

Problem Solving

Summary

The students will be able to draw a model to help them write expressions that can be use to solve one and twostep problems.

Materials

- *Problem Solving Quiz with Answers* (see below)
- [Problem Solving PowerPoint](#) (ppt)
- [Practice Problems worksheet](#) (pdf)
- [Drawing Cards](#)

U.S. Census data

Chart paper

8½ by 11inch white paper

Computer with sound

Projector

Books:

- *About Teaching Mathematics: A K8 Resource*
, by Marilyn Burns; ISBN 094135525X
- *8Step Model Drawing: Singapore's Best ProblemSolving MATH Strategies*
, by Bob Hogan and Char Forsten; ISBN 13973188458956
- *Word Problems for Model Drawing Practice*
, by Catherine Jones Kuhns; ISBN 9781934026533

Article:

Marjorie Montague. *Math Problem Solving for Upper Elementary Students With Disabilities. The Access Center: Improving Outcomes for All Students K8.*

Background for Teachers

"The skills and strategies needed for successful mathematical problem solving start developing in the preschool years, when children acquire a basic conceptual understanding of the base 10 numerical system... Students in grades three, four, and five continue to apply and refine the skills and strategies necessary to solve real life mathematics problems... However, many students, especially students with learning disabilities, have difficulty solving math word problems because they often cannot decide what to do to solve the problem. Most textbooks are not very helpful when it comes to teaching students how to solve math problems.

Teaching mathematical problem solving is a challenge for many teachers, many of whom rely almost exclusively on mathematics textbooks to guide instruction. Most mathematics textbooks simply instruct students to draw a picture or make a diagram...

Students who have difficulty solving math word problems usually draw a picture of the problem without considering the relationship among the problem components and, as a result, still do not understand the problem and therefore cannot make a plan to solve it. So, it is not simply a matter of 'drawing a picture or making a diagram'; rather, it is the type of picture or diagram that is important. Effective visual representations, whether with manipulatives, with paper and pencil, or in one's imagination, show the relationship among the problem parts.

For upper elementary students, math problem solving instruction should start with onestep problems involving only whole numbers. When students have mastered the problems at this level, they can progress to onestep problems with decimals. They can then progress to twostep problems with whole numbers, and so on."

(From *Math Problem Solving for Upper Elementary Students with Disabilities*; Marjorie Montague, Ph.D., University of Miami; see Resources.)

This lesson will explore a variety of strategies, methods, and classroom structures that can be used in helping students to become better problem solvers, but the main focus of the lesson will be on using a "whole/part" model that can be used as a tool to help students understand and solve one and two operation problems that are required by the fifth Grade Math Core. This "whole/part" model also relates to the fifth Grade Science Core, Standard 1, which deals with physical and chemical changes in matter. In this science standard students learn that matter cannot be created or destroyed, and that the sum of the parts is equal to the whole. Often this is a hard concept for students to understand, but, by using the "whole/part" model in math and science, it can help to deepen students understanding of this fundamental concept.

When students approach a math problem, they need to be armed with strategies that will allow them to be successful. Since students face a wide variety of problems, they need a variety of strategies. The "whole/part" approach is just one approach to problem solving and is not applicable to all types of problems. It works well for many one step "choose an operation" type problems and many multiple step problems.

Intended Learning Outcomes

Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solving problems.

Instructional Procedures

Invitation to Learn:

Explain to the class that today they will be discussing problem solving, and to get everyone into the spirit of problem solving you are going to give them some problems to solve. Have students find the Problem Solving Quiz (this quiz has trick questions and riddles) and work the problems. Give participants time to complete the quiz. Discuss the answers to the questions and have students share strategies they used to find the answers.

Problem Solving Quiz Answers

Some months have 30 days; some months have 31 days. How many months have 28 days?
12, they all have at least 28 days

How many birthdays does the average person have?
Only 1

A farmer had 17 sheep. All but 9 died. How many does the farmer have left?
He has 9; the rest died

How much dirt may be removed from a hole that is 3 feet deep, 2 feet wide, and 10 feet long?
None; you cannot take dirt out of a hole.

Take 2 apples from 3 apples and what do you have?
You have 2 apples

Divide 30 by $\frac{1}{2}$ and add 10. What's the answer?
70 because $30 \div \frac{1}{2} = 30 \times \frac{2}{1} = 60$; $60 + 10 = 70$

I've got 2 U.S. coins that total 55 cents. One of the coins is not a nickel. What are the 2 coins?
A halfdollar and a nickel. One's not a nickel; the other one is.

There are 12 1cent stamps in a dozen, but how many 2cent stamps are there in a dozen?
12 is always a dozen

How is the moon like a dollar?
They both have 4 quarters

What is the difference between a new penny and an old quarter?
24 cents

Where do you buy a ruler that is 3 feet long?

At a yard sale

How many times can you subtract 6 from 30?

Only once; after that you no longer have 30

Instructional Procedures:

Students should be seated in cooperative teams of 4. Explain that they will be doing numbered heads together so everyone needs a number between 14. When the team is given a question or problem, they should discuss it and be prepared to share the team's responses with the class. Begin by posing the question: What is the most important aspect of teaching students how to be successful problem solvers? Give the teams time to discuss the question.

Call a number. Members of each team with that number should stand and share with the whole class their team's comments about the question.

Use the *Problem Solving PowerPoint* with ideas from *About Teaching Mathematics* by Marilyn Burns on "Managing the Classroom for Problem Solving" and from Marjorie Montague on what research says about problem solving, to continue the discussion (see Resources).

Introduce the "whole/part" model by modeling the drawing process using the problems on the *Practice Problems worksheet*.

Continue with guided practice. Have students work the next problems on their worksheets as a team. Discuss each question and have teams share their solutions.

Have participants work the final problems on the worksheet individually. Give help where needed.

Make the following points:

The "whole/part" model does not work with all types of problems but is effective with many "choose an operation" and multiplestep problems.

With practice, students can learn to identify when to use "whole/part."

Some students will not need the help of this strategy, especially with simple onestep problems, but if they learn how to use it they will have it as a tool when they encounter more difficult problems.

Singapore Math uses similar model drawing strategies that expand to many different types of problems (see the resource section for more on Singapore model drawing).

The "whole/part" model can be used to help students understand the relationship of the parts to the whole in the fifth Grade Science Standard dealing with physical and chemical changes of matter.

Use numbered heads together to discuss the question: What is the most effective way to teach students to use the "whole/part" model to solve problems? Bring out the following points:

Doing a problem a day can be effective, because students can focus on one problem at a time and grow their abilities by working on increasingly difficult problems over time.

This helps create a classroom culture where students are unafraid to try new approaches to problems and share their successes and failures.

Teaching students to write math problems can help them to become better problemsolvers as they look closely at how different types of problems are structured. (See the Activity section below.)

Discuss ways students can be guided to write gradelevelappropriate problems, such as:

Suggesting themes or situations they can use to build problems around.

Providing students with partial problems that need some information added to make them complete.

Providing students with a drawing and having them write a problem to match.

Having students act out a problem situation.

Providing data sets to use in the problem.

Lesson and Activity Time Schedule:

Invitation to Learn: 10 minutes

Lesson procedures: 50 minutes

Problem writing activity: 30 minutes

Total lesson and activity time 90 minutes.

Activity Connected to Lesson:

Problem Writing Activity:

Divide the cooperative teams of 46 in half to make teams of 23.

Show examples of studentwritten problems.

Explain that each team will need to write 4 different problems. One problem should use the "whole/part" model drawing provided on a Drawing Card, one problem using information from the U.S. Census data set, one about life at Core Academy, and one free choice.

Problems should be multiple step problems and apply to the fifth Grade Core.

Each problem should be clearly written in large letters on an 8 ½" by 11" sheet of paper. All problems should be displayed on one piece of chart paper. An illustration to decorate the problems and humor to make us laugh is appreciated.

The solution to each problem should be clearly written in large letters on an 8½" by 11" sheet of paper and pasted to the back side of the chart paper.

Allow time for teams to work.

When problems have been completed, have each team share. Have the class solve problems as time permits.

Extensions

Assign the class a "Problem of the Day." Have students work in pairs, teams or individually to solve the problem. Have students share their solutions with the class and discuss.

Family Connections:

Encourage students to share or teach what they have learned about model drawing with parents and family members.

Assessment Plan

Use student problem solutions to determine their understanding of the process and what type of problems they need to be assigned to continue to progress.

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