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Prereading Strategies and Activities

Prelude

Mathematics students will readily admit they often skip over the mathematical text and go right to the problem section of a lesson in the text. As teachers, we attempt to remedy the situation by cajoling and coaxing the students to open the book and read. However, we suspect that many of our students pay little attention to this, for they know that they will learn the important content from our presentation of the content in class or can refer back to examples in the text for help with assigned problems. What appears to be missing is the students' willingness to read and learn from the text. So if willingness is the key, how do we instill this in our students?

We know that children learn to read after they have demonstrated a readiness to learn. We can surmise that when our students are ready to read mathematical text, they will do so. So our role seems clear: facilitate this readiness. The key components for readiness to learn are interest, competence, and confidence. First, the text must capture the attention of the reader by containing content that is both interesting and relevant. Also, students must possess the skills that allow them to read efficiently and know that they either possess these skills or will soon have them. Competence in reading mathematical text includes understanding the vocabulary and the background or fundamentals of the concepts in the reading. To foster confidence, Vacca and Vacca (1999) suggest that we

arouse curiosity, elicit predictions, and urge our students to ask questions about the new content. The prereading strategies and activities presented in this chapter are designed to promote and encourage student readiness and willingness to read mathematical text and content.

As teachers of mathematics, we are often limited by time constraints and the amount of content we are obliged to cover. Some of us may feel that teaching reading is not a priority. However, if we overlook this part of our instruction, we limit the amount of mathematics and diversity of mathematical processes that students might learn. Moreover, if we address the reading of mathematical content initially, we stand a chance of turning out students who are effective readers and, ultimately, successful communicators of mathematics.

Chapter One begins with the review/preview process, which later strategies and activities refer back to. The following prereading strategies and activities are explored in this chapter:

Review/preview process
Knowledge ratings
Anticipation guides
PreP (prereading plan)
Problem-solving prep
Wordsmithing

Review/Preview Process

WHAT? Description

The review/preview process takes place prior to the students' reading of the text. There are two parts to the process: (1) teachers present a review of the prerequisite or background material needed to understand the new content and (2) students preview the new content.

To review the background content, teachers should do one or more of the following:

- Summarize background material.
- Pose a problem from the background material.
- Share a historical anecdote regarding the new concepts.
- Present an interesting problem to be solved after students read and learn the new content.

To preview the assigned reading, students should complete the following tasks:

- Note the title.
- Note all subtitles.
- Note all boxed or highlighted definitions and theorems.
- Note all pictures and graphics.
- Note all other boxed or highlighted special sections, such as biographies of mathematicians or special applications.

WHY? Objectives

The review process allows the mathematics student to:

- Recall necessary mathematical concepts and processes.
- Connect previously learned concepts with new concepts.
- Approach the new content with curiosity and interest.

Previewing allows the mathematics student to:

- Obtain an overview of the reading.
- Pose questions regarding new concepts and anticipate the answers to these questions.
- Delineate or categorize different methods or concepts regarding the main topics from the text.

HOW? Worksheet

The lesson that follows gives a review/preview worksheet that students may use to assist in the review/preview process.

Review/Preview Process

NAME DATE

ASSIGNMENT: Briefly answer the following questions as you preview the section on

_____ on pages _____.

List all titles and subtitles from the new content.
What background concepts do I need to know?
What new concepts and processes do I anticipate learning?
What questions do I have regarding the new content?

Knowledge Ratings

WHAT? Description

Charts that ask the student to assess their prior knowledge are called knowledge ratings (Blachowicz, 1986). The teacher presents students with a list of concepts or topics and surveys their knowledge on these topics. The survey headings for Knowledge Rating charts may take various forms, as the examples that follow show.

WHY? Objectives

Completing the knowledge ratings chart will allow the mathematics student to:

- Self-assess prior knowledge of topics to be studied.
- Target problem areas and make study plans.
- Point out to the teacher personal problem areas.

Reviewing the completed knowledge ratings charts will allow the teacher to:

- Observe problem areas and gaps in learning for students.
- Plan content focus and time allotment for particular topics.
- Find and assign other readings or assignments on problem subjects.

HOW? Example

The following example is from a unit on functions in advanced algebra.

Knowledge Rating for a Unit on Functions

How much do you know about the terms listed in the table? Place an X in the spaces that signal your knowledge.

	A lot!	**Some**	**Not much**
Function			
Domain			
Range			
x intercept			
y intercept			
Vertical line test			
Horizontal line test			

Knowledge Ratings: Rating for a College Algebra Course

NAME DATE

How much do you know about the equations listed below? Place an X in the spaces that signal your knowledge.

	Can define	Can give an example	Can sketch basic graph	Am totally lost
Linear equation				
Identity equation				
Constant equation				
Quadratic equation				
Polynomial equation				
Rational equation				
Logarithmic equation				
Exponential equation				

My learning goals for this part of the semester are the following:

1. I will _____
2. In terms of studying, I will spend _____ each _____ on studying and homework.
3. I will earn at a(n) _____ on this unit.

_____ _____

signature date

Knowledge Rating for a Unit on Graphing Rational Functions

NAME DATE

Place an X in the spaces for which you agree.

	I can define	I can give an example of	I can graph or find on the graph	I can graph or find on the graph using my graphing calculator
Rational function				
x intercept				
y intercept				
Vertical asymptote				
Horizontal asymptote				
Extrema				

Knowledge Ratings: Template

NAME DATE

± ··· ∞ ≈ ∈ ∞ ∅ ± ··· ∞ ≈ ∈ ∞ ∅ ± ··· ∅ ≈ ∈ ∞ ∅ ± ··· ∈ ≈ ∈ ∞ ∅ ± ··· ± ≈ ∈ ∞ ∅ ± ··· ∞ ≈ ∈ ∞ ∅

Topics	**A lot!**	**Some**	**Not much**

Anticipation Guides

WHAT? Description

Anticipation guides (Herber, 1978) are lists of statements that challenge students to explore their knowledge of concepts prior to reading the text and to discover through reading the text's explanation of these concepts.

A mathematical anticipation guide usually contains four to five statements, each with two parts. First, the student is asked to agree or disagree with each statement. Then the student reads the text and determines whether the text or author agrees with each statement.

WHY? Objectives

Anticipation guides allow and motivate mathematics students to:

- Explore their opinions and prior knowledge of mathematical concepts.
- Read closely to find evidence to support their claims or discover the text's view.
- Uncover and identify any misconceptions regarding these concepts.

HOW? Example

Here is an example of an anticipation guide for a section on linear equations in two variables.

Anticipation Guides: Selection on Linear Equations in Two Variables

Directions: In the column labeled ME, place a check next to any statement with which you agree. After reading the section, consider the column labeled TEXT, and place a check next to any statement with which the text agrees.

Me	Text	
_____	_____	1. The solution set for any linear equation in x and y is exactly one ordered pair.
_____	_____	2. The graph of a linear equation is a line.
_____	_____	3. The slope of a vertical line is zero.
_____	_____	4. Slope-intercept form looks like: $y = mx + b$.
_____	_____	5. Two parallel lines have equal slopes.

Anticipation Guides: Solving Quadratic Equations in One Variable

NAME _____ DATE _____

Select the chapter or section in any Algebra II text that discusses solving quadratic equations in one variable. Follow the directions in the anticipation guide below.

Directions: In the column labeled ME, place a check next to any statement with which you agree. After reading the section, consider the column labeled TEXT, and place a check next to any statement with which the text agrees.

Me	Text	
_____	_____	1. Quadratic equations have at most two solutions.
_____	_____	2. The quadratic formula can be used to solve any quadratic equation.
_____	_____	3. If $x^2 = 25$, then the solution set for x is {5}.
_____	_____	4. Completing the square is a valid method for solving quadratic equations.
_____	_____	5. When using the factoring method to solve a quadratic equation, you must set the equation equal to zero before you factor.

Anticipation Guides: Measures of Central Tendency

NAME DATE

Directions: In the column labeled ME, place a check next to any statement with which you agree. After reading the section, consider the column labeled TEXT, and place a check next to any statement with which the text agrees.

Me	Text	
_____	_____	1. The median is the middle-most value of a data set.
_____	_____	2. The mean = median = mode of every data set.
_____	_____	3. The mode is the most recurring number in a data set.
_____	_____	4. If the median is more than the mean, then the data set is skewed to the left.
_____	_____	5. If a set contains an even number of data, then the median will be equal to the mean of the two numbers in the middle of the data set.

PreP

WHAT? Description

The Prereading Plan (PreP) (Langer, 1981) is a large-group brainstorming activity. The teacher guides students in activating, sharing, and fine-tuning prior knowledge. Initially, the teacher chooses one of the key concepts of the reading or lesson and then guides the students in the brainstorming of this concept. Langer suggests that the teacher follow a three-step process to guide the students' collective thoughts:

1. *Initial associations.* The teacher asks, "What comes to mind when you hear _____?" The teacher writes student responses on board.
2. *Secondary reflections.* The teacher asks individual students regarding their responses, "What made you think of _____?" The teacher writes the student reflections under appropriate initial responses on board.
3. *Refining knowledge.* The teacher asks, "Do you have any new ideas or thoughts after hearing your peers' ideas?" The teacher writes new ideas on board.

WHY? Objectives

The PreP allows mathematics students to:

- Activate prior knowledge.
- Hear and reflect on peers' ideas.
- Clarify, refine, and enlarge knowledge.

HOW? Example

The teacher presents the new concept of rational numbers and uses the three-step process in this way:

1. Initial associations	Fraction Whole number Not a square root Not pi
2. Secondary reflections	Fraction—fraction of integers Whole number—integers Not a square root. Could be square root of perfect square. Not pi. Pi is a decimal, approximately 3.14, where the decimal digits go on forever and ever with no pattern.
3. Refining knowledge	A rational number is a fraction of integer over integer. Rational numbers are decimals that terminate or have a repeating pattern.

Problem-Solving Prep

The National Council of Supervisors of Mathematics (1988) says that the principal reason for studying mathematics is to learn to solve problems.

WHAT? Description

Problem solving is the process of resolving the confusion or mystery of an unfamiliar situation. The twentieth-century mathematician George Polya devoted his life to helping students become good problem solvers. In his famous book *How to Solve It* (1973), he outlines a four-step process for solving problems:

1. *Understand the problem,* which means read, reread, make a guess, restate the problem, and/or rewrite the question.
2. *Devise a plan,* which means draw a picture, construct a table or graph, use a model, find a pattern, work backward, and/or use a formula or equation appropriate to solving the problem.
3. *Carry out the plan,* which means write out work, solve an equation, and/or recheck work.
4. *Look back,* which means verify or check the solution referring to the initial problem, reread the problem, generalize to larger problem, pose questions for further exploration, and/or compose related problems.

During the problem-solving prep process, students follow a guided reading format to help hone their problem-solving skills. This process may be used prior to or during a section covering applications in an algebra text.

WHY? Objectives

Using the problem-solving prep process, students will:

- Spend time reading problems for understanding.
- Find personal meaning by rewriting problems in their own words.

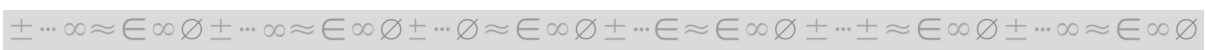
- Practice using different strategies to solve problems.
- Focus on the understanding phase of problem solving.
- Build confidence in their ability to solve problems.

HOW? Lessons

See the lessons that follow.

Problem-Solving Prep

NAME DATE



ASSIGNMENT: Answer each of the questions below for the written problem. Refer to the following list of problem-solving strategies when answering the "Devise a Plan" question:

- Draw a picture.
- Guess and check.
- Sketch a table or graph.
- Find a pattern.
- Work backward.
- Use a formula or equation.
- Use a model.

Problem: Ten years ago, Sarah paid $80 for a guitar that once belonged to Bob Dylan. Two years ago, she sold it for $90. Last year, she bought it back for $100 and sold it immediately for $110. How much profit did she make?

UNDERSTAND: Rewrite the problem in your own words.
UNDERSTAND: Make a guess, and explain your reasoning.
DEVISE A PLAN: Choose one of the problem-solving strategies listed above.
CARRY OUT PLAN: Use the strategy to solve the problem.
LOOK BACK: Create a similar problem.

Problem-Solving Prep

NAME DATE

ASSIGNMENT: Answer each of the questions below for the written problem. Refer to the following list of problem-solving strategies when answering the "Devise a Plan" question:

- Draw a picture.
- Guess and check.
- Sketch a table or graph.
- Find a pattern.
- Work backward.
- Use a formula or equation.
- Use a model.

Problem: Imagine that the earth is a perfect sphere and its circumference is exactly 25,000 miles at the equator. Now imagine that a band is placed around the earth directly above the equator. The circumference of the band is 10 feet longer than the circumference of the earth. Is it possible to place a 12-inch ruler between the earth and the band?

UNDERSTAND: Rewrite the problem in your own words.
UNDERSTAND: Make a guess, and explain your reasoning.
DEVISE A PLAN: Choose one of the problem-solving strategies listed above.
CARRY OUT PLAN: Use the strategy to solve the problem.
LOOK BACK: Create a similar problem.

Problem-Solving Prep

NAME DATE

ASSIGNMENT: Answer each of the questions below for the written problem. Refer to the following list of problem-solving strategies when answering the "Devise a Plan" question:

- Draw a picture.
- Guess and check.
- Sketch a table or graph.
- Find a pattern.
- Work backward.
- Use a formula or equation.
- Use a model.

Problem: The three Hobbits, Bilbo, Frodo, and Sam, each had a different amount of gold coins. Frodo had twice the amount that Bilbo had. Sam had twice the amount that Frodo had. How many gold coins did each of them have?

UNDERSTAND: Rewrite the problem in your own words.
UNDERSTAND: Make a guess.
DEVISE A PLAN: Choose one of the problem-solving strategies listed above.
CARRY OUT PLAN: Use the strategy to solve the problem.
LOOK BACK: Create a similar problem.

Problem-Solving Prep

NAME DATE

ASSIGNMENT: Answer each of the questions below for the written problem. Refer to the following list of problem-solving strategies when answering the "Devise a Plan" question:

- Draw a picture.
- Guess and check.
- Sketch a table or graph.
- Find a pattern.
- Work backward.
- Use a formula or equation.
- Use a model.

Problem: A man put one pair of rabbits in a certain place entirely surrounded by a wall. How many pairs of rabbits can be produced from that pair in a year if the nature of these rabbits is such that every month, each pair bears a new pair, which from the second month on becomes productive?

UNDERSTAND: Rewrite the problem in your own words.
UNDERSTAND: Make a guess.
DEVISE A PLAN: Choose one of the problem-solving strategies listed above.
CARRY OUT PLAN: Use the strategy to solve the problem.
LOOK BACK: Create a similar problem.

Wordsmithing

WHAT? Description

A *wordsmith* is a person who coins new words. Writers are often collectors of words. An author who considers herself a wordsmith experiments with new words or uses words in ways that are somewhat unusual. For example, a graphing calculator might be referred to as a *graphulator.* The wordsmithing activity has the student actively searching for new words and considering what these words mean. Because much of the mathematics in algebra texts builds off the prior lesson (that is, it is recursive), students often discover this is true of the vocabulary of algebra.

In this activity, the student scans the new content in the text, searching for new algebraic words. As she discovers a new word, she writes it on a sheet of paper containing a three-column matrix, leaving two of the columns blank. After completing her list of new terms, the student guesses what each word means and writes this definition or description in the cell next to the word. Then, after reading the assigned content or lesson, she fills out the cells in the final column of the matrix with the correct definitions. If the wordsmithing activity is repeated often enough, students can become quite adept at guessing the meanings of the new words.

WHY? Objectives

After completing the wordsmithing activity, students will:

- Learn the definitions of new words.
- Become good at defining terms in their own words.
- Become better readers, for they must read carefully to find the definitions of the new words.
- Become algebraic wordsmiths.

HOW? Examples

See the lessons for matrices.

Wordsmithing: Matrix

NAME DATE

Chapter _____ on pages _____.

New term	Your initial definition	The text's definition

Wordsmithing: Matrix

NAME DATE

ASSIGNMENT: Guess what the terms mean, and write your guess in column 2. Then use the text to find the correct definition, and write it in column 3.

New term	Your initial definition	The text's definition
Function		
Linear function		
Constant function		
Identity function		
Domain		
Range		
One-to-one function		