But, in the following problem, "increase" relates to *multiplication*. "A bungee cord will increase in length 3 feet for every 1 second during a jump. By how much will the cord expand in 7 seconds?" (Multiply 3 ft. times 7.)

Two- and Three-Column Notes *(pages 118-122, 3rd ed.)* are useful strategies to help students organize their thinking and understanding. The teacher needs to start by modeling two-column Main Idea—Detail Notes for the students. Use their content materials and model or have other students model until the majority of students can complete the notes independently. Students can "bring to the table" their own background knowledge and examples by including them in a third column added to the right of the "Details" column.

Other motivating, transforming strategies to incorporate into mathematics lessons are **RAFT** assignments *(pages 186-189, 3rd ed.)* for the creative writers in your math class, **graphic organizers** *(pages 92-104, 3rd ed.)* and **Picture Notes** *(pages 105-107, 3rd ed.)* for those who are visual learners, and **songs** (to memorize procedures and learn vocabulary terms) for those who are musically talented.

Metacognition

Metacognition is vital in the mathematics classroom. Writing and discussion are two CRISS principles that will help your students be metacognitive learners. The National Council of Teachers of Mathematics has claimed for years that **journal writing** *(see Chapter 7, 3rd ed.)* is a valuable activity in a mathematics classroom. Think about using journals (non-graded writing) on a regular basis to get students to write about their learning and their learning struggles. Have them write in words:

- A description of a solution they originally did using numbers and/or mathematical symbols.
- What they did wrong in solving a problem on a test or on homework.
- What they need to change in order to solve a problem correctly that they originally missed.
- What they learned today, this week, this month.
- How they would apply what they learned to the "real world."
- Which note-taking strategies work best for them and why.
- Which problem-solving organizers work best for them and why.
- The steps of a mathematical process or procedure.
- The relationship between mathematical terms or concepts.
- The meanings of mathematical terms or concepts.
- Draw a graph of your learning. Using a vertical scale of 1-5 ("1" being no understanding and "5" being total comprehension), plot a point for each math topic (list topics across the bottom of the graph) that represents how well you learned it. Write a comment about the highest and lowest values of your graph.

One or more of these responses can be added on a regular basis to homework assignments and tests. For homework, it is helpful for pairs or small groups of students to **discuss** their responses before individually writing them down. With tests, we find when students correct their own tests (which they then "own"), write out the correct procedures and, in addition, explain in words **why** they missed specific items, they begin to see assessments as additional opportunities for learning. Identifying mistakes and faulty logic is very metacognitive, and the students should earn points for their effort.

We hope we have convinced you that Project CRISS principles and strategies will lead all students to success in learning mathematics.

About the Authors:

Joseph Harvey, CRISS District Trainer, has 27 years experience as a mathematics teacher. He teaches at Charles W. Flanagan High School (Broward County) in Pembroke Pines, Florida. Joseph holds a Bachelor of Science in Mathematics degree from the Trevecca Nazarene College in Nashville, Tennessee, and his Masters in Mathematics Education from the University of South Florida. Joseph conducts Level I trainings specifically with math teachers in mind and has customized his training to meet their needs. You may contact Joseph at algebra29@hotmail.com.

Lynn Havens is the Director of Project CRISS. She co-authored the CRISS training manual and *Project CRISS for Students: It's a Brain Thing ~ Learning How to Learn!* Before her involvement with CRISS, she taught mathematics and science at the junior high and high school levels. You may contact Lynn at lhavens@projectcriss.com.

6-5 Fractions, Decimals, and Percents

Main Ideas

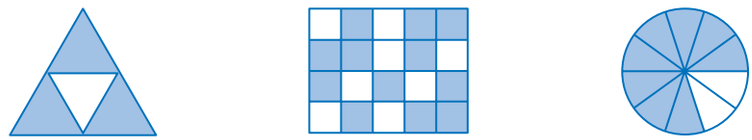
- Express percents as fractions and vice versa.
- Express percents as decimals and vice versa.

New Vocabulary

percent

GET READY for the Lesson

A portion of each figure is shaded.



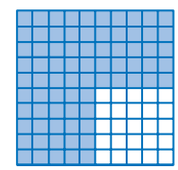
a. Write a ratio that compares the shaded portion of each figure to its total area as a fraction in simplest form.

b. Rewrite each fraction using a denominator of 100.

c. Which figure has the greatest portion of its area shaded?

d. Was it easier to compare the fractions in part **a** or part **b**? Explain.

Percents and Fractions A **percent** is a ratio that compares a number to 100. The meaning of 75% is shown at the right. In the figure, 75 out of 100 squares are shaded.



Reading Math

Percent There are 100 *cents* in one dollar. *Percent* means per *hundred* or *hundredths*.

To write a percent as a fraction, express the ratio as a fraction with a denominator of 100. Then simplify if possible. Notice that a percent can be greater than 100% or less than 1%.

EXAMPLE Percents as Fractions

1 **Express each percent as a fraction in simplest form.**

a. **45%**

$$45\% = \frac{45}{100}$$
$$= \frac{9}{20}$$

b. **120%**

$$120\% = \frac{120}{100}$$
$$= \frac{6}{5} \text{ or } 1\frac{1}{5}$$

c. **0.5%**

$$0.5\% = \frac{0.5}{100}$$
$$= \frac{0.5}{100} \cdot \frac{10}{10}$$
$$= \frac{5}{1000} \text{ or } \frac{1}{200}$$

Multiply by $\frac{10}{10}$ to eliminate the decimal in the numerator.

d. $83\frac{1}{3}\%$

$$83\tfrac{1}{3}\% = \frac{83\frac{1}{3}}{100}$$

The fraction bar indicates division.

$$= 83\tfrac{1}{3} \div 100$$
$$= \frac{\overset{5}{\cancel{250}}}{3} \cdot \frac{1}{\underset{2}{\cancel{100}}} \text{ or } \frac{5}{6}$$

CHECK Your Progress

1A. 60% **1B.** 150% **1C.** 0.2% **1D.** $20\frac{1}{2}\%$

To write a fraction as a percent, write an equivalent fraction with a denominator of 100.