

Research theme: Research on active learning prevention of current arithmetic lessons through a model lesson for introduction of ratio, which aims to conduct active learning

1. Lesson title: Active learning through comparing long leg robot drama posters (Learning unit: ratio)

2. Research subject and materials

(1) Research subject

The Central Council for Education of Japan advised that active learning should be independent-cooperative learning to find out and solve the learning assignment in November 2014 (regarding curriculum standard of primary and secondary education). We can pick up key words such as independent (positive learning), cooperative, active and exploration. Active learning should be imagined as arithmetical activities in arithmetic lessons because the activities are assorted independent-objective aware-pupil centred activities related to arithmetical assignments. The types of the activities are operational-experiential, research based, exploratory, application of pupils' thinking, expansive-applicable activities and so forth.

In 1998 and 2008, the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) revised the Guidelines for the Course of Study and kept on emphasizing that such arithmetical activities should be conducted in primary schools. Why has MEXT modified the name of the learning approach to "Active learning" and started recommending teachers to conduct? As the reason of this MEXT advice, we might assume that active learning is not common in Japanese primary schools. Through this research, we would like to discuss why arithmetic lessons are not active and what are preventing the lessons from being dynamic.

(2) Lesson materials

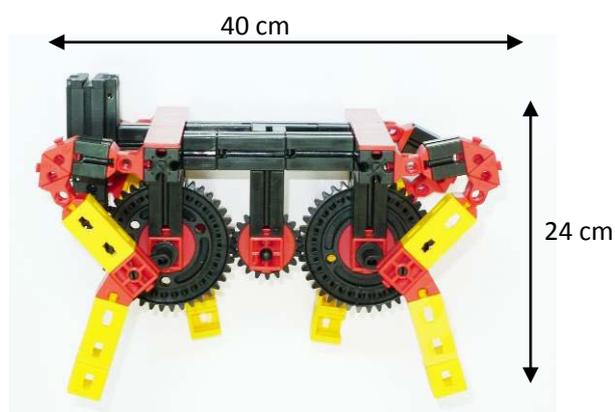
When we compare two different values in our daily lives, we generally use the difference. Comparison by times are commonly used when the difference between two values are expressed like two times bigger (longer), three times bigger (longer) and a half times bigger (longer). Comparison using times is not common in our everyday lives. Teachers are demanded to teach that a **ratio** is a relationship between two numbers indicating how many times the first number contains the second. We can intentionally show extremely wrong comparison samples to let the pupils find out the concept of the ratio.

Let us assume that a primary school class intends to play a drama. A long leg robot appears in the drama. In order to advertise the drama, three groups of the class drew the drama posters. Each of them has the robot image on it. Let us check which poster can show the robot leg length correctly.

We can give above assignment to this research model lesson class and let the pupils think how to compare the body length and the leg length of the robot.

The long leg robot

Body length	40 cm
Leg length	24 cm



Images of the robot on the actual posters

	Group 1	Group 2	Group 3
Body length	50 cm	50 cm	50 cm
Leg length	24 cm	30 cm	34 cm
Robot image			

This question gives pupils an opportunity to find out same ratios. Group 2 drew the robot image with the leg length to the body length ratio 0.6 to 1. The group 2's ratio is same to the original ratio of the leg length to the body length. Group 3 robot image has the 16 cm length difference between the body length and the leg length. After pupils realise each group's drawing plan, let the pupils discuss which poster can show the robot leg length correctly.

The research model lesson teacher can intentionally introduce debate like "The difference between the body length and the leg length is 16 cm. If the difference must be always constant, a 100 cm long body robot has 84 cm long legs." We should expect the learners can find out a new comparison style beyond the difference.

We can also introduce how to use proportional estimation.

Group 2 robot body length: 50 cm, Original robot body length: 40 cm

$50 \div 40 = 1.25$ (The group 2 robot image has 1.25 times longer body length than the original robot.)

The length of the legs must be 1.25 times longer.

$24 \times 1.25 = 30$ (cm)

Then we move on to next step.

If we multiply the original body length by 2, the body length is 80 cm and the leg length is 48 cm.

If we multiply the original body length by 3, the body length is 120 cm and the leg length is 72 cm.

After each calculation we have to confirm the followings.

Original robot, Leg length \div Body length: $24 \div 40 = 0.6$

Group B robot, Leg length \div Body length: $30 \div 50 = 0.6$

80 cm long body robot, Leg length \div Body length: $48 \div 80 = 0.6$

120 cm long body robot, Leg length \div Body length: $72 \div 120 = 0.6$

Each robot's leg length to body length ratio is 0.6 to 1. These robots' leg lengths are 0.6 times longer than the body lengths. To find out the same value is important to understand the concept of the ratio.

3. Objective and teaching plan of the unit (11 lesson hours)

(1) Objective

- Pupils will be able to understand the meaning and usage of ratio and percentage. They will be able to apply the ratio concept to solve the questions.

(2) Teaching plan

- 1) 2 hours, Meaning and usage of the ratio (This lesson plan is the first lesson)
- 2) 3 hours, Percentage
- 3) 4 hours, How to apply percentage to our daily life
- 4) 2 hours, Review and exercises

4. Teaching of this lesson

(1) Objective

- Pupils will be able to use ratio (times) to compare objects instead of using difference.

(2) Lesson development

Major Learning activity	Remarks												
<p>1. Let us check which poster can show the robot leg length correctly.</p> <p>Teacher (T): (Show the actual long leg robot to the class.) The body length of the robot is 40 cm and the leg length is 24 cm. (Show actual posters to the class.) Which poster can show the robot length correctly?</p> <p>Child or Children (C): The group 1 robot's leg lengths are less than a half of the body length. They are too short and not correct.</p> <p>C: I think group 3's poster is correct because the length difference between the body and the leg is 16 cm. The original robot has the same difference.</p> <p>C: I think group 2 drew the robot correctly. $30 \div 50 = 0.6$ The leg length is 0.6 times of the body length. This is same to the original robot.</p> <p>2. Discussion on comparisons using the difference and the ratio</p> <p>T: We have two styles to compare objects. One is using the difference and another is using times.</p> <p>C: If we can use the length difference to draw the robot correctly, a 100 cm body length robot must have 86 cm long legs. It does not show the correct image of the original robot.</p> <p>C: If a robot body is 20 cm long, a leg must be only 4 cm long.</p> <p>C: If we apply the idea "The leg length is 0.6 times of the body length", the 100 cm long body robot has 60 cm long legs and the 20 cm long body robot has 12 cm long legs.</p> <p>3. Review the usage of the comparison</p> <p>C: Using the original robot's design, we divided the leg length by the body length and the answer was 0.6. We found a correct image using this value.</p> <p>T: The value 0.6 is called the leg length to the body length ratio.</p>	<ul style="list-style-type: none"> • A primary class is going to play a dram. In order to advertise the drama, three groups of the class drew posters, on which the main character "Long Leg Robot" is drawn. • Keep on talking with the children; show the class the images of the posters and lengths of the robot body and legs drawn on the posters. <table border="1" data-bbox="810 629 1422 736"> <thead> <tr> <th></th> <th>Group 1</th> <th>Group 2</th> <th>Group 3</th> </tr> </thead> <tbody> <tr> <td>Body length</td> <td>50 cm</td> <td>50 cm</td> <td>50 cm</td> </tr> <tr> <td>Leg length</td> <td>24 cm</td> <td>30 cm</td> <td>34 cm</td> </tr> </tbody> </table> <ul style="list-style-type: none"> • Prepare a piece of paper to draw a 100 cm body length robot on it. Let children think about the length of the legs of the robot. Use Group 2 style and Group 3 style to determine the legs length. • Teach children that a ratio is a relationship between two numbers indicating how many times the first number contains the second. Let the class confirm that we used the concept of the ratio to find out the correct robot drawing. 		Group 1	Group 2	Group 3	Body length	50 cm	50 cm	50 cm	Leg length	24 cm	30 cm	34 cm
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