June 29

Grade 5 Mathematics Lesson Plan

June 29, 2012 Period 5
Grade 5 Classroom 4; 39 students
Teacher: TAKAHASHI, Takeo

1. Name of the Unit: Let's investigate solid figures

2. Goals of the Unit

- Students will try to investigate properties of cubes and cuboids (rectangular prisms) based on their previous study of geometric figures. [Interest, Eagerness, and Attitude]
- Students will think about properties of cubes and cuboids by focusing on constituent parts of solid figures. [Mathematical Way of Thinking]
- Students will be able to draw nets of cubes and cuboids. [Mathematical Skill]
- Students will know the numbers of edges, vertices and faces of cubes and cuboids. In addition, students will understand the parallel and perpendicular relationships among faces and edges. [Knowledge and Understanding]
- Students will understand the concept and properties of prisms. [Knowledge and Understanding]

3. About the Unit

Students have been studying about the basic solid figures. In the Grade 1 unit, "Let's Play with Shapes," students examined solid figures intuitively through observations and investigations of the features of concrete materials. In Grade 2 unit, "Shapes of Boxes," students discovered relationships between plane figures and rectangular prisms by copying the faces of boxes and building boxes using rectangles and squares. They have also explored properties of cubes and cuboids by focusing on their constituent parts of faces, edges and vertices.

In this lesson, students will first clarify the concept of cubes and cuboids by observing the shapes of faces in cubes and cuboids. Then, they will deepen their understanding of the characteristics of cubes and cuboids. As students examine cubes and cuboids, it is natural for them to notice perpendicular and parallel relationships of faces and edges. Therefore, this lesson will also enrich students' spatial sense.

With respect to cubes and cuboids, students have learned about their sketches and nets, parallel and perpendicular relationships of faces and edges, and their constituent parts. In addition, students have learned that there are 11 different nets of a cube.

In this lesson, based on students' previous study, students will think about the reason why 7 edges must be cut in order to open a cube into a net. I believe that students' understanding of the constituent parts of cubes will be deepened by thinking about the reason why the number of edges to be cut to open a cube must be 7. What follows are anticipated students' reasoning.

[Solution 1] Figure 1 shows a result of cutting open a cube. This net is composed of 6 squares, and by connecting these 6 squares at 5 appropriate locations, a net of a squares we can make different nets of a cube. For these 5 locations, 10 of the 24 sides of the squares are used. Therefore, there are 24-10=14 sides are left. Since each pair of these 14 sides will form an edge of a cube, 14 ÷ 2 = 7 is the number of edges of a cube that must be cut to open a cube.

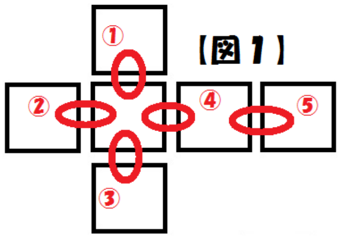

Figure 1

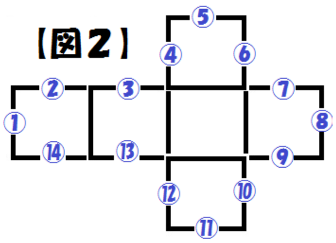

Figure 2

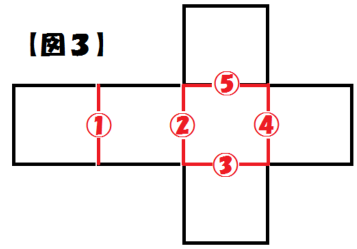

Figure 3

[Solution 2] I anticipate many students will use this reasoning. When a cube is cut open, it will match one of the 11 possible nets of a cube. In these nets, as shown in Figure 2, there are 14 sides of squares that will become edges of a cube when the nets are folded to make a cube. These 14 sides will be paired up to make edges of a cube. Therefore, the answer is 14 ÷ 2 = 7. The main difference of this solution from Solution 1, is the question, whether or not there will always be 14 sides of squares will be left unconnected. However, this question may be answered by focusing on the relationship between the number of items in a line and the number of spaces in between.
[Solution 3] This reasoning may be as popular as Solution 2. There are 12 edges in a cube. Of those edges, 5 edges still remain in a net of a cube. Therefore, the answer is 12 - 5 = 7.

4. Relationship to the Research Theme

The mathematics group has set this year's research theme as "nurturing students who can think on their own, express their ideas, and learn from each other." We have been focusing on the aim of developing "mathematical ways of thinking" in our students and conducting *kyozai kenkyuu* with "coherence of content" in mind. In addition, starting this year, we began to focus on students expression using diagrams such as number lines. By doing so, we want to attempt to develop students "mathematical ways of thinking" as they learn from each other. With this research in mind, we will briefly discuss the idea of "ability to deepen own understanding and give an account of own ideas" that relates to the research theme.

○ About "ability to deepen own understanding and give an account of own ideas"

In the mathematics group, by "giving an account of own ideas," we are imagining a student going back and forth between "what I am thinking" and "diagrams representing my thinking" as necessary while explaining his or her own thinking.

Thus, "deepen own understanding and give an account of own ideas" means for students to renew and modify what they have learned previously while explaining their ideas using those contents. For example, think of the various properties of operations. At first, they are just knowledge, for example, if the divisor becomes 10 times, the quotient will become 1/10. However, while studying the division by decimal numbers, this idea becomes an important method to transform the divisor into whole numbers (which they have previously learned). Or, in the situations involving inversely proportional relationships (constant product, i.e., □×△=A), this property may be considered as the reason why an quantity becomes 1/10 as much when the other quantity becomes 10 times as much. In other words, we consider students' understanding is "deepened" whey they can use an idea in a context that is different from the context in which the idea was learned originally. Therefore, perhaps we can say that to "deepen own understanding and give an account of own ideas" in mathematics means that students can "use what they have learned previously as appropriate in situations and make coherent explanation with conviction."

Furthermore, with respect to the four perspectives on "research methods" suggested by the Research Committee below, we will focus on the first two ideas.

◎ Designing a learning environment in which students will feel a desire to or a necessity to think.
◎ Designing a learning environment which may promote thinking that will be connected to real life situations.
○ Designing a lesson that can deepen students' understanding
○ Ways of expressing ideas.

This is because we believe that students will learn to ask questions if they are placed in situations where they feel they want to think, or they must express their thinking, and if everyone in the situation, including the teacher, learn from each other. Furthermore, in such situations, students will be solving problems using what they have learned previously, in other words, it is a real-life situations.

5. Unit Plan (1 lesson)
Topic Lesson 1 lesson (Today's lesson is 1 of 1)

6. Instruction of the Lesson
(1) Goal of the Lesson

○ Students will deepen their understanding of characteristics and properties of cubes by examining and understanding the reason why 7 edges must be cut in order to open a cube into a net.

(2) Flow of the Lesson

Step	Anticipated students' actions	○ Points of considerations ☆ Evaluation (Evaluation method)
Grasp	Show a cube and 2 or 3 different nets of a cube for demonstration. How many edges of a cube do we need to cut to open it to be a net? • 6 edges • 7 edges • 8 edges	○ Do not let students actually cut open a cube. ○ Remove the nets once students understand what it means to open a cube.
Plan	● Actually verify. • It looks like we need to cut 7 edges always.	
Explore	We discovered that if we cut 7 edges of a cube, we can open it to make different nets. Why do we always have to cut 7 edges to make any net?	

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<td>Sharing & Discussion</td>
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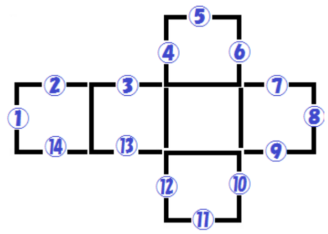
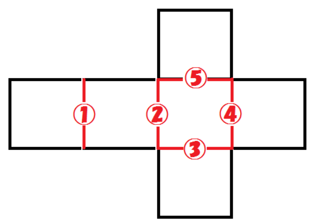
● Please explain why you think we need to cut 7 edges. (After students wrote their ideas in their notebooks, have them share their ideas.)

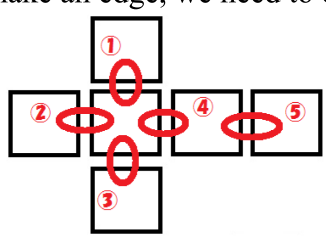
- It's because I tried to imagine opening a cube in my head.
- When we fold a net to make a cube, 2 sides from 2 squares will match up to make an edge of a cube. Since there are 14 sides in a net (along the perimeter), we will need to cut 14 ÷ 2 = 7 edges.



- In a cube, there are 12 edges, but 5 of them are still left intact in a net. Therefore, 12-5=7 edges must be cut.



- A net of a cube is made up of 6 squares. In 6 squares, there are 24 sides, but we need to use 10 of them to connect the squares to make a net because 2 sides from 2 square together will make an edge of a cube. So, if we take away 10 from 24, we know that there are 14 sides of the squares are still left. Since 2 sides make an edge, we need to cut 14 ÷ 2 = 7 edges.



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○ While students are writing their ideas in their notebooks, monitor their ideas and think about the order in which the ideas are to be shared.

☆ Are students thinking about the number of edges to be cut with their own reasons? (Notebooks, oral presentations)

☆ Are students making connections to the number of faces and edges of a cube? (Notebooks, oral presentations)

○ As students cut open the cubes they made themselves. tell them to think carefully so that they will not end up with the same net.

○ To make it easier to see how sides of the squares in a net will match up to form an edge, have a permanent marker to mark the sides.

○ Depending on how the lesson plays out, ask students how many edges of an octahedron must be cut to open it to make a net.

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<td>Summarize</td>
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- Write a journal entry.

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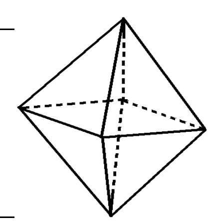

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