

# Rationale

## Important Pedagogical Content Knowledge For Teaching Addition & Subtraction

This self-exam will encourage consideration of many nuances of teaching addition and subtraction. Each time a teacher models, illustrates and/or discusses a solution to one of these problems, choices are made about how to represent the problem and how to reason with the operations to solve the problem. The items in this self-exam will help teacher become more aware of their choices.

### Background

The knowledge teachers bring to a classroom is critical for student performance. Teachers with minimal understanding of curriculum content will be not be as effective as those with deeper understanding. But what content knowledge is important?

Being able to get the correct answer is not sufficient. Accurately representing concepts and reasoning strategies that are commonly used to solve problems is important.

Mathematics concepts used in solving problems are represented with:

- language,
- symbols, and
- manipulatives or models.

The context and actions in these problems sometimes helps determine an appropriate representation.

Suppose students are expected to solve:

...**a comparison problem that involves subtraction**. Some students might be confused if the teacher uses the language "take away," and proceeds to remove objects and count what is left.

...**a problem that involves a missing addend**. Some students might be confused if they decide to add on to see how many more, but the teacher uses subtraction to solve the problem with symbols.

...**a problem involving length**. Some students might be confused if the teacher represents the problem with discrete objects.

Similarly, each reasoning strategy can be represented by illustrating the step-by-step thinking with:

- language,
- actions with symbols or equations, and
- actions using manipulatives or models.

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The context and numbers involved in these problems sometimes helps determine an appropriate representation and an efficient solution strategy.

Suppose students are expected to solve:

**...a problem involving addition of two-digit numbers.** This is an opportunity for students to use a variety of different mental mathematics reasoning strategies. But some students might be left with the impression that counting on is a good way to solve these problems if they are encouraged to use discrete objects and draw a picture without an appropriate discussion about efficient thinking.

**...a problem that involves subtracting 13 - 8.** One student explains verbally, "Thirteen take away 3 is 10. Then take 5 more away to get 5." Some students might be confused if the teacher illustrates that thinking on a number line by starting at 13, then going back 3 to 10, then going back 2 more to get to 8. That's 5 less.

The choice each teacher makes to represent a problem and the reasoning strategy they use may be mathematically correct and allow them to get the correct answer, but the problem structure, the context, and the numbers involved may make the choice ineffective for some students. Situations like those described above occur much more often than what we would like. Teachers sometimes jump straight from the problem to a symbolic representation, then solve that without connecting it to the context of the problem. Other teachers simply do not think about representing a problem situation in a way that is consistent with the context of the problem.

If you are interested in examining the items and having your students/teachers take the self-exam, go to:

[thinkingwithnumbers.com](http://thinkingwithnumbers.com)

look for Teaching Resources

click on Important Pedagogical Content Knowledge For Teaching Addition & Subtraction

Depending on the device you are using, you may have to scroll down to see the Teaching Resources heading.