

“CAUTION: What Really is
Problem Solving K-6?”

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Overview

- Why develop Problem Solving?
- How can we improve?
 - Develop plan



WKU Student Initial Thoughts



Test Score Analysis

- CATS
- EXPLORE
- ACT



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.



National Resources

- NCTM Focal Points
- Book: "Principles and Standards for School Mathematics"
 - 6 principles present
 - Content vs. Process Standards
- "Helping Your Child Learn Math" publication from Great Source and USDOE
 - Are you using manipulatives?
 - Are you guiding not directing learning?

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- Helping Children Learn Mathematics" publication
 - Important to have good materials
 - Should be spending 60 minutes per day in math instruction
 - Weekly study groups are the ideal prof. dev. opportunities

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- Problem Solving research article – “Teaching Mathematical Problem Solving: Implementing the Vision” by McIntosh and Jarret (2000)
 - Quote on top of page 4 about questioning students to find out what they are thinking
 - Why teach open ended problem solving?
 - Pages 15-18 - how to teach problem solving, types of questions to ask,
 - Pages 20-21 - how to find good problem solving tasks



State Level – Example from Indiana

- ISTEP+
 - Applied Skills
 - Problem Solving is defined as mapping back to two indicators within two different Standards in addition to Problem Solving.
- Indiana Academic Standards
 - Differences from grade to grade in Problem Solving
 - Where are the Strategies?



Levels of Problem Solving

- Word Problems
- Applied Skills – ISTEP+ 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.
- Maps to:
 - Computation:
 - 5.2.1 Solve problems involving multiplication and division of any whole numbers.
 - Problem Solving:
 - 5.7.7 Make precise calculations and check the validity of the results in the context of the problem



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

- *Show All Work*

Applied Skills Problem Example (Cont.)

- Maps to:
 - Computation:
 - 5.2.1 Solve problems involving multiplication and division of any whole numbers.
 - 5.2.6 Use estimation to decide whether answers are reasonable in addition, subtraction, multiplication, and division problems.
 - Problem Solving:
 - 5.7.6 Know and apply appropriate methods for estimating results of rational-number computations.
 - 5.7.7 Make precise calculations and check the validity of the results in the context of the problem.
 - 5.7.8 Decide whether a solution is reasonable in the context of



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.



WKU Student Thoughts

- Share thoughts about Word Problems vs. Problem Solving
- What did you see when searching for a Problem Solving Scenario to teach in the field?



Grafitti Activity

Group Participants



Thought #1

- “Students who must resort to memorizing will lack understanding and will likely feel little sense of satisfaction, perhaps withdrawing from learning altogether. In fact, he says, evidence suggests that if students memorize and practice procedures repeatedly in a rote fashion, it’s difficult for them to go back later and gain a deeper understanding of the mathematical concepts underlying those procedures.”



Thought #2

- “Teachers will sometimes find themselves in the uncomfortable position of not knowing the solution. Letting go of the ‘expert’ role teachers have traditionally played requires experience, confidence, and self-awareness.”



Thought(s) #3

- There needs to be a shift of what “understanding” and “learning” might really mean.
- “A problem is not necessarily solved because the correct answer has been made. A problem is not truly solved unless the learner understands what he has done and knows why his actions were appropriate.”



Thought(s) #4

- Selecting good problems is the key – “problems need to be hard enough to present a challenge without being so difficult as to be a total mystery.”
- “Traditional teaching approaches involving rote learning and teacher-centered instructional strategies often do not meet the learning needs of many students who may be active learners or require multiple entrances into the curriculum.”



Thought(s) #5

- "Often, teachers mistakenly correlate problem solving with word problems."
- "In open-ended problem solving, the problem will have multiple possible answers that can be derived by multiple solution methods. The focus is not on the answer to the problem, but on the methods for arriving at an answer. Genuine problem solving requires a problem that is just beyond the student's skills level so that she will not automatically know which solution method to use. The problem should be nonroutine, in that the student perceives the problem as challenging and unfamiliar, yet not insurmountable"



Thought #6

- "Many students view mathematics as a routine, mundane, static set of facts and rules to be learned primarily through memorization rather than as an evolving, expanding science of inquiry and experimentation that is discovered and created through experimentation and conjecture."



Thought #7

- “[Good problem solvers] must learn persistence and the ability to tolerate a certain amount of frustrations. To develop these abilities, students need to experience the frustration and exhilaration of struggling with and overcoming a daunting intellectual obstacle.”



Thought #8

- “Students in mathematics classes that do not emphasize problem solving are being deprived, as well, of the feelings of exhilaration and empowerment that come from mastering a difficult problems. They are not developing the tools and the confidence they will need to tackle the types of problems that will occur in their working and personal lives. They often fail to gain a deeper conceptual understanding that comes from constructing one’s own mathematical truths through deep thinking.”



How do we teach Problem Solving?

- Develop understanding of strategies
 - Examine *Problem Solver* materials
 - Examine Textbook Series
 - Look at state Standards
 - Understand NCTM Focal Points
- Determine what strategies fit in at what level and to what degree
 - Model, Supported, Independent
 - “Gradual Release of Responsibility”



How does this impact PreService Teachers at WKU?

- Ashley Toczko
- Abigail Watkins



Ashley's Thoughts: KY Standard and Grade Level

- Grade Level: Kindergarten
- Standard Addressed: KY Core Content: *MA-EP-2.1.4*
- *Students will use nonstandard and standard units of measurement to identify measurable attributes of an object. (Capacity)*



Problem Solving Standard Alignment


- **NCTM Standard:**
- Understand measurable attributes of objects and the units, systems, and processes of measurement
- Apply appropriate techniques, tools, and formulas to determine measurements

Problem Solving


Problem and Strategy


- Strategy used: Guess and Check
- Problem: Which container will hold the most popcorn?
- How was it presented: Small group as a task rotation.


1. Which container do you think will hold the most popcorn?




2. How many cups of popcorn did each hold?










3. Which container held the most popcorn?





Abby's Thoughts : Problem Solving Scenario

- Problem Solving with Money
 - Worksheet
 - Can you buy it?
 - How much money is left over?
 - How many different ways can you make this amount using various coins?
 - First grade students



Strategy Chosen to Model

- Draw a picture strategy
 - Modeled on Activboard
 - Some first graders struggled independently, but were able to succeed with guidance
 - Some lacked enough prior knowledge



Reflection of Instruction

- Hard for the students to understand that there was more than one correct way
- Allowed to work together; students were not used to this and were concerned about others copying rather than collaboration



Possible Structure of Problem Solving Instruction

- Idea: Problem Solving Cycle
 - Example:
 - 7 – 10 days on one strategy (EX: Four Frames Math)
 - 2 days of modeling
 - 3 days of collaborative partner or small group practice
 - Teacher supported
 - Homogeneous grouping recommended
 - 2 days of independent problem solving
 - Maybe the last is the assessment day
 - 15 minutes maximum per day every day



Assessment

- How do we score the problem solving?
 - Use rubrics
 - Teacher created
 - Problem Solver
 - ISTEP+
- How do we ensure that problem solving instruction does not have gaps and/or overlapping?
 - Scaffolding of instruction between grade levels
 - Ex: Eastern Green



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?



Questions?
