Grade 6 arithmetical science lesson plan
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Research theme: Discuss a teaching method and materials on how to let any children find and create negative numbers through extracting necessity and inevitability of existence of the negative numbers.

1. Lesson title: "Where should we place 0?" Introduction of negative numbers

2. The main point of this practice

(1) Actual introduction and problems of positive and negative numbers at grade 7 (grade 1 at Japanese lower secondary schools).

Generally in Japan, teachers use the negative temperature symbol "-" to introduce negative numbers. Then children learn how to use the number line to express east-west transportation from a base point 0 with positive and negative numbers. Through this challenge children have to understand that 0 does not mean an empty space and each of them can place their 0s on their number lines. They also have to realise that the left side of the 0 are negative numbers and the right side of the 0 are positive numbers.

It might be easy for the grade 7 students to learn negative numbers through above procedure. But teachers give definitions and the symbol of negative numbers and they show the number line must have the base point 0. I do not think this teaching and learning approach is suitable for children; children's curiosity, finding and creativity are neglected.

(2) Finding base point 0 to perceive the existence of negative numbers through necessity and inevitability

This lesson plan applies inflexibility of a primary arithmetic subtraction rule to extract learners' curiosity. In Japanese primary schools, children learn positive rational numbers.

If we have two positive numbers: **a**, **b** and **a > b**. The following expressions are meaningful and children can make calculations.

a + b, **b + a** (addition), **a x b**, **b x a** (multiplication), **a ÷ b**, **b ÷ a** (division)

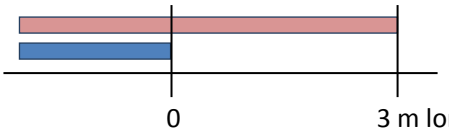
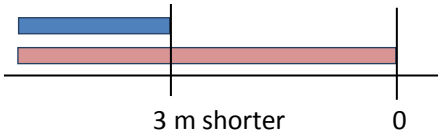
But only subtraction is an exception. An expression **a - b** is meaningful and calculatable but a swapped expression **b - a** is not calculatable for children under Japanese primary arithmetic curriculum because the answer is negative number. If we deliberately let children encounter this inflexibility, they might think this is curious and intentional. When you ask children the value difference between **b** and **a**, they can answer instantly. We can let the children to express **b - a** using number line and "Where should we place 0?" becomes necessary. If children can place 0 properly, they will be able to find the existence of numbers less than 0.

(3) Tools

A 2m tape  A 5 m tape 

(Please use a 20 cm long blue magnet tape and a 50 cm long red magnet tape.)

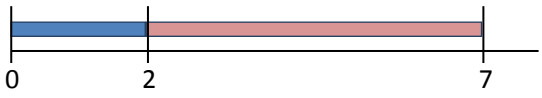
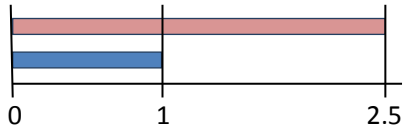
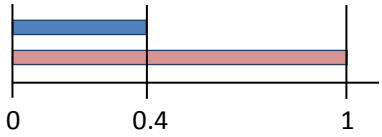
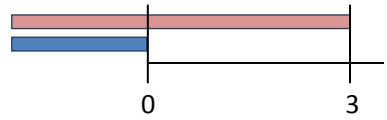
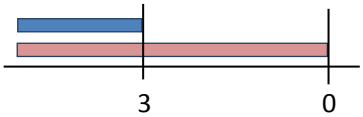
What is the length difference between two tapes?

• 5 m - 2 m case	• 2m - 5m case
	
If we define 2m as 0, the 5 m tape is 3 m longer than 0.	If we define 5m as 0, the 2 m tape is 3 m shorter than 0.

3. Objectives of this practical

- Through comparing to addition, division and multiplication, let children to find a subtraction expression which has small value minuend than the subtrahend is not meaningful.
- Let the children understand the position of 0 on the number line and notice that the existence of numbers which are less than 0.

4. Procedure of this practical

Flow of children's learning	Remarks
The teacher shows children a 20 cm long blue magnet tape written 2 m , and a 50 cm long red magnet tape written 5 m Teacher: Let us make some calculations using these two tapes. Children: Connect the 2 m tape and the 5 m tape. 2 + 5= 7 Teacher: Express the answer (a 7 m tape) using the tapes.  Children: We can swap the tapes. 5 + 2 = 7 Children: The 5m tape is 2.5 times longer than the 2m tape. 5 ÷ 2 = 2.5  Children: We can swap them again. 2 ÷ 5 = 0.4  Children: A rectangle, 2 m wide and 5 m long, has an area of 10 m^2. 2 m x 5 m = 10 m^2 Children: We can swap them again. 5 m x 2 m = 10 m^2 Children: The 5 m tape is 3 m longer than the 2 m tape. 5 - 2 =3 Children: The length difference between 5 m and 2 m is 3 m. Teacher: Where is 0 on the number line? Children: If we define 2 m as 0, 5 m tape is 3.  Teacher: Can we swap then again? 2 - 5 = ? Children: The expression "2 - 5" does not exist. Teacher: Aren't we able to swap the tapes? What does "2 - 5" mean? Children: The length difference between the 2 m tape and the 5 m tape. Teacher: Do we know the value difference between them? Children: The value difference is 3 m. Teacher: The answers of "5 - 2" and "2 - 5" are same, aren't they? Children: These different expressions must have different answers. Teacher: Can we describe "2 - 5 = ?" using the number line? Teacher: Where should we place 0 this time? Children: If we place 0 at the end of the 5 m tape, the 2 m tape is 3 m shorter than 0.  Children: The answer of "2 - 5" is 3 less than 0.	• We can use magnet tapes to visualise the questions and explanations. • Each time we use the number line, ask children "Where is the 0?", "Where is the answer "7?" to enhance children's thinking. • Keep on asking children to think about the swapped expressions. Let the children consider whether the swapped expressions are meaningful or not. •We cannot express the result of multiplication using the number line but let children to confirm the swapped expression is meaningful. • Let children confirm subtraction does not have the swapped expression to extract curiosity. • The similarity between "2 - 5" and "5 - 2" is the value difference of "3". Teacher should intentionally make a mistake like "The answer of 2 - 5 = 3." This intentional wrong answer might ignite debate among children. • Ask children the position of the 0 and let them find 3 exists left side of the 0.