Helping Students With Word Problems

Schema-Based Instruction: Additive Schemas

What is schema-based instruction? Schema-based instruction teaches students to categorize word problems by the word problem's underlying mathematical structure and then use an appropriate solution strategy. One category of schema is additive.

How is it different from common instructional practice? Typical word problem instruction asks students to find keywords or identify word problems by an operation. Both approaches can mislead students because key words can represent more than one operation. Identifying word problems by a single math operation is problematic because word problems can usually be solved by more than one operation. Furthermore, multistep word problems usually require multiple operations.

Why should I teach schemas? Schemas support solving single- and multi-step word problems because students begin to recognize separate and distinct mathematical structures.

What will students learn? Students will be able to recognize schemas of word problems, translate the information into a visual representation or equation, and correctly solve for the missing information.

What should I avoid when teaching schemas? Don't tell students to look for key words. Don't tell students "This is an [addition/subtraction/multiplication] word problem."

What students can this help? Schema-based instruction can support typical learners, students with disabilities, and multilingual/English learners.

There are three kinds of additive schemas. Additive schemas involve addition or subtraction procedures. One additive schema is the **compare** problem. Compare problems are sometimes called *difference* problems.

Compare or **difference** problems are when two sets are compared for a difference. Students must find the difference, the greater set, or the lesser set.

💡 Student knowledge: Students need to know if they are solving for the difference, the greater set, or the lesser set.

Greater − Less = Difference

Difference unknown:	Greater set unknown:	Lesser set unknown:
• The small dog has 3 spots. The large dog has 7 spots. How many more spots does the large dog have than the small dog?	• Cy has 3 more pencils than Brody. Cy has 7 pencils. How many pencils does Brody have?	• Ava has 9 fewer points than Giovani. Ava has 2 points. How many points does Giovani have?
$7 - 3 = \bigcirc$	$7 - \bigcirc = 3$	$\bigcirc - 2 = 9$

Adapted from Powell & Fuchs (2018) & IRIS Center [https://iris.peabody.vanderbilt.edu/module/math/cresource/q2/p06/]

How do I teach this?

What should I do?	What does this look like?
Choose a schema to introduce to students.	"This is a type of problem called a compare problem. Let me show you why. "
Start with stories that contain all the information.	"Giovani has 11 points. Ava has 9 fewer points than Giovani. Ava has 2 points. We're comparing Ava's points to Giovani's points. We know the greater set (Giovani), the lesser set (Ava), and the difference between the numbers."
Show students how to translate the information for each schema into a visual representation or equation. Teach students to use language in the full context of the schema, not to rely on key words.	**Greater** − **Less** = **Difference** (Giovani's points) − (Ava's points) = (Difference) $11 - 2 = 9$
Teach students how to solve a word problem with an unknown quantity.	Enrique has 10 fewer points than Daniela. Enrique has 7 points. How many points does Daniela have?
Students need to: 1. Read the word problem. 2. Identify the schema. 3. Translate the information into a visual representation or equation. 4. Solve the problem.	"What kind of problem is this?" *Compare problem.* "How do you know?" *We're comparing Enrique and Daniela's points.* What do you know? *Daniela has more points, so Enrique is the lesser set. And we know the difference, which is 10. We don't know the greater set.* **Greater** − **Less** = **Difference** Greater (Daniela) − 7 = 10 $17 - 7 = 10$

Watch Dr. Sarah Powell introduce this additive schema.   ▶ https://youtu.be/V_d7cLP1MSk