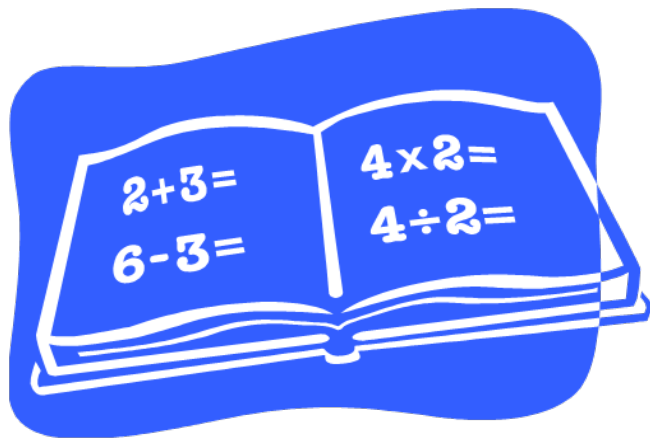


“Math Comprehension and Fluency in the Classroom”



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Great Resource!



- *Comprehending Math: Adapting Reading Strategies to Teach Mathematics, K-6* by Arthur Hyde, 2006



Problem with Math Textbooks



- Most people deny the importance of language in the world of mathematics.
 - Textbook publishers are very sensitive to the feedback from teachers whose message has been crystal clear for years: Too many words on the page will make learning too hard for the kids who can't read well.
 - “Johnny is not a good reader. Math is the only subject he likes (or does well in).”



Critical Thinking



- Reading and language as well as mathematics and problem solving!
- Three main principles:
 - Engaging prior knowledge
 - Organizing knowledge
 - Monitoring and reflecting on one's learning



Magic Tricks that Teachers Use



- **Just look for the KEY word!**
 - If you see “sum” or “all together”, you add the numbers!
 - If you see “take away” or “difference”, then subtract the smaller number from the bigger number.
- **What message does this send?**
 - Don’t read the problem!
 - Don’t imagine the situation!
 - Ignore the context!
 - Abandon your prior knowledge!



Classroom Climate



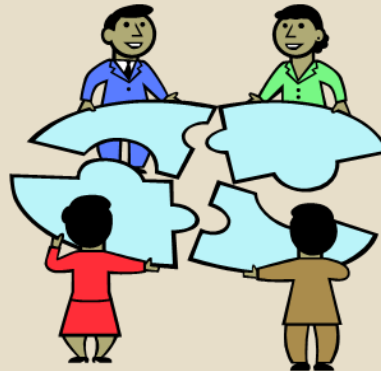
- All children can profit from discussing, verbalizing thoughts, talking mathematics, but girls develop language strengths earlier than boys and, when encouraged, can use them effectively to build mathematical understanding.



Mathematical Thinking and Problem Solving



- Math is the science of patterns; much more than arithmetic
- The goal of mathematics teaching should be understanding concepts, not merely memorizing facts and procedures.
- To understand mathematical concepts, students must use language.



Math and Reading Wars



- **Reading Wars:**
 - Decoding, phonics, and word attack skills
- **Math Wars:**
 - Arithmetic computational proficiency and math facts
- **Both go beyond the facts and basic skills!!!!**



How do you get better at Math?



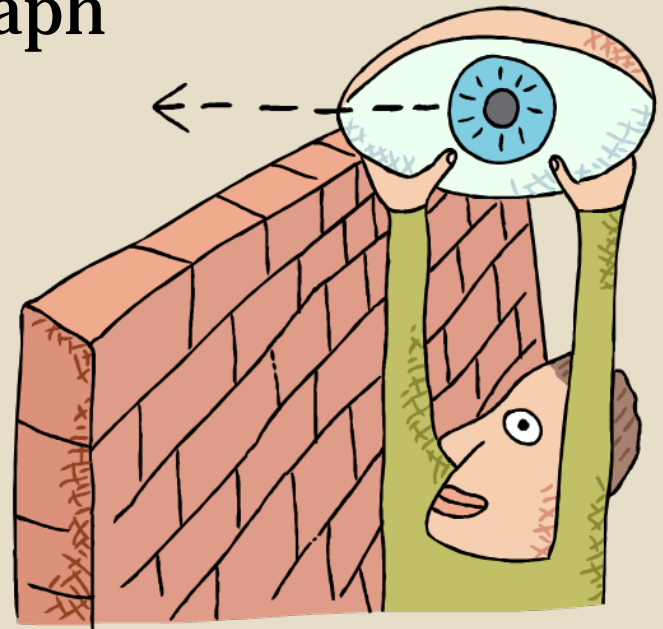
- How do you get better at reading?
 - By reading more...
- Same with mathematics!
 - Problem solving needs to continue to challenge and push students when they are ready for the skills.



Developing Own Representations...



- Discuss the problem in small groups
- Use manipulatives
- Act It Out
- Draw a picture, diagram, or graph
- Make a list or table



Why is it critical to braid language, thinking, and mathematics?



- When math is taught with the language pruned or purged, who is immediately penalized?
 - Those who use language as their language facility as a means of processing ideas
 - Those who develop their language facility early
 - ✦ **Girls**



Reading Comprehension Strategies



- Making Connections
- Asking Questions
- Visualizing
- Inferring and Predicting
- Determining Importance
- Synthesizing
- Metacognitive Monitoring



The Braid Model of Problem Solving



**UNDERSTANDING THE PROBLEM -- READING
THE STORY**



Visualization



- Do I see pictures in my mind?
- How do they help me understand the situation?
- Imagine the SITUATION. What is going on here?



Asking Questions



- (and discussing the problem in small groups)
 - K: What do I know for sure?
 - W: What do I want to figure out, find out, or do?
 - C: Are there any special conditions, rules, or tricks I have to watch out for?



Making Connections



- **Math to Self**

- What does this situation remind me of?
- Have I ever been in any situation like this?

- **Math to World**

- Is this related to anything I've seen in social studies, science, or the arts?
- Or, related to anything I have seen anywhere?



Making Connections (cont.)



- **Math to Math**

- What is the main idea from mathematics that is happening here?
- Where have I seen that idea before?
- What are some other math ideas that are related to this one?
- Can I use them to help me with this problem?



Infer



- What inferences have I made?
- For each connection, what is its significance?
- Look back at my notes on K and C. Which are facts and which are inferences?
- Are my inferences accurate?



The Braid Model of Problem Solving



PLANNING HOW TO SOLVE THE PROBLEM



Planning how to Solve the Problem



- What REPRESENTATIONS can I use to help me solve the problem?
- Which problem-solving strategy will help me the most in this situation?
 - Make a model, Act it Out, Find a Pattern, Work Backward, Draw a Picture, Make a Table, Use Logical Reasoning, Solve a Simpler Problem, Make an Organized List, Write an equation, Draw a diagram, Predict/Test

The Braid Model of Problem Solving



**CARRYING OUT THE PLAN –
SOLVING THE PROBLEM**



Carrying Out the Plan – Solving the Problem



- **Work on the problem using a strategy.**
 - Does this strategy show me something I didn't see before now?
 - Should I try another strategy?
 - Am I able to infer any PATTERNS?
 - Am I able to predict based on this inferred pattern?



The Braid Model of Problem Solving



LOOKING BACK/CHECKING



Looking Back/Checking



- Does my answer make sense for the problem?
- Is there a pattern that makes the answer reasonable?
- What **CONNECTIONS** link this problem and answer to the big ideas of mathematics?
- Is there another way to do this? Have I made an assumption?



Problem Solving Literature

- **International**
 - TIMMS Study
- **National**
 - NAEP Study
 - NCTM Standards
- **State**
 - CATS
 - Combined Curriculum Document



International

- TIMMS

- ✦ Why are we (U.S) not doing as well as other countries?
 - Findings - Procedures vs. Making Connections
 - When teachers (8th grade) are giving problem solving scenarios, in all countries that were doing well, teachers will allow students to make connections to the problem. Students need to get to the independent level of making connections to the problem.
 - Question - Do the questions need to have a connection to what we are doing?
 - Answer - Problem Solving needs to be embedded in what is currently going on in the curriculum.

National

- NAEP Study
 - ✦ NCTM Standards
 - more teachers know about the standards, the higher the students perform on the NAEP Test
 - ✦ Use of calculators/technology
 - grade 8 - students who use calculators daily perform higher
 - 4th grade use monthly, 8th grade daily
 - ✦ Math Textbook use needs to be present and thoughtful.

National (cont.)

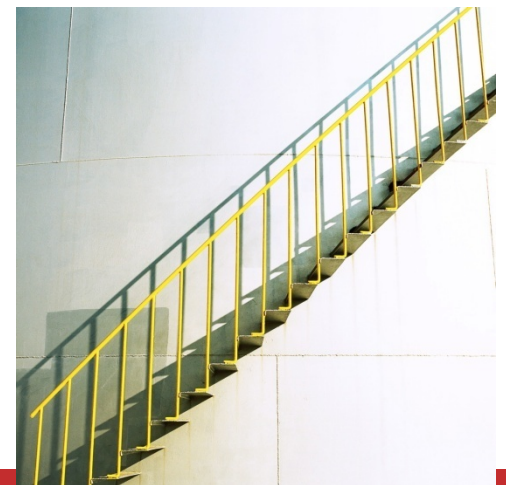


- ✦ **Homework**
 - when spending 15-30 minutes daily, perform better than students who spend more time or less time
- ✦ Kids who like math, believe math is useful – score highest.
- ✦ Kids who disagree math is memorization and disagree that there is only one way to solve a problem score highest.



Levels of Problem Solving

- Word Problems
- Applied Skills – state test type problems
- Open-ended Problem Solving
 - Refer to literature
 - ✦ “Teaching Mathematical Problem Solving: Implementing the Vision”



Word Problem Example

- Number 2 from ISTEP+ 2003 Fall Grade 6:
- Willis earns \$11 a week mowing lawns. He wants to earn enough money to buy a video game system that costs \$110. Find the actual number of weeks it will take Willis to earn enough money to buy the video game system.



Applied Skills Problem Solving Example

- Willis earns \$11 a week mowing lawns. He wants to earn enough money to buy a video game system that costs \$150. On the lines below, explain how you would estimate the number of weeks it would take Willis to earn the money to buy the video game system.
-
-
-

Now find the actual number of weeks it will take Willis to earn enough money to buy the video game system.

- ***Show All Work***

Problem Solving Example

- Willis earns \$10-25 a week mowing lawns. He wants to earn enough money to buy a video game system that costs \$150. Give a minimum of 3 ways in which he can earn the money to purchase the game system. (Show work)
- Which way would be the most efficient way to earn the money? Explain.

Connection to Literacy

- How is Problem Solving related to literacy / writing?
 - Explain how you know what you know
 - Use examples from the story/problem to support your answer
 - Defend your reasoning
 - Be thorough in your response
 - Include details



Literacy Connection (cont.)

- Why does responding to a Problem Solving prompt require good writing skills?
 - ✦ Fully accomplish the task?
 - ✦ Include many relevant ideas?
 - ✦ Organize ideas logically?



Activities for the Classroom?



PROJECTS AND ASSIGNMENTS
I HAVE TRIED!

“Wacky Word Problems”



- **Materials needed:**

- magazine pictures and words (enough for each group to have one), glue, construction paper, pens, markers

- **Activity:**

- Have a student from each group draw a picture at random that you have cut out of a magazine.
- Have a student from each group draw a word at random that you have cut out of a magazine.
- Have groups brainstorm how they could write a math problem with at least 4 sentences involving the word and picture.

“Wacky Word Problems” (cont.)



- **Product:**

- Groups will then write the problem in final form on the construction paper. This must have a title and use the word and picture in the appropriate positions.
- On another sheet of construction paper the students will show the solution mathematically and explain in written form. This page should be titled “Solution to _____”

- ***Variation:** You may choose to have the word problems cover a specific content area in math. For example:
Pythagorean Theorem

“Math Magazine”



- Students create an editorial staff
- Students create rubric
- Each student is responsible for a piece of the magazine



“Math Personality Poem”



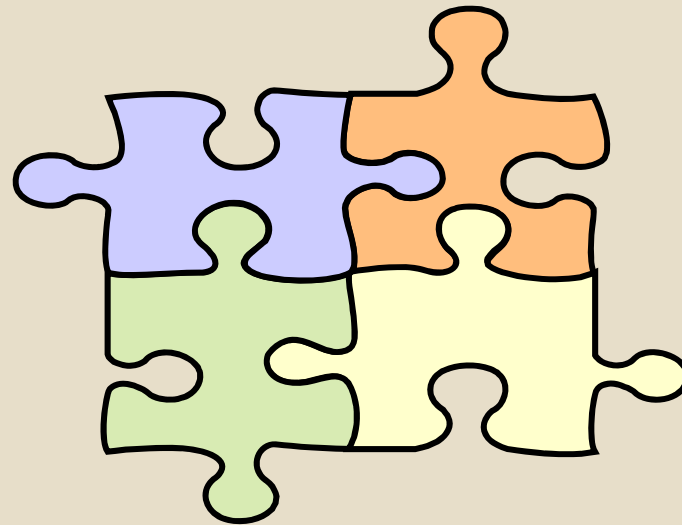
- -First line: Name
- -Second line: Four words that describe you
- -Third line: “Feels that...” (write 4 things about writing, math, and/or school)
- -Fourth line: “Fears that...” (write 4 things about writing, math, and/or school)
- -Fifth line: “Would like...” (write 3 things about writing, math, and/or school)
- -Sixth line: Another word to describe self



“Matrix Logic Problems”



- **Students choose a theme for their problem**
 - Design problem with a minimum of a 4 X 4 for students to do with clues that are just enough to solve
 - Sample – Activity!



“Problem Solving Strategies Writing Activity”



- **Audience:**
 - You are writing to yourself the problem solving strategies to solve any type of word problem.
- **Task:**
 - Write the 5 strategies you would use to solve a word problem.
- **Background:**
 - People in the math education field are trying to analyze what students are thinking about when solving a problem. They want to hear the student’s perspective.
- **Purpose:**
 - You are learning to reflect on your thinking.

“Problem Solving Strategies Writing Activity” (cont.)



- Procedure:
 - 1. Brainstorm individually strategies for problem solving.
 - 2. Write 5 problem solving strategies.
- Work on a set of problems.
- Discuss the “outrageous” steps previously written by other students
- Work another set of problems
- While looking at your personal strategies, discuss with class whether your strategies would have worked to solve the problem(s).
- Discuss and make needed corrections.

The Dot and the Line



- <http://www.youtube.com/watch?v=OmSbdvzbOzY>
- What would an interview with the dot at the beginning of the story sound like? With the line? With the Squiggly? (application)
- What would you conclude was the reason the squiggly couldn't make designs? (application)
- On the chalkboard, construct some examples of other uses of the line in our world. (application)
- Make a diary of the line telling about the mathematical hardships of designing other shapes. (application)
- Compare and contrast the line to the squiggly. (analysis)

The Dot and the Line (cont.)

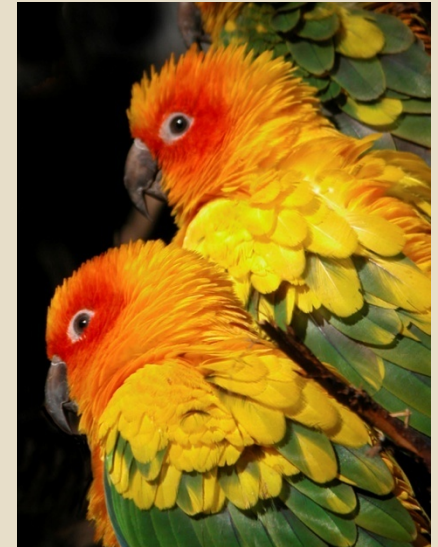


- Specify and analyze the differences in the way the line expressed his moods. (analysis)
- Find a humorous quote in the story and suggest how it is humorous and why. Act out some other situations that would be humorous. (synthesis)
- Invent a house in which the dot and the line could live. Try also to design things such as a car, bed, games, etc. (synthesis)
- Support or defend in a panel discussion the dot's choice to leave the squiggly for the line. What if the squiggly and the dot were married – would this be an affair?
- Debate the importance of the line versus the squiggly in our society.

Fluency in Reading and Math!



- Show Lorikeets...
- Show Muffins...[lorikeets and muffins.doc](#)



Questions?

- For this presentation:

- <http://edtech.wku.edu/~jtassell/presentations/>

