## Problem Solving in the Primary Classroom

Rena Pate - Danville District 118, rena@primarymathrules.com

When I was in second grade, the words math and computation were synonymous. Each day, we completed a worksheet of 30-50 computation problems with one story problem at the bottom of the page. We called it the "dreaded story problem." Even our teacher called it that! On most days her instructions were to just cross it off because it was too hard or complicated for us to do. On occasion our teacher would be in "a mood" and would require us to complete the problem. So, we would do what any second grader would do. Half of us would add the two numbers together and the other half would subtract the two numbers. Of course, half of us would get the problem right and the other half would get it wrong. When I began teaching math, I realized that the only problem solving we were doing were percentages and fractions because half would get it right and $50 \%$ would get it wrong! That was 1968. Unfortunately, not a lot has changed since then. The only difference is that we have an exciting name like, "Problem of the Day" for the story problem.

Most programs do not offer daily multiple opportunities to problem solve, and the problems are usually one step and simplistic. My Action Research Thesis was written about the importance of teaching problem solving in the primary classroom. Through my research I tried to locate and identify some of the highest quality materials available. Unfortunately, after conducting an extensive search of private and textbook companies and scouring material at NCTM conferences, the only resources I was able to find were simple "Problem of the Day" manuals. This
became my inspiration to write a book that would meet this need.

Take the following story problem examples:

- Alexandra has 4 cats. Her aunt gives her 3 more cats. How many does she have now?
- Rich has 5 cookies. He eats 2 of the cookies. How many does he have left?

These are typical story problems found in most series today. While we are jumping up and down wondering why our kids aren't excited about problem solving, these are the questions our students are thinking:

- "Who in their right mind has 4 cats and if you did why would you get 3 more?"
- "What’s wrong with Rich? Any normal kid would have eaten all 5 cookies!"

These kinds of story problems aren't relevant to children today. They are also too simplistic and can usually be solved by adding or subtracting the two numbers. Instead, we should be teaching our students multiple ways to solve complex and multistep problems. As adults we realize that there are multitudes of ways to solve real life problems, and if we want our students to be future problem solvers we need them to realize this as well.

I spend 15-20 minutes each day problem solving with my kids. My children quickly learn that it is just as important to be able to tell me how they arrived at the answer as it is to get the correct answer.

Therefore, every student must be able to explain his/her reasoning. After a student models his/her strategy I challenge the rest of the class to come up with a different way to solve the problem. Modeling multiple methods of problem solving provides struggling students with clear examples they might use in the future. It also pushes more advanced students to look farther outside the box.

Take the following example: There are 15 items in my school box. If 4 are pencils, 3 are erasers, and the rest are crayons, how many are crayons?

The first student explains that he used a part, part, part-whole box. He put 15 in the whole and 4 and 3 in the parts. He then knew it was a subtraction problem and once he subtracted 4 and 3 from 15 he would solve for the number of crayons.

The second student explains that she counted up. "I knew I had to get to 15 items so I added the 4 and 3 to get 7 . I then used the number line to see how much I needed to add to 7 until I had 15."

The third student shares that she drew a picture. "I drew the 4 pencils and 3 erasers and then kept drawing crayons until I had 15 items. Then I could count how many crayons I drew."

Clearly each of these 3 students is working at a different capability of problem solving. All three are going to get the correct answer if given a question like this on a test. Your goal is to assist the student who had to work much too hard drawing all of those pictures by showing her that there are increasingly easier ways to get the correct answer.

We typically solve 4 different types of problems each day. While one Problem of the Day isn't nearly enough, time limitations and attention spans rarely allow you to work on more than four problems a day.

At the end of this article there is a sample from the book When Do Dandelions Become Weeds? A Guide to Teaching Problem Solving in the Primary Classroom. It is a scripted lesson whereby the teacher reads the script and draws (after student responses) what is written in bold - just like the sample on the chalkboard.

I use the scripted lessons with one response for each problem for the first month or so of school so my students can be exposed to a variety of problem solving strategies. After that time, you are ready to accept multiple methods to solve each problem.

Once your students are experienced at identifying multiple ways to problem solve, it is time to move to more complex and multi-step problems. Look at the following samples:

## Different Kinds of Homes

1. $\qquad$ people live in an igloo. $\qquad$ live in a cabin. How many people are living there? Are there more igloo or cabin people? How many more?
2. My apartment building has $\qquad$ stories. If ___ people live on each floor, how many people live in my apartment building?
3. It takes $\qquad$ stilts to hold up one beach house. How many stilts would it take to hold up $\qquad$ beach houses?
4. A ski lodge has $\qquad$ floors. Each floor has one less room than the floor below. If the bottom floor has $\qquad$ rooms, how many are on the top floor? How many rooms altogether?

The Little Red Hen

1. One bundle of wheat could be ground into $\qquad$ cups of flour. How many cups could she get out of $\qquad$ bundles of wheat?
2. Little Red can bake $\qquad$ loaves each day. How many would that make in a week?
3. Little Red baked __white, ___ wheat, and ___cinnamon loaves. How many loaves is that? Put them in order from most to least? How many more does most have than least?
4. Little Red changes her mind and decides to share her bread with duck, dog and cat. If she cuts a loaf into $\qquad$ pieces, how many will each get?

My problem solving topics now center around: current holidays and sports; characters and events in stories we are reading in the classroom; parts of our school day, etc. It is important to keep the topics of high interest to students as the application for our problem solving goals
"Different Kinds of Homes" fits with a basal story and social studies unit where we study different kinds of homes around the world. Problem 1 requires work with number sense. Problem 2 teaches students multiplication through repeated addition. Problem 4 is a much more complex problem where students might have to draw a diagram or create a formula to solve.
"The Little Red Hen" takes a childhood classic and requires students to work with number sense, multiple patterning, and fractions. Questions 3 and 4 even provide discussion opportunities on what kind of bread do students think she really did bake and who thinks that when she shared it was the right thing to do?

Notice that the number amounts are purposefully left blank for two reasons. You know your students best and can choose numbers that would be appropriate for the level of problem solving they are ready to complete. The other reason is that it gives you an opportunity to teach your students how basic problem solving skills will help them as their problems become more difficult and the numbers get larger. Take Little Red Question 2 as an example. If I taught this lesson early in the week, I might put a 2 in the blank. As we problem solved, my students would discover that using our doubles or counting by twos would be an easy way to get the answer. If I re-taught this lesson at the end of the week I might put the number 8 in the blank. We could initially use our doubles to get started and then use a hundred chart to add the doubles together. Another fun thing to do is let students choose the numbers the second time you problem solve. When someone chooses 99 (thinking it will be funny) you can actually challenge students to find an easy way that the problem could still be solved.

Problem solving is a lot of work for the teacher and for your students. You will begin this journey with the goal of raising student achievement in problem solving. While you will easily accomplish this goal, you will also discover that you and your students are now experienced, successful AND eager problem solvers.

## About the Author

Rena Pate is a National Board Certified Teacher. She has a BS degree from the University of Illinois and a Master's in Teaching and Learning Mathematics. She has taught first grade for 23 years in Danville, Illinois.

She has presented at several ICTM workshops, regional NCTM in New Orleans and St. Louis and the Annual NCTM in

Indianapolis. You can see her presentation at the regional NCTM in Chicago, Illinois,

November $29^{\text {th }}$. For more information, visit her website at primarymathrules.com.

Below is a sample from the book When Do Dandelions Become Weeds? A Guide to Teaching Problem Solving in the Primary Classroom by Rena Pate.

## Day 26



Draw a part-part whole box. We had 15 kick balls. The bigger kids kicked 4 of them onto the roof. How many balls do we have left? If 3 classes had to share the remaining balls, how many would each get? How many would be leftover?


Record the letters APT and the values 2, 3,4 on the board. Who can make a word out of these letters? Let's take that word and repeat it 2 times. Transfer the values under the letters. What can we do to make it easier to add these together? Can someone make a different word? See if they know PAT and TAP patterns would be equal? What about a 2 letter word?


My candy jar has 3 gumdrops, 5 lemon drops, and 8 gummy worms. Record initials and numbers. How many pieces of candy do I have? Put them in order from greatest to least. If I cut my gummy worms in half how many pieces would I now have? If I am allowed to eat 2 pieces a day, how many days will my candy last me?


Dan, Sam, Kam and Pam are collecting lightning bugs. Record their names on the board. Sam collected 6 . The other children have collected 10, 4 and 7 . Figure out who has which amount. Dan has the most. Pam has less than Sam. Kam has less than Dan.

