Sweets Arithmetic Online Study. Make Sweets with Eyes, Ears, Nose, Mouth, Hands and Head.

Ueno Mayumi
Home-education-laboratory, Japan

Abstract

Even in Japan, the online education is progressing at a rapid pace due to the covid-19. Online content with learning effect is required. Is there any online content that anyone can easily view?
Since eight years before, I have been holding a classroom for elementary school students to make sweets and to teach arithmetic related to it. Making sweets uses arithmetic, such as thinking about procedures, measuring ingredients, and thinking about proportions. For example, I will introduce the arithmetic of banana cake . "The recipe is for four people. If two more your friends are coming and you want to make a banana cake for six people. How do you calculate the quantity? " . The students who are hard to think in school arithmetic lessons start thinking positively. Because they want their two friends to eat the banana cake they made. So the students tend to like arithmetic because of recognizing that it is useful as well as remembering the delicious taste of sweets. I have made a workbook for six sweets arithmetic studies: banana cake, tart, Japanese rice sweet, ball cake, cream puff, and madeleine. In this paper, I would like to show how to connect sweets making with arithmetic learning.

Keywords arithmetic, sweet, online lessons, feltball math

1. Introduction

I have been teaching high school math for a long time. Looking at the process of students' understanding of mathematics, I found that it was difficult to accept ideas that they had never experienced. Therefore, I wanted to give elementary school students various math experiences, so I combined sweets making and arithmetic experiences. After the hands-on experience of making sweets, the children came up with good ideas when they did arithmetic problems related to it. The good aroma of baking sweets may have played a role. I will introduce six sweets menus and related arithmetic concepts.

2. Banana cake and ratio concept

The ingredients for the banana cake are 100 g of butter, 200 g of bread flour, and 150 g of sugar for four people. Children who are not accustomed to the digital scale do not know how to use it at first, but as they go along, they gradually get used to it and sensuously remember how much 150g or 200g is. In addition, when cutting butter, it is possible to consider the ratio from the total amount and cut it with a rough examination. Making rough predictions is a very important task in arithmetic learning. Ask

arithmetic problems while baking a banana cake, "The banana cake you are just making is for four people, but you want to make it when your grandpa and grandma come. How can you calculate it to make it for six people?" This can be solved by considering the ratio of 4: 6, but children aged 7 and 8 have not yet learned in class. Children who still want to solve the problem try to think with felt balls side by side as shown in the Fig1. In the case of butter, four felt balls represent 100 g. So two felt balls represent 50g. Therefore, it can be intuitively understood that six felt balls represent 150 g. In the case of bread flour, four felt balls represent 200 g, so two felt balls represent 100 g. Therefore, it can be calculated that six felt balls represent 300 g. Since sugar is 150g for four people, it is a little difficult to calculate, but since they understand how to calculate it, they can calculate it by using a brush calculation or a calculator. By visualizing the concept of arithemetic with felt balls in this way, even small children can solve this arithmetic problem. Also, it may be easy to come up with a good idea because it has a nice scent of baking cake. The faces of the children who solved the problem are lively.

Fig.1.bananacake and ratio concept

3. Fruit tarts and costing

Tart is also popular with children. After all, its deliciousness is outstanding and the fruit toppings can be served freely. Children serve a variety of fruits such as strawberries, kiwis, oranges, pineapples and yellow peaches. Since this is an online lesson, some students live overseas and use fruits that are rare in Japan, such as dragon fruit, so it's interesting. Now let's talk about arithmetic. Tart is very expensive to buy at a cake shop. The task of this arithmetic is to calculate the cost of making it at home. For example, if you use one pack of strawberries, the cost will be the price of strawberries. The problem is about milk, butter and eggs. Because making a tart didn't use up the entire pack. In the case of milk, 1000 ml is contained in one pack. The amount used to make the tart is 400 ml. If one pack of milk costs 200 yen, how can you calculate the amount of milk it costs? Let's think about 10 felt balls side by side. If 10 felt balls represent 1000 ml, 400 ml corresponds to 4 felt balls. Now, let's think about the amount of money. If 10 felt balls represent 200 yen, one is 20 yen. Since I used 4 felt balls this time, the price of milk is 80 yen. Next, let's consider the case of butter. Butter is 400 yen per pack of 200g. The butter used to make the tart is 130g. So this time, you will think about 20 felt balls side by side. Twenty felt balls represent 200 g. On the other hand, it represents 400 yen. Focusing on the weight, one felt ball represents 10 g. Focusing on the amount of money, one felt ball represents 20 yen. Since 130g

was used to make the tart, it is good to calculate the amount of money for 13 balls. Therefore, it can be seen that the cost of butter is 260 yen. The total cost of strawberries, milk, butter and eggs is 1,060 yen. Tart can be cheaper than buying it. it's recommended.

Fig.2.Fruit tart and costing

4 Ichigo Daifuku and binary number magic

Do you know "Ichigo Daifuku" made from Japanese glutinous rice? It is a popular Japanese confectionery that wraps strawberries in red bean paste and wraps them in a mochi . Dissolving glutinous rice powder in water and heating it in a microwave oven gives it a smooth feel like mochi. The children were so pleased with the fluffy feel that they cheered. Add a decoration to Ichigo Daifuku to make it look like a rabbit. This is to do the binary number magic that the rabbit comes out. Binary number magic is a play that was played among the common people as a "Metsukeji" in the Edo period. The method of Metsukeji is that the performer guesses what the other person has chosen. In this case, you ask your friend to choose his favorite from the 12 Japanese sweets shown in Fig.3.

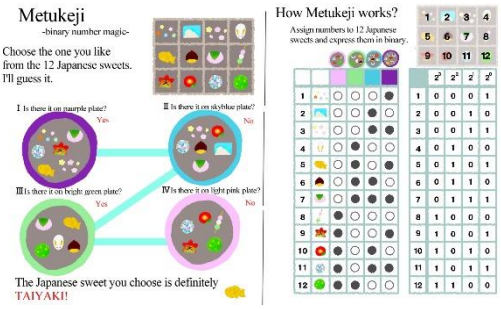

Fig.3.Metukeji

And you ask him if the sweet he chooses is on a purple plate, on a sky blue plate, on a yellow-green plate, on a pink plate.

With their answers, you can identify the sweets selected by him. This mechanism is as shown in Fig.3. Assign numbers 1 to 12 to Japanese sweets and express them in binary. The purple dish represents the 0th power of 2; the sky blue dish represents the first power of 2; the yellow-green dish represents the second power of 2, and the pink dish represents the third power of 2 . It represents the binary digit. Once this mechanism is understood, the children will also make their own Metsukeji. Some children are interested in how N-ary numbers work, which can be a developmental learning experience.

5 Ball cake and Fractional division

I wanted to make sweets like felt balls, so I proposed to children a ball cake in which the dough of the cake is baked with a takoyaki machine. In Japan, many households have takoyaki. Children enjoy the baked ball cake with various toppings such as chocolate and nuts.

This arithmetic is to visualize the calculation mechanism using felt balls. If you ask children to freely make mathematical formulas with 12 felt balls, they will actively work on them. In the lower grades, addition and subtraction are the main activities, and in the upper grades, division is also available. Ask them to represent 12 divided by 3 that each thinks. Then, as shown in Fig.4, Partitive division and Quotative division comes out. In the way of Partitive division is how many candies per person when 12 candies are divided by 3 people?

Quotative division is how many 3 candies is included in 12 candies. After explaining the difference between the two, let's think about the division of fractions. Now consider dividing 3 by a 1/4. In general, it is said that it is easy to think that fractional division is the way of quotative. Let's think how many 1/4 is there in 3? Here is a device. If 4 felt balls are regarded as 1, 12 felt balls can represent 3. Since one felt ball represents 1/4, the number of felt balls is the answer to this prpblem. Let's stretch out a little and try the way of partitive!As shown in the Fig.5, if three felt balls are divided into 1/4 person, the number of felt balls for one person is 12. It feels a little painful to divide a person into four.

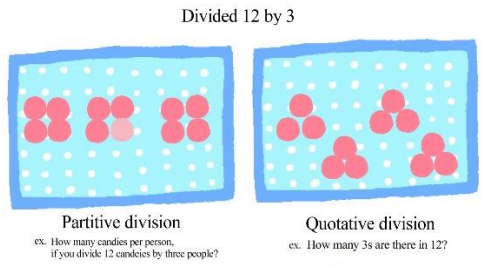

Fig.4. Divided 12 by 3

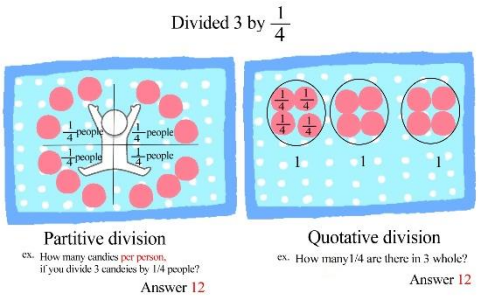

Fig.5. Divided 3 by 1/4

6 Cream puffs and discount calculation

Have you ever baked cream puffs at home? During online lessons, half of the students have choux pastry that does not swell, or even if it swells, it deflate as soon as it is taken out of the oven. That's right. Cream puffs are sweets that can make mistakes. Not only can you fail. you want to revenge again and again. That is the mystery of making sweets. People learn every time they make mistakes. Then, it is arithmetic. After finish you play shops and play with cream puffs you made. Then the customer says. "This shoe is crushed, so discount it by 20%!". Well, what's the 20% discount? The clerk is surprised in Fig.6. Now, let's explain about 20% by arranging 10 felt balls side by side. Percentage is to consider how much the part will be when the whole is 100.The weight, volume, area, amount of money, population, etc. are all the amount compared to 100. If the standard is 100, consider the amount occupied in it. Now, assuming that one felt ball is 10%, 10 felt balls represent 100%. So what kind of

quantity do you want to deal ,this time is about price of cream puffs. Is the price of one cream puffs 100 yen, 200 yen or 1000 yen? A 20% discount can be calculated for any price. That is the goodness of arithmetic. Let's say 200 yen per piece. If 10 felt balls represent 200 yen, one will represent 20 yen. With a 20% discount, this means two felt balls. A 20% discount of 200 yen is 160 yen by subtracting 40 yen from 200 yen. Let's take a discount calculation lesson for various amounts.

Fig6.Cream puffs and discount calculation

price ¥	discount rate	How much?
100	20%	80
200	30%	140
300	20%	240
400	30%	280
500	10%	450

Discount amout table

7 Madeleine and area of a circle

Madeleine's ingredients are sugar, butter, cake flour, all 130g and 3 eggs, which are simple ingredients. Moreover, it is surprisingly delicious. Therefore, it is always high in the children's sweets ranking. In fact, the most popular is ball cake. This is because ball cakes use unfamiliar buttermilk powder. The children were delighted to meet this unknown powder for the first time. Children love mystery. This arithmetic is about the area of a circle. Cut the madeleine into small pieces and rearrange them as shown in Fig.7. Then, what was a round shape becomes a square, and if you cut it into smaller pieces, make sure that it approaches a rectangle. This eventually evolved into an extreme idea. So, when I asked them to calculate the area of the rectangle, it was strange. Isn't it closer to the formula for the area of a circle? Wow, very mysterious. One of the way to invite children to the world of mathematics is to show the mysteries of the mathematics world. When doing this work, many children actually draw a circle on a piece of paper, cut it out, and rearrange it. Such an experience is very important.

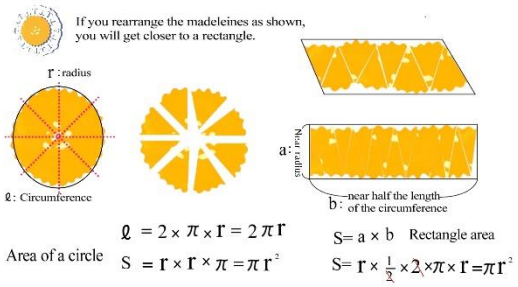

Fig.7. Madeleine and area of a circle

8 summary

Arithmetic is useful in everyday life. If you realize this a little when you are a child, the children may be willing to learn. Today, the world is in increasing demand for online content with learning effects. I hope this Sweets Arithmetic Study will become one of them, and I reported on my experience.

Reference

[1] Seymour Aubrey Papert ,"MIND STOARM",1995 published MIRAI(Japan)