Pedagogical Content Knowledge: What we need to know to teach Mathematics?

Shweta Naik

22^{th} June 2018

Note:

- You have 15 minutes to work on the scenarios below.
- These scenarios are the classroom situations that we encounter often, today collectively we will understand how these situations can be handled; and what role content plays in it.

1. A student added two fractions as shown below

   $\frac{3}{7} + \frac{2}{3} = \frac{5}{10}$

   The teacher marked this response as wrong. The next day mother of the student arrived in the school and pointed out that her daughter followed exactly the same method that the teachers often use. She pointed that if marks in History are $\frac{35}{50}$ and marks in Geography are $\frac{27}{50}$, then the teachers also add them as $\frac{67}{100}$.

   How would you respond to this parent?

2. Imagine that you are teaching division of fractions. Look at the following problem:

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

   To make this problem meaningful to students design some real-world or story problems or sketch some diagrams that you think represent this division problem.

3. Ms. Shahenaz just finished teaching number divisibility to her students. She gave them various numbers to try and figure out divisors. For number 6177, the students said following:

   Zarine:
   6177 is divisible by 7 because sum of the digits of 6177 is 21 and that is divisible by 7.

   Aisha:
   The number is divisible by 7 as last two digits of this number are divisible by 7.

   Joseph:
   If the last digit of any number is divisible by 7, then the number is divisible by 7. Here 7 is divisible by 7, and therefore 6177 is divisible by 7.

   Tell us how would you respond to Zarine, Aisha and Mathew. Further, what can you tell them about the divisibility of a number by 7?

4. A student was asked to fill in the appropriate sign $<$, $>$ or $=$, in the following comparison of expressions

$$59 \div 42 \; \square \; 359 \div 342$$

A student said he would write the *equal to* sign because

$$\begin{aligned} 59 \div 42 &= 1 \ \textit{remainder} \ 17 \\ 359 \div 342 &= 1 \ \textit{remainder} \ 17 \end{aligned}$$

According to the student, in both the explanations the answer is 1 and the remainder is 17, and that is why they are equal.

How would you respond to this student?

5. Rashida teacher asked students to fill the following table for powers of 2. She imagined that students will understand the pattern and learn rules for zero and negative power.

Power	2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}
Expected students' responses	16	8	4						

To her surprise, the students did not discover the pattern as she expected. The students wrote $2^0 = 0$, $2^{-1} = -2$. When asked how did they arrive at this answer, one student said,

yesterday we learned that x^4 has 4 x's, cube of x has three x's, and square of x has two x's. So when you have x^0 doesn't that mean you have 0 x?

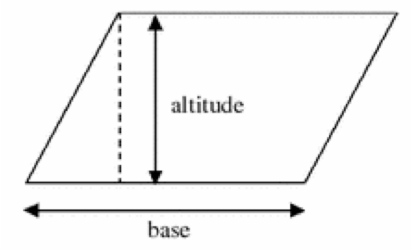
How would you respond to this student?

6. A student said, I do not understand why

$$(-1).(-1) = 1$$

Please outline as many different ways as possible of explaining this mathematical fact to your students.

7. The area of the parallelogram can be calculated by multiplying the length of its base by its altitude.



Sketch as many examples as you can of parallelograms to which students might fail to apply this formula.

8. When asked to describe inverse of trigonometric functions, a student gave following explanation:

> Just like numbers if you want to find the inverse of the function say $sinx$, you should multiply sinx by the multiplicative inverse (or reciprocal) $\frac{1}{sinx} = cosecx$. That way you get the identity 1, because $sinx \times \frac{1}{sinx} = 1$. One can follow the same procedure for the other functions as well.

How would you respond to this student?