Center on Technology and Disability

www.CTDinstitute.org

Understanding Word Problems in Mathematics

Re-published with permission from
American Institutes for Research

AMERICAN INSTITUTES FOR RESEARCH®

Understanding Word Problems in Mathematics

By: Judy Zorfass, Tracy Gray, and PowerUp WHAT WORKS (2014)

INTRODUCTION

For many students who struggle with mathematics, word problems are just a jumble of words and numbers. However, you can help students make sense of these problems by teaching them problem-solving processes. Indeed, as students move forward in their mathematical learning, they will need to apply problem-solving processes to more and more complex situations so they become college and career ready. The first Common Core State Standard (CCSS) for mathematical practice focuses specifically on problem solving:

- CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.

Proficient students are able to explain the meaning of a problem and look for entry points to its solution. They are able to analyze givens, constraints, relationships, and goals. They make conjectures about the form and the meaning of the solution, and they plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and they try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress, and they change course if necessary. In contrast, students who struggle with mathematics may find it difficult to successfully carry out parts (or, indeed, all) of this complex process.

STRATEGIES TO HELP STUDENTS

To solve a word problem, students need to understand its context and develop a strategy to solve it. There are many ways to help your students build these skills and understand how to use them in specific situations (see UDL Checkpoint 6.2: Support planning and strategy development).

One strategy is to use a process chart, which can guide students as they tackle a new problem. It helps to focus on how each step of the process supports students

as they work to access the problem. An example problem-solving process is provided below:

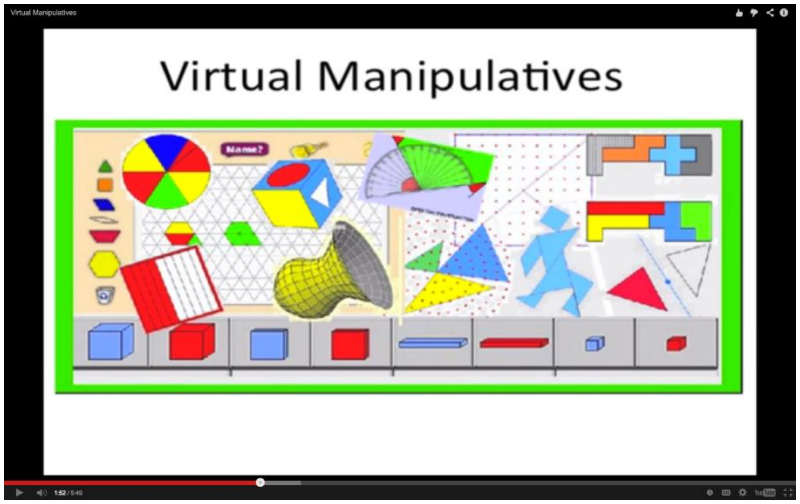
1. Read the problem, then reread it and highlight key words and numbers. *Reading the problem a second time with annotations helps students sort out the core information from the background noise.*
2. Draw a picture of the situation that the problem presents. It may be helpful to first visualize a story or imagine a movie scene. *Visualizing a story can be a powerful strategy that helps students create a picture or diagram of the problem.*
3. Determine the goal of the problem.
4. Establish a strategy or write an equation to represent the picture. Estimate an answer, if possible. *Estimating or approximating an answer helps students decide if they are on the right track.*
5. Solve the problem and check the reasonableness of your answer. *Reminding students that it is rare to complete a problem correctly on the first attempt encourages them to embrace mistakes and errors* (see UDL Checkpoint 3.2: Highlight patterns, critical features, big ideas, and relationships).
6. Explain your solution method.

Teacher-student interaction will help you differentiate instruction. Ask students to compare and contrast different approaches, and then summarize their responses for them. Students should understand what works and does not work (and why); which methods are more efficient; and how models differ. It is critical that teachers elicit, value, and celebrate approaches that are different but nonetheless arrive at the correct solution. Encourage your students to use pictures, diagrams, charts, expressions, and equations as part of the problem-solving process. Discuss with them how their picture, diagram, chart, expression, or equation relates to the situation in the problem. Ask them to explain why they chose it and why they think it is a good mathematical expression to use for the problem they are tackling.

ONLINE RESOURCES

There are many technology tools and resources that can support students as they work to understand problems and expand their repertoire of appropriate models.

Virtual manipulatives can be used in addition to (or as an alternative to) the physical manipulatives that are already found in most mathematics classrooms. The following short video, Virtual Manipulatives, below provides an overview of how to make use of virtual manipulatives.



There are also many websites that offer lesson plans for teachers. ReadWriteThink, for example, provides a number of high-quality materials, including several that focus specifically on developing reading comprehension through mathematical problem solving. Look for links to other suggested materials on PowerUp's Pinterest page.

IN THE CLASSROOM

As the end of the school year approaches, almost all of Mr. Garcia's Grade 3 students are proficient at multiplying and dividing numbers up to 100. Most are able to apply their skills to solve word problems, but several students are still struggling—in particular, they have difficulty articulating explanations for their solutions. Throughout the year, Mr. Garcia's students have been building a class website, through which they share useful resources with other third-grade students and show parents their progress in class.

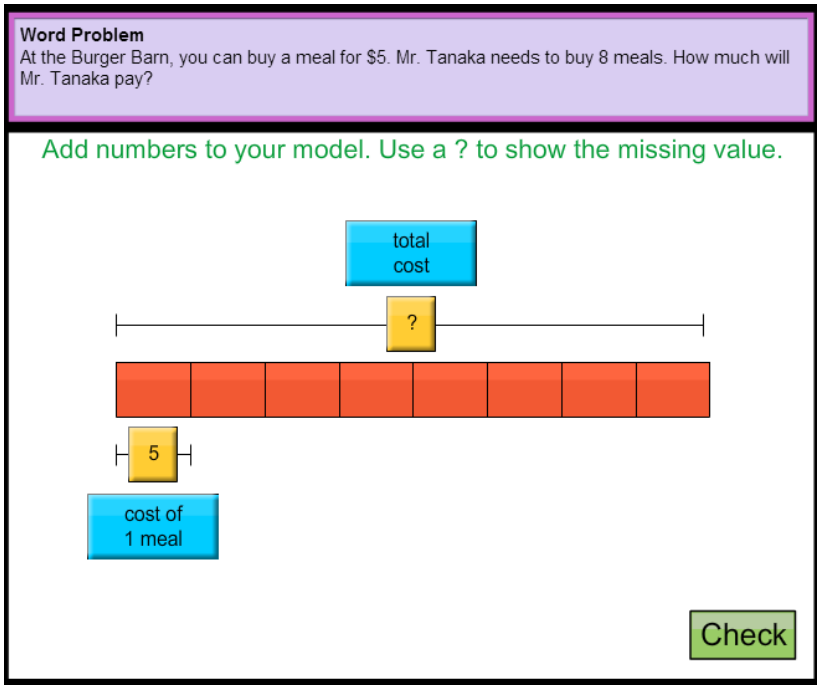
Mr. Garcia decides that his next lesson will reinforce their understanding of problem-solving strategies in alignment with the CCSS on mathematical practice (see above). Students will create their own word problems and write the solutions

to those problems. The final product will be a presentation that can be shared on the class website.

While Mr. Garcia will rely heavily on his interactive whiteboard to communicate visually with the class, he will also encourage his students to use a variety of technology tools, including:

- The Thinking Blocks applet to demonstrate multiplication and division models
- Software for creating presentations (e.g., PowerPoint, Keynote, Prezi)
- A platform for sharing presentations on the class website (e.g., SlideShare, Prezi)
- Digital organizers that students can use to collect personal notes and reference material
- A polling tool to elicit student feedback

Mr. Garcia decides to begin the class by reviewing the problem-solving process. He works with the entire class to solve a multiplication problem from Thinking Blocks:



Students then work in pairs to create their own problems. When the class comes back together later in the lesson, Mr. Garcia will invite a few pairs to present their

problems and solutions, specifically choosing students who are able to provide clear explanations. All students will then write up their problems and solutions to share on the class website. To finish the lesson, students will write summaries that describe how to determine whether a word problem requires multiplication or division.

Mr. Garcia's lesson plan is divided into three sections—launch, learning task, and closure—and is outlined in the chart below.

Lesson Plan

Launch	• Review the lesson goal. • Introduce the lesson, explaining that students will create their own multiplication and division word problems. • Review the problem-solving process by using a multiplication problem. • Review the problem-solving process again, this time using a division problem.
Learning Task	• Give students instructions about the learning task. • Consider students' strengths, weaknesses, and learning styles when pairing them up to work. • Circulate around the room while students work, listening to conversations and providing support, as necessary. • When students have finished, bring them back together and have a few students present their problems. • Have students return to their pairs and create two more problems.
Closure	• Have students write a summary about how to determine whether a word problem requires multiplication or division.

ONLINE TEACHER RESOURCES

This article draws from the PowerUp WHAT WORKS website, particularly the Understanding Problems Instructional Strategy Guide. PowerUp is a free, teacher-

friendly website that requires no log in or registration. The Instructional Strategy Guide on Understanding Problems includes a brief overview of the topic with an accompanying slide show; a list of the relevant mathematics Common Core State Standards; evidence-based teaching strategies to differentiate instruction using technology; short videos; and links to resources that will help you use technology to support mathematics instruction. If you want to dig deeper into the research foundation behind best practices in the use of virtual manipulatives, take a look at our Tech Research Brief on the topic. If you are responsible for professional development, check out the PD Support Materials for helpful ideas and materials for using the resources. Want more information? Go to PowerUp WHAT WORKS.