

PCK for teaching mathematics: Meaning of arithmetic operations

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Lee Shulman: Pedagogical content knowledge (1986)

Pedagogical content knowledge or PCK:

A “special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding”

What knowledge is needed to teach mathematics effectively?

- Mathematics content knowledge (at primary level, secondary level, etc.)
- Pedagogical skill / knowledge
- Understanding students' thinking
- Knowledge of representations connected with mathematics
- Variety of contexts which can be modelled using mathematics (meaning of numbers, operations)

Understanding the thinking behind errors

- Students frequently make errors. Why do they make these errors?
- e.g., Subtract 5 from 3.

What kind of situations are modelled by subtraction?

- Make two word problems involving subtraction in which the “meaning” of subtraction is different.

What kind of situations are modelled by addition?

- Make two word problems involving addition in which the “meaning” of addition is different.

Situations modelled by addition and subtraction

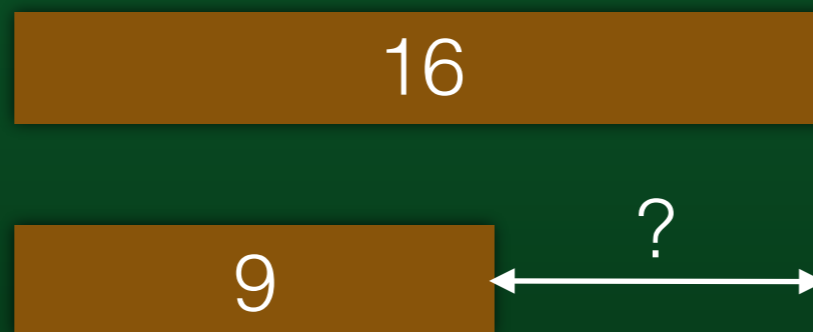
- Combine



- Change



- Compare



Different kinds of combine problems

- Make word problems involving “combine” situations in which the unknown is in different positions of the diagram.

Example from multiplication

- See the following problems. What do you notice?

$$\begin{array}{r} 0.3 \\ + 0.6 \\ \hline 0.9 \end{array}$$

$$\begin{array}{r} 0.3 \\ \times 0.6 \\ \hline 0.18 \end{array}$$

$$\begin{array}{r} 2.3 \\ + 1.6 \\ \hline 3.9 \end{array}$$

$$\begin{array}{r} 2.3 \\ \times 1.6 \\ \hline 3.68 \end{array}$$

What kind of situations are modelled by multiplication?

- Make two word problems involving multiplication of whole numbers where the situations modelled are completely different.

What kind of situations are modelled by division?

- Make two word problems involving division of whole numbers where the “meaning” of division is different.

Multiplication beyond whole numbers

- What kind of situations are modelled by multiplication (going beyond whole numbers).
- Are the same situations modelled also by division?

A student in the class had added fractions like this:
 $3/7 + 2/3 = 5/10$. Why do you think students add in this way?

When the teacher asked the student why she had done it in this way, the student said that her father had taught her. The teacher explained that this method was wrong. On the following day there was a complaint from the father. He pointed out that the teacher had added exactly like his method. This was his example, Marks in history: $35/50$. Marks in geography: $24/50$. Total marks in social studies: $35/50 + 24/50 = 59/100$.

How would you respond to the parent's criticism?

Can you construct a word problem (a situation based problem) for the following operation?

$$1\frac{3}{4} \div \frac{1}{2}$$

Will you accept this proof?

$$\text{Re } 1 = 100 \text{ p}$$

$$= (10 \times 10) \text{ p}$$

$$= (1/10 \times 1/10) \text{ Rs}$$

$$= 1/100 \text{ Rs}$$

$$= 1 \text{ p}$$

Thank you!

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