DOWNLOAD PDF PROBLEM SOLVING AND WORD PROBLEMS (MATH SUCCESS)

Chapter 1 : Problem Solving Checklist | UDL Strategies

*Problem Solving and Word Problems (Math Success) [Rebecca Wingard-Nelson] on www.nxgvision.com *FREE* shipping on qualifying offers. Provides an overview of basic problem-solving strategies and skills, including solving algebraic expressions and equations and different kinds of word problems.*

STEM Teacher Preparation and Development Schema-based instruction, which teaches students to focus on the underlying structure of math word problems, improves learning for students of all levels. I became interested in looking for better ways to teach math problems because of my daughter, who suffered brain damage in early childhood which inhibited her development of language skills. Despite this delay in developing language, she showed great understanding of mathematical concepts at an early age. I remember being amazed when she showed us how the calendar repeats itself every 28 years and quickly mastered her multiplication tables. However, she continued to have a difficult time solving math word problems. Many students â€" both in mainstream and special education â€" struggle with math word problems. I believe that schema-based instruction can be a powerful tool for math teachers and parents to empower student success. Math word problems have traditionally been problematic for many students. A student may read two problems and believe them to be different because of the language and situation presented. For example, a problem about how far a bicycle can travel at a certain speed and another problem with a scenario involving a spaceship might appear to be very different â€" but at their core are similar rate problems. Through schema-based instruction, we help the student focus on the underlying problem structure and represent the problem text using visual schematic diagrams that show how quantities in a word problem are related. It is well documented that many students, especially those struggling in math, jump immediately into calculating the answers when solving math word problems without understanding the premise and reasoning whether the answer is meaningful. With schema-based instruction, we get to the essence of a math word problem by having the student identify what type of problem it is ratio, proportion, percent of change, etc. Then we teach them to use schematic diagrams that help them visualize how quantities in a word problem are related. Because comprehension is particularly difficult for many students struggling in math, we provide schematic diagrams as they translate and integrate information in the problem into the representation before they are taught to construct their own diagrams. Is it similar to or different from others that I have solved before? What solution strategy is most appropriate? Is the answer reasonable? After promising results here, we added districts in Florida and Utah to add demographic and geographic diversity to our sample. Interestingly, we found that this improved performance compared to peers was consistent whether the student was in special education or conventional classroom settings. This is true for teachers as well. The improvement in student outcomes is maintained over time, even if the teachers do not participate in additional professional development training related to schema-based instruction. Tips for Encouraging Success in Math Word Problem Solving Schema-based instruction is a powerful tool for teaching math word problem solving. Ensure that classroom math instruction not only includes sufficient problem solving activities but also focuses on foundational mathematics content e. Make word problems and situations mirror real life experiences that kids will encounter. My work with middle school students shows that the more relevant and pertinent to real life we can make math, the more students will buy into learning and doing math. It is important that all students who have persistent math difficulties, even those in middle school, receive word problem solving interventions of sufficient quality and intensity more focused time, small group instruction to accelerate their progress. Explicitly teach and review the language used in mathematics so that students understand what is being asked in a problem and how the problem should be solved. Students at risk for math difficulties need instructional support e. What are the steps to solve this problem? Does the answer make sense? This practice is important, because it enhances mathematical metacognition by requiring students to both express their own thinking and listen to the ideas of their peers.

Chapter 2 : Math Word Problems Worksheets

A Fermi question is an estimation problem that teaches students reasoning and problem solving skills. They involve making estimations about problems that have limited information and seem.

Often, they are "under the gun", stressed and very short for time. Consequently, when they encounter a new problem or decision they must make, they react with a decision that seemed to work before. Not all problems can be solved and decisions made by the following, rather rational approach. However, the following basic guidelines will get you started. Note that it might be more your nature to view a "problem" as an "opportunity". Therefore, you might substitute "problem" for "opportunity" in the following guidelines. Define the problem This is often where people struggle. They react to what they think the problem is. Ask yourself and others, the following questions: Where is it happening? How is it happening? When is it happening? With whom is it happening? To be an effective manager, you need to address issues more than people. Why is it happening? It may be helpful at this point to use a variety of research methods. If the problem still seems overwhelming, break it down by repeating steps until you have descriptions of several related problems. Verifying your understanding of the problems: It helps a great deal to verify your problem analysis for conferring with a peer or someone else. If you discover that you are looking at several related problems, then prioritize which ones you should address first. Note the difference between "important" and "urgent" problems. Often, what we consider to be important problems to consider are really just urgent problems. Important problems deserve more attention. Understand your role in the problem: Your role in the problem can greatly influence how you perceive the role of others. Or, you are feel very guilty about your role in the problem, you may ignore the accountabilities of others. Otherwise, people tend to be inhibited about offering their impressions of the real causes of problems. Write down a description of the cause of the problem and in terms of what is happening, where, when, how, with whom and why. Brainstorm for solutions to the problem. Very simply put, brainstorming is collecting as many ideas as possible, then screening them to find the best idea. A wonderful set of skills used to identify the underlying cause of issues is Systems Thinking. Select an approach to resolve the problem When selecting the best approach, consider: Which approach is the most likely to solve the problem for the long term? Which approach is the most realistic to accomplish for now? Do you have the resources? Do you have enough time to implement the approach? What is the extent of risk associated with each alternative? The nature of this step, in particular, in the problem solving process is why problem solving and decision making are highly integrated. Plan the implementation of the best alternative this is your action plan Carefully consider "What will the situation look like when the problem is solved? What systems or processes should be changed in your organization, for example, a new policy or procedure? How will you know if the steps are being followed or not? How much time will you need to implement the solution? Write a schedule that includes the start and stop times, and when you expect to see certain indicators of success. Who will primarily be responsible for ensuring implementation of the plan? Write down the answers to the above questions and consider this as your action plan. Communicate the plan to those who will involved in implementing it and, at least, to your immediate supervisor. An important aspect of this step in the problem-solving process is continually observation and feedback. Monitor implementation of the plan Monitor the indicators of success: Are you seeing what you would expect from the indicators? Will the plan be done according to schedule? If the plan is not being followed as expected, then consider: Was the plan realistic? Are there sufficient resources to accomplish the plan on schedule? Should more priority be placed on various aspects of the plan? Should the plan be changed? Verify if the problem has been resolved or not One of the best ways to verify if a problem has been solved or not is to resume normal operations in the organization. Still, you should consider: What changes should be made to avoid this type of problem in the future? Consider changes to policies and procedures, training, etc. Lastly, consider "What did you learn from this problem solving? Consider writing a brief memo that highlights the success of the problem solving effort, and what you

learned as a result. Share it with your supervisor, peers and subordinates. Rational Versus Organic Approach to Problem Solving Rational A person with this preference often prefers using a comprehensive and logical approach similar to the guidelines in the above section. For example, the rational approach, described below, is often used when addressing large, complex matters in strategic planning. Examine all potential causes for the problem. Identify all alternatives to resolve the problem. Carefully select an alternative. Develop an orderly implementation plan to implement that best alternative. Carefully monitor implementation of the plan. Verify if the problem has been resolved or not. A major advantage of this approach is that it gives a strong sense of order in an otherwise chaotic situation and provides a common frame of reference from which people can communicate in the situation. A major disadvantage of this approach is that it can take a long time to finish. Some people might argue, too, that the world is much too chaotic for the rational approach to be useful. Organic Some people assert that the dynamics of organizations and people are not nearly so mechanistic as to be improved by solving one problem after another. For many people it is an approach to organizational consulting. The following quote is often used when explaining the organic or holistic approach to problem solving. Some higher or wider interest appeared on the horizon and through this broadening of outlook, the insoluble lost its urgency. It was not solved logically in its own terms, but faded when confronted with a new and stronger life urge. It also suits the nature of people who shun linear and mechanistic approaches to projects. The major disadvantage is that the approach often provides no clear frame of reference around which people can communicate, feel comfortable and measure progress toward solutions to problems.

Chapter 3 : Runde's Room: 5 Activities for Teaching Problem-Solving

Solving word problems is far more about effective reading skills and far less about math. You might be asking, then, why do so many strong readers fear solving word problems? Because, math word problems have a perception problem.

Five of her students are bored with the easy problems. Student Confidence For many students, just looking at a word problem leads to anxiety. No one can think clearly with a sense of dread or fear of failure looming! Plans are great, but not when students use them as a crutch rather than a tool. Differentiation Teachers want students to excel quickly and often push too fast, too soon. In the case of word problems, you have to go slow to go fast. Teach a Problem-Solving Routine Kids and adults are notoriously impulsive problem solvers. When I was in elementary school, this was actually a pretty reliable strategy! But today, kids are asked to solve much more complex problems, often with tricky wording or intentional distractors. Grow flexible thinkers and build confidence by teaching a routine. A problem solving routine simply encourages students to slow down and think before and after solving. To make the problem solving routine meaningful and effective: This can be as simple as adjusting the numbers in a problem or removing distractors for struggling students. Scaffolding word problems will grow confidence and improve problem solving skills by gradually increasing the level difficulty as the child is ready. This is especially effective when you are trying to teach students different structures of word problems to go with a certain operation. For example, comparison subtraction problems are very challenging for some students. By starting with a simple version, you allow students to focus on the problem itself, rather than becoming intimidated or frustrated. Compare Problems Side-by-Side To develop flexible thinking, nothing is more powerful than analyzing and comparing word problems. Start by using problems that have similar stories and numbers, but different problem structures. Encourage conversation, use visual representations, and have students explain the difference in structure and operation. Click here to download a blank copy of these problems. My freebie includes several variations to help you differentiate. Kady Dupre has worked as a classroom teacher, instructional coach, and intervention teacher in elementary grades. She loves creating learning resources for students and teachers. She authors Teacher Trap , a blog aimed at sharing her challenges, successes, and insights as a teacher.

Chapter 4 : Problem Solving and Decision Making (Solving Problems and Making Decisions)

The No. 1 issue math students struggle with is solving word problems. Math Problem Solving provides a solution. Each lesson teaches a key problem-solving strategy by breaking it down into manageable steps and then providing guided and independent practice to reinforce the learning.

The SQRQCQ method is particularly useful for children with learning disabilities and can be used effectively in special education programs. Step 1 - SURVEY the Math Problem The first step to solving a math word problem is to read the problem it in its entirety to understand what you are being asked to solve. After you read it, you can decide the most relevant aspects of the problem that need to be solved and what aspects are not relevant to solving the problem. The idea here is to get a general understanding. Basically, what are the questions being asked by the problem? Determine which aspects of the problem are interrelated. Identify all relevant facts and information needed to solve the problem. As you do, write them down. Be sure to write down what steps or operations you will use for easy reference. Be sure to follow the steps you outlined while setting up an equation or using a formula. As you complete each step, check it off your list. If it does not appear logical, review the steps you took to find the answer and look for calculation or set-up errors. Recalculate the numbers or make other changes until you get an answer that makes sense. Math word problems tend to be especially challenging for Learning Disabled LD students. LD students often lack "Concept Imagery", or the ability to visualize the whole problem by creating a complete mental image. LD students may also struggle to understand the words or wording within math word problems correctly. The inability to correctly interpret and understand wording greatly impacts their math reasoning skills and often leads them to making the wrong calculations and arriving incorrect conclusions. Remembering and manipulating information and details in their working memory is another challenge some LD students face as they try to see the whole picture. Slow processing of information, followed by frustration and anxiety, will often lead LD students to try and get through math word problems as quickly as possible â€” which is why they often jump straight into computations in their attempt to make it to the finish line as quickly as possible. It provides just enough direction to guide them through the reasoning process without overwhelming them. SQRQCQ is also a mnemonic that is easy for students to remember and which they can fall back on when completing homework or taking tests.

Chapter 5 : Word Problems Worksheets | Dynamically Created Word Problems

Math Problem Solving 3rd grade Math Grade 3 Math Problems:) Math - Numbers Growth mindset activities Math Classroom Classroom Ideas Success criteria Forward Collaboration Learning Skill but also vital for math problem solving - they consistently work with partners in math so we really focus on this during that time.

This post aims to give you some new ideas to get your students digging deep into word problems, on their way to becoming problem-solving masters. I hang an anchor chart in the classroom, and we complete an entry in our Interactive Math Journals click HERE to see this resource in greater detail. These resources contain a checklist for CUBES right on the page that students need to complete before they begin solving the problem. I LOVE using these pages for quick formative assessments in the classroom - and they make a great portfolio piece to keep parents informed of what we are doing in the classroom, and how their child is progressing. There are 2 different versions of each word problem so you can easily provide differentiation for your students or provide some extra practice for students who need some reinforcement with the concepts. Using my Building Better Responses in Math has been the key to this in my classroom. This resource breaks down the problem-solving process step-by-step and creates a set of easy-to-follow success criteria for students, ensuring that they have not only solved the problem, but also communicated their thinking during the process. We start out with our first success criteria, and every time we master a criteria usually every two to three weeks , we add another criteria to our board there are 9 criteria in all. This gives the students a model to reference. This resource also comes with printables for students to practice each criteria in isolation, as well as pages for scaffolding the steps each time they add a new one. All pages contain a checklist for students so they can be sure they are completing each step. I start with an answer, and get each student to write a word problem for the answer on a sticky note. They quickly check in with me before they post their question. When we first started this activity, students were including the answer IN their question, but with more practice, they are now thinking more about writing the word problem with the answer in mind. I love letting my students explore word problems together. They often have different ideas and strategies for how to solve a problem, which leads to awesome conversations about justifying their answers. I always make them responsible for completing their own pages, but they can work together on the solutions. These resources have students working together in groups of 4. I hear the BEST math talk when using this resource, and I watch them go back into their notes to help them with their solutions, which makes my teacher heart smile. Each of these resources also contains an editable template, so you can add in any word problem you want to work on - better yet, give your students the opportunity to come up with the problem themselves. You can also have them work together on large chart paper, or just give them some clip boards for their paper and let them work anywhere they wish within the room. Let them be the experts - Lastly, let your students be the experts. I do a lot of peer and self-evaluation with problem-solving. This makes them really think about what is needed in the solution to fully answer the problem. I also like to post all the responses on the board, and allow students time to present their solutions - explaining what they did and how they know they are correct, or what they would do differently next time. To help them differentiate between explaining HOW they solved the problem, and WHY they chose the steps they did, I also like to do an activity where I give the students two different colors of stickers or sticky notes. They walk around the gallery of math, examining all the solutions, and place the one color where they see students explaining HOW, and the other color for WHY. This really helps them see the difference between the two. I then allow them time to go back to their own solutions, to see if they have completed both steps, and improve upon their communication. These are just a few ideas.

Chapter 6 : Teaching Problem Solving in Math - The Owl Teacher

Tips for Encouraging Success in Math Word Problem Solving. Schema-based instruction is a powerful tool for teaching math word problem solving. Below are some principles for improving all students' math word problem solving skills.

The Teacher Studio 3: On to challenge 3. I am hoping something in this post resonates with you--and if it does, please consider dropping into the Facebook group and sharing your thoughts! My point is this. We can give students word problems that ask them to multiply. They are both important--but we need to be mindful of what we are working on when we select our problems. Secondly, we often use the term "problem solving" and "word problems" as if they mean the same thing. Students can be provided MANY situations where problem solving is required--but are not word problems. More on THAT later! As we know, making math meaningful with real world applications is critical. Word problems can be a great way for students to see how math ties to the real world--as long as we find good problems! Teaching Problem Solving Strategies First of all, I think it is really important to give students problem solving "tools" in their toolbox. So often our textbooks teach one strategy in each chapter That way, as different problems come up throughout the year, they can draw from this foundation. Knowing how to work backward, draw a picture, make a table--these are all so important not just on the one page of the math textbook, but for their rest of their mathematical lives! The image below is the set of task cards I use at the beginning of the year to teach 7 different strategies. I explicitly teach each one--then the last set of cards asks students to apply what they have learned and select an appropriate strategy. Just click the image or HERE if you are interested. Research has shown that the first ten minutes of math class is the time when students are most "ripe" for engagement--and so often that ten minutes is spent doing procedures or correcting homework! Whether this be a number talk, a math discussion--or a word problem--getting students engaged with and talking about math is so important. I do this in a few different ways I project one problem on the board and students first talk about it, then solve independently, then share solutions and thinking. Each student gets a copy of the problem to glue into their math notebook, they work to solve independently, then share in pairs or bring it back to the whole class for a discussion. Provide a problem maybe a task card, maybe projected where a small group first discusses strategies that would work no paper and pencil! Students work to solve a problem on their own and then different students share their strategies with the class or under a document camera. This can also be a great time for students who organized their work really well to showcase that! Solve a problem as a whole class and then send students off to try writing a similar problem. Use a problem that has blanks instead of numbers and then give three choices of numbers to use Word Problems on Display Another great way to incorporate more problem solving is simply to have tons of problems available at all times! You can even find ways to differentiate This is a perfect way to help students do a little self-assessing about their readiness for different tasks--and if they have a true growth mindset, it is fun to watch them push themselves toward more rigorous problems! Whether it be on one of my problem solving pocket charts or a bin of problem solving task cards, there are specifically chosen to either complement the content we are working on or to merely engage the students in meaningful, motivating problems. This is a perfect time for me to pull out some of my seasonal problems or problems that have "cool" and extreme facts or that pique their interest. Once they have the tools in their toolbox, my students actually gravitate toward these problems when they have extra time! Cooperative Problem Solving in a Math Workshop Like previously mentioned, having problems around the room is a great way to provide students with problems. Students can work alone OR collaboratively on problems that are chosen for them--or that they can freely select as mentioned above. In other words, you can have problems around the room for fast finishers, but you can also have those problems be a part of a math workshop plan. Perhaps you might have one problem that is "required" and then students can use the rest of their rotation to select from other problems. Or you might ask students to solve a problem in two different ways I do this once in a while as a sort of "final copy" of a problem You have tons of options--and by getting problems ready ahead of time, this is an easy station to use

Ways to Differentiate and Scaffold Problem Solving One of the many "truths" about teaching as that no two students are ever in exactly the same place. There are times when working on the same problem is meaningful, but there are other times that we need to be mindful of these differing abilities. Here are few nuggets to ponder. Sometimes students can tackle the same problem if you make "tools" available to them. If you are truly working on the problem solving process and not a skills like subtraction , why not make manipulatives or calculators available? This puts students on equal footing for the first part--but allows those who are ready to move on to the next part. This also would allow you time to meet with those who need help on the first part while the others tackle the second part. This is a great way to make problems more accessible to students. Do a "presolve" meeting with anyone who is interested. What I mean by this is Put "hints" up someplace in the room. A simple piece of folded paper taped to the board with a hint inside can free students up who get stuck beyond "unsticking" without needing teacher help. Even a series of hints can be useful! Have students offer to be problem coaches for the day You WILL have to teach students how to give hints rather than do the work for them It works for you too--teachers often give away too much to students. Try asking questions like, "What do you know already? Use problems that have different number choices see above Have your problems around the room categorized Color coded envelopes or bins? Or check out this post for some other ideas. This is certainly true when we teach math. In particular, after twenty-six years and counting! About 15 years ago, I was teaching a math lesson and was listening in to a conversation two students were having about a word problem and I heard this: So when we are immersed in fractions, students may find themselves warming up with a money problem. Or when we are working on partial products, students may need to divide to solve a problem. No longer do I do the thinking for them by choosing a fraction word problem during your fraction unit, you have done part of the work Of course, when I teach multiplication, we DO need to solve multiplication stories In my class, problem solving is like a box of chocolates One thing I think is important to reflect on are the "verbs" we associate with teaching and learning with problem solving. And what about the students? Or do they wait? One great thing to do is to lay out some of these verbs for ourselves--and our students. Making an anchor chart of "my job" and "your job" is a great way to help craft that culture of math investigation and mindset. Give it a try--see what you and your students can come up with! One shared responsibility teachers and students DO need to have is assessment and self-monitoring more on this in an upcoming challenge! It might help you and your students get on the same page for the complex world of problem solving--or might inspire you to write one together! Here are some of my favorite word problem resources Have you missed the other posts in this series? And make sure to answer the screener questions! Rather pin this for later?

Chapter 7 : Study Skills: Strategies for Solving Math Word Problems

Teaching students how to solve word problems is one of our most important math job! Problem solving strategies are key as well as finding differentiated, just right problems that are engaging and have real-world situations.

The problem with CUBES and similar strategies is that as students get older, the problems require more thinking, with layers that cannot be solved with a simple pull and put together method. Without a real understanding of how to comprehend a word problem, students are not only led astray, but grow up thinking that problems are not worth investigating. In fact, students using these approaches can get the impression that problems are neat and tidy; when actually problems can get quite messy requiring logic, persistence, and creativity as trying alternative strategies can help clear the muddy waters a bit. One answer is for teachers to first spend valuable instructional time investigating and modeling what it means to actually understand a word problem. Below you will find a sample anchor lesson for modelling how to think like a real mathematician when understanding word problems. Anchor Lesson for what it looks like and sounds like to understand a word problem like a Real Mathematician Purpose: Students will notice how a mathematician understands a word problem. Students will relate the skills a mathematician uses in understanding to that of a reader, scientist, historian, etc. Students will identify how using the strategies makes comprehension easier. Put up the following text or something just as difficult on Smartboard. Students should not have a copy of this. But we also observed that the two equilibria solutions for the logistic population model differ: Challenge your students to switch roles with you. They are now the teacher and you are the student. Make sure you have read this ahead of time several times. Really impress the students with your oral reading. Exaggerate your reading so it sounds like you really understand the piece. Have the students talk to a partner and come up with a grade on how you did as a reader. Ask them what grade they gave you and why they gave you that grade. Reveal that if they asked you anything about what you read, you would not be able to answer it because you really have no idea what you read. Add that real reading means you are actively involved. It takes both text and thinking. Let the students know the same thing happens in mathematics. Sometimes we just keep moving along in our problem solving without thinking. Sometimes we even just circle magic words and underline numbers thinking this alone will help us make meaning of the problem. But, without any real connections to what we underline, we rush into strategies without thinking and that can sometimes lead us astray. Raise your own hand. Put the following problem or any open-ended math prompt on your Smartboard. Students should not have a copy of the problem. That can be distracting. You want them to pay attention to your Think Aloud. A total of 8, runners started a long distance race. The results of the race are listed below. The rest of the runners did not finish the race. Calculate the number of runners who finished the race in less than 4 hours. Show and explain all your work, even if you used a calculator. Calculate the number of runners who did not finish the race. Show all your work. Explain why you did each step. Give out the following T-Chart for students to complete during your Think Aloud. Make a copy on chart paper to use as an anchor reference in future problem solving. Tell students that you are going to think aloud through this problem. Challenge them to notice and write anything you did to help you make meaning of the text and think like a real mathematician. Read the entire problem through one time Do not read parts A or B yet. I think I better reread it slowly and take it apart. Stop and make a personal connection that helps you visualize the scenario, but get off track a little. Use this step if you are noticing students losing focus during problem solving. I went to a marathon once. I can picture that day. That was a really hot day. That connection is not helping me make meaning of the text. I better reread it from the beginning to get myself back on track. Share that you first want to remove the numbers in your mind so you can connect to the story. Now replace the numbers accordingly: Identify there are three parts that make up the total number the runners in the race. Reread the problem again, this time with the numbers included. Let me make sense of this before I move on. So 1, runners finished the race in less than 4 hours. Point out the remaining part of the open number line leaving four more fifths. If I think of 0. That

means most of the runners finished the race in 4 or more hours. Purposely do not underline numbers and circle magic words. Just connect to context and meaning. Estimate and make numbers friendly and reasonable. Draw as a fraction bar or show it on your open number line. I really understand the story in this math. Stop and have partners share what they noticed you doing to think like a real mathematician and not just do fake math. Discuss with the whole class and write down what the students noticed as a T-chart on chart paper to use as a reference. Take ideas and reframe them to include good thinking strategies. Challenge the students to discover how this all helped you make meaning of the text. Remember to share that is how mathematicians think. In fact, it is how scientists think, and historians, etc. Good thinking is good thinking. It crosses over content area. Students should now record their reflections on the right side of the T-Chart. Do not solve the problem. It can be a problem they solve later on. Students Give it a Go: Hand out copies of similar problems and have partners use active reading strategies to think through the problems out loud to each other. While one student thinks aloud, the other student notices what critical thinking habits they used to make meaning of the text. If you have time, they can solve the problem. Be careful not to rush into this. The focus here is how to think critically through problem solving. We have found this to be very useful in helping students recognize when their attention wavers and then have the tools they need to get back on track in their problem solving. Feel free to download and share!

Chapter 8 : Word Problems Are More than Magic - Corwin Connect

5 Activities for Teaching Problem-Solving This " 5 Activities for Teaching " post (click the link for more 5 Activity Ideas) is all about Problem-Solving in Math. As our testing relies heavily on our students' ability to problem-solve and analyze and solve word problems, we have a heavy focus on problem-solving all year long.

The use, distribution or reproduction in other forums is permitted, provided the original author s or licensor are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms. Abstract Successfully solving mathematical word problems requires both mental representation skills and reading comprehension skills. Given this, it seems legitimate to assume that students from a RME curriculum experience difficulties when asked to solve semantically complex word problems. We investigated this assumption under 80 sixth grade students who were classified as successful and less successful word problem solvers based on a standardized mathematics test. To this end, students completed word problems that ask for both mental representation skills and reading comprehension skills. The results showed that even successful word problem solvers had a low performance on semantically complex word problems, despite adequate performance on semantically less complex word problems. Based on this study, we concluded that reading comprehension skills should be given a more prominent role during word problem solving instruction in RME. Mathematical word problems refer to mathematical exercises that present relevant information on a problem as text, rather than in the form of mathematical notation Rasmussen and King, ; Timmermans et al. Both of these aspects are related in such a way that developing a deeper understanding of the text of the word problem serves as a crucial step before the correct mathematical computations can be performed. Hence, a key challenge for word problem solvers is to get an adequate understanding of the problem statement Lee et al. Two individual skills are relevant in this regard. First, an important factor contributing to a deeper understanding of the text of the word problem is the ability to construct a rich and coherent mental representation containing all the relations between the solution-relevant elements that are derived from the text base of the word problem De Corte et al. That is, word problem solvers have to use a problem-model strategy in which they translate the problem statement into a qualitative mental representation of the problem situation hidden in the text Pape, ; Van der Schoot et al. This mental representation subsequently allows them to make a solution plan and execute the required mathematical operations. Although successful word problem solvers appear to employ such a problem-model strategy by drawing on their mental representation skills, less successful problem solvers often adopt an impulsive, superficial direct translation strategy, in which they only focus on selecting the presented numbers that, in turn, form the basis for their mathematical calculations Verschaffel et al. It has been suggested that reading comprehension abilities are especially helpful in dealing with semantic-linguistic word problem characteristics such as the sequence of the known elements in the text of the word problem, the degree to which the semantic relations between the given and unknown quantities of the problem are made explicit, and the relevance of the information in the text of the word problem De Corte et al. This might explain why the use of a problem-model strategy is not sufficient in all circumstances. That is, word problems containing semantically complex features require both accurate mental representation skills and reading comprehension skills, whereas for word problems with a lower semantic-linguistic complexity, well-developed mental representational skills might be sufficient. These findings suggest that, to teach students how to effectively solve mathematical word problems, mental representation skills and reading comprehension skills should both be part of the mathematics education program. Particularly, paying attention to semantic-linguistic features of word problems is relevant to help students improve their word problem solving success, as word problems become semantically more complex as students progress in their educational career, for example, when they make the transition to secondary education. Word problems offered in secondary school subjects like geometry, physics and biology, include more verbal information and

generally contain more complex semantic-linguistic text features Silver and Cai, ; Helwig et al. The Netherlands, like many other countries, currently places great emphasis on the teaching of word problem solving in contemporary mathematics education Ruijssenaars et al. The teaching of mathematics in the Netherlands takes place within the context of a domain-specific instructional approach, called Realistic Mathematics Education RME, Van den Heuvel-Panhuizen, , where the process of mathematical word problem solving plays an important role Van den Boer, ; Barnes, ; Prenger, ; Van den Heuvel-Panhuizen, ; Hickendorff, Studies investigating the educational practice of RME show that the teaching of mental representation skills receives much attention in word problem solving instruction Van den Heuvel-Panhuizen, ; Van Dijk et al. However, reading comprehension skills enabling students to become sensitive to semantic-linguistic complexities in a word problem appear to be trained fewer and less explicitly in the instructional practice of RME, in spite of its proven importance in previous studies e. This is presumably because teachers may underestimate or are not aware of the importance of reading comprehension skills for solving word problems Hajer, ; Van Eerde, Thus, the current approach to teaching word problem solving appears to emphasize the development of mental representation skills, but seems to pay less attention to the role of reading comprehension skills. In this respect, the way in which word problem solving is taught in the RME curriculum does not seem to be aligned with what is currently known from research about the factors involved in effective word problem solving. Based on the above analysis of the RME curriculum it seems legitimate to assume that students attending such a curriculum may be at a disadvantage when semantic-linguistic characteristics of a word problem have to be taken into account. That is, students from an RME curriculum are likely to experience difficulties when ask to solve mathematical word problems with a high semantic-linguistic complexity. First, we classified students as successful or less successful word problem solvers with the help of a mathematics test that is part of the RME curriculum, viz. This test can be considered a method-specific i. Hence, this test reflects the skills that students learn in the RME classroom, in order to solve word problems Doorman et al. This procedure provides an advantage over prior studies of, among others, Hegarty et al. The classification used in the present study, on the other hand, is based on an external, well-established measure of mathematical word problem solving, which is independent of the main dependent variable of the study i. This allowed us to make more meaningful group comparisons. As previously mentioned, a key aspect that differentiates successful from less successful word problem solvers concerns their ability to construct an accurate mental representation of the problem text. Previous studies have shown that asking students to solve compare problems, especially inconsistent compare problems see Example 1 , is a suitable method for investigating whether or not they have effectively constructed an accurate mental representation of the problem statement e. That is 2 euro more than at the supermarket. If you need to buy seven bottles of olive oil, how much will it cost at the supermarket? At the supermarket, a bottle of olive oil costs 2 euro more than at the grocery store. If you need to buy 7 bottles of olive oil, how much will you pay at the supermarket? So, inconsistent word problems create greater cognitive complexity than consistent word problems see Example 2 , requiring students to ignore the well-established association between more with increases and addition, and less with decreases and subtraction Schumacher and Fuchs, Empirical evidence corroborates this interpretation by showing that word problem solvers make more reversal errors on inconsistent than on consistent word problems i. Especially students who fail to build an accurate mental representation of the problem statement, and thus immediately start calculating with the given numbers and relational term, seem to be less successful on inconsistent word problems Hegarty et al. In the present study, we expected neither successful nor less successful problem solvers to experience difficulties with solving consistent compare word problems. However, we did assume that successful word problem solvers in the RME curriculum would experience less difficulties with correctly solving inconsistent compare problems as a result of their reliance on mental representation skills acquired during word problem solving instruction in RME , than less successful problem solvers who employ a more superficial problem solving approach Verschaffel et al. If the semantic complexity of compare problems increases, we expected that even students classified as successful

word problem solvers according to our classification based on the RME instruction may come to experience difficulties with correctly solving inconsistent compare problems. In this case, correctly solving a word problem requires students to use both mental representational skills and reading comprehension skills, while word problem solving instruction in RME presumably has provided students only with considerable training in the first of these two skills. A relatively well-studied and accepted way to increase the semantic complexity of inconsistent compare problems is to manipulate the relational term Lewis and Mayer, ; Van der Schoot et al. Accordingly, the influence of reading comprehension skills on word problem solving can only be studied for students who mentally represent the problem statement accurately, that is, the group of successful problem solvers in our study. So, although our group of successful word problem solvers may draw upon their mental representation skills, the insufficient attention to reading comprehension skills in the educational practice of RME is likely to cause them to experience difficulties with correctly solving semantically complex marked inconsistent word problems. At the supermarket, a bottle of olive oil costs 2 euro less than at the grocery store. If you need to buy seven bottles of olive oil, how much will you pay at the supermarket? That is 2 euro less than at the supermarket. According to several researchers, the extent to which successful word problem solvers might be able to overcome difficulties with correctly solving marked inconsistent word problems is related to their reading comprehension skills e. This suggests that reading comprehension skills, together with mental representation skills, might be necessary to deal with semantically complex word problems. In sum, the present study aimed to test the following hypotheses: We hypothesized that, as a result of difficulties with constructing a coherent mental representation of word problems, less successful word problem solvers in the RME curriculum would make more errors on both unmarked and marked inconsistent word problems than on unmarked and marked consistent word problems. We hypothesized that, as a result of paying insufficient attention to reading comprehension skills in the teaching of word problem solving, successful word problem solvers in the RME curriculum would experience difficulties with solving semantically complex, marked inconsistent word problems, but not with solving semantically less complex, unmarked, inconsistent word problems. We hypothesized that, as a result of the alleged relation between reading comprehension ability and the ability to overcome the semantic-linguistic complexities of a word problem, a positive relation for successful problem solvers exists between reading comprehension ability and the number of correctly solved marked inconsistent word problems. Materials and Methods Selection of Participants Data from 80 Dutch sixth-grade students 42 boys, 38 girls from eight elementary schools in the Netherlands were collected. These students had a mean age of They were almost equally divided in two groups by means of the median split method on the basis of their score on the CITO Institute for Educational Measurement Mathematics test The CITO Mathematics test is a nationwide standardized test that reflects the way in which word problem solving is instructed in Realistic Mathematics Education. The test contains elements like mental arithmetic addition, subtraction, multiplication, and division , complex applications problems involving multiple operations and measurement and geometry knowledge of measurement situations , all of which are offered as mathematical word problems. Parents provided written informed consent based on printed information about the purpose of the study. This study was carried out in accordance with the ethical procedures of the Vrije Universiteit Amsterdam. Instruments and Procedure The two measurement instruments that were used in this study were administrated to the students by three trained independent research assistants in a session of approximately 45 min. Inconsistency Task The inconsistency task contained eight two-step compare problems see Appendix in Supplementary Material that were selected from the study of Hegarty et al. All of the word problems consisted of three sentences. The first sentence of each compare problem was an assignment statement expressing the value of the first variable, namely the price of a product at a well-known Dutch store or supermarket e. The second sentence contained a relational statement, expressing the value of the second variable i. In the third sentence, the problem solver was asked to find a multiple of the value of the second variable e. The answer to these compare problems always involved first computing the value of the second variable e. The eight compare problems were separated in four different word problem types see Appendix in Supplementary

Material by crossing the following two within-subject factors: Consistency referred to whether the relational term in the second sentence was consistent or inconsistent with the required arithmetic operation. A consistent sentence explicitly expressed the value of the second variable e. An inconsistent sentence related the value of the second variable to the first by using a pronominal reference e. Markedness referred to whether the relational term was a marked i. A marked relational term i. Hence, marked and unmarked word problems were considered as semantically more complex and semantically less complex word problems respectively. The stimuli were arranged in four material sets. Each participant was presented with eight word problems, two from each word problem type. The order in which the word problems were presented in each set was pseudorandomized. Each set was presented to 20 participants. Across word problems, we controlled for the difficulty of the required calculations, and for the number of letters in the names of the variables i. The numerical values used in consistent and inconsistent problems of each word problem type were matched for magnitude see Van der Schoot et al. This test is part of the standard Dutch CITO pupil monitoring system and is designed to determine general reading comprehension level in elementary school children. This test consists of two modules, each involving a text and 25 multiple choice questions. The questions pertained to the word, sentence or text level, and tapped both the text base and situational representation that the reader constructed from the text Kintsch, Follow-up tests were performed using paired sample t-tests. According to Pierce et al. These difference scores reflect the differences in performance between the consistent and inconsistent word problem types, and can be taken as a measure of the extent to which students are able to construct a mental representation of the described problem situation. The lower the difference score, the less word problem solvers suffer from the inconsistency. The correlations were first calculated for the less successful and successful word problem solvers together, and then, to test the third hypothesis, for each of these groups separately. Our approach deviates from, but provides an important advantage over, the study by Van der Schoot et al. That is, the results obtained by Van der Schoot et al.

Chapter 9 : The Secret to Solving Word Problems. Hint: It's Not about Math | Mindprint Learning

I know I talk about problem solving and word problems a TON, but I wanted to share briefly today about possibly "rethinking" the term problem solving a little bit. If we are wanting students to be able to make sense of the mathematical world around them, word problems can certainly help provide "real world" contexts for applying math.

The Teacher Studio 8: If we are wanting students to be able to make sense of the mathematical world around them, word problems can certainly help provide "real world" contexts for applying math. My students solve word problems DAILY, and I am a huge believer in giving students a variety of rigorous problems to work on independently and collaboratively. If you are short of word problems, check out the zillions I have in my store by clicking on the "word problem" custom category on the left side of my store! Instead today I want to take a peek at a few phrases lifted directly from the Standards for Mathematical Practice--and even if you do not teach in a Common Core state, I am hopeful that you will embrace these 8 essential "best practices" for math instruction. Take a peek at these two phrases for just a minute. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. This is certainly not a "word problem" as we typically think about them Do you see what I mean? This problem is a perfect example of a problem that provides students with a ton of opportunity to apply what they know about math--without a word problem! I want to show you another way I try to help my students understand that problem solving is far more than simply solving word problems. Because I start the year reviewing the addition algorithm, finding a way to kick that skill up a notch--in a way that will challenge even my "gifted-est" students was a goal of mine a few years back I wanted something that would give TONS of math practice, have multiple solutions, be perfect to work on alone or collaboratively, have multiple levels, and need NO teacher assistance. Many of my top students come in not super used to struggling Let me show you what this involves. So that had to happen first. To a new color palette I am SO much happier now So what IS this, anyway? This is my "Mind Boggling Math" board The only "skill" they need is addition with regrouping--and perseverance! Students use this board--which can be displayed in your room or just handed out as a printable--and the numbers on the board are used for a variety of different problem solving tasks, each of which is differentiated. It takes a fair amount of work to solve them The second part of each activity is far more open ended and asks students to create their OWN solution,based on what they did on the first part. It asks students to think about addition in a far more sophisticated way! They need to estimate Trust me--there can be some pretty substantial frustration with some students! I love how we work as a class to talk about having grit and perseverance--and also how to support each other as we work through tricky learning situations. I do have a few students for whom these are still a little too much--so made a 2 digit version too and can make calculators available as a scaffold--that way they still get the problem solving experiences without the computation issues--I can work on the computation separately. See what you think! While my students work on this, I plan to pull them one at a time to do their fact interviews to help me get a handle on what they might need in terms of intervention in that area. If you want to try that freebie above, just click the image below. Here are the three Mind Boggling Math resources I have in my store What can YOUR students learn about persevering and problem solving?!