OpenLearn Works

The Open University

TI-AIE

Comparing and contrasting tasks: volume and capacity

Elementary Maths

Comparing and contrasting tasks: volume and capacity

Contents

What this unit is about

'Compare and contrast' is an activity to make students aware of mathematical properties and their applications. It is effective for learning about subtle samenesses and differences. When you compare, you identify what is the same; when you contrast, you identify what is different.

Measuring is a skill that is used frequently in everyday life. For example: measuring the quantity of water to be added for cooking, the quantity of fuel to fill up your car, the length of cloth for a new dress, etc. Estimation is often used in many such daily measurements, for example: add *about* two cups of water, the car will need *about* half a tank of fuel, etc. In school mathematics *exact* measures and *correct* units are usually needed.

Capacity and volume are measurements related to three-dimensional objects which are often confused by students. In this unit you will think about helping your students to understand the similarities and differences between capacity and volume by using the teaching technique of 'compare and contrast'.

What you can learn in this unit

- How to use the 'compare and contrast' technique to help students notice mathematical properties.
- Some effective ways to teach the difference between volume and capacity.
- Some teaching ideas to promote understanding measurement of three-dimensional objects.

This unit links to the teaching requirements of the NCF (2005) and NCFTE (2009) as in Resource 1 and will help you to meet those requirements.

1 'Compare and contrast' tasks to learn about mathematical properties

'Compare and contrast' is a technique to make students aware of mathematical properties and applications. It is effective for learning about subtle samenesses and differences. When you compare you identify what is the same, when you contrast you identify what is different.

The actions of comparing and contrasting force us to think about the properties of mathematical objects and to notice what is the same and what is different. While doing so, students may make connections they might not normally consider. They are prompted into mathematical thinking processes such as generalising, conjecturing about what stays the same and what can change (called 'variance' and 'invariance'), and then verifying these conjectures. This is an example of the national curriculum requirements of helping students use abstractions to perceive relationships, to 'see' structures, to reason things out for themselves, and to argue the truth or falsity of statements.

Volume and capacity are properties of three-dimensional objects. Volume is the space that a three-dimensional object occupies or contains; capacity, on the other hand, is the property of a container and describes how much a container can hold. Students often get confused by these two concepts (Watson et al., 2013). Activity 1 will help your students to become aware of the characteristics and measurements of three-dimensional shapes. The activity also requires the students to start thinking intuitively about the difference between volume and capacity.

Before attempting to use the activities in this unit with your students, it would be a good idea to complete all, or at least part, of the activities yourself. It would be even better if you could try them out with a colleague as that will help you when you reflect on the experience. Trying them for yourself will mean you get insights into learners' experiences which can, in turn, influence your teaching and your own experiences as a teacher.

When you are ready, use the activities with your students and, once again, reflect and make notes on how well the activity went and the learning that happened. This will help you to develop a more student-focused teaching environment.

Activity 1: Exploring three-dimensional objects

- Ask your students to name any object that they have used during the previous day. As they name objects, write them on the black board. You will end up with a list of objects, e.g. glass, tube of toothpaste, plate, book, pen, pencil, coins, ruler, paper, bowl, knife, spoon, bottle, eraser, chalk, telephone, television, bucket, mug, towel, ball, etc.
- Once your students are done, circle some of these objects and ask them if they can find something that is common to all the circled objects. Choosing objects for which the students could easily estimate the three dimensions will save time.

Now arrange the students into small groups or pairs. Ask the students the following questions:

- For each circled object, estimate the following:

Table 1 *Estimating template.*

Object	Length	Width/breadth	Height
Glass			
Tube of toothpaste			
Book			
Pencil			
Coin			
Bottle			
Television			

- If all these objects were made of gold, which would be the most expensive (or least expensive)? Then, arrange these objects in the *increasing* order of their worth.

- In comparing the worth of each object above, which measurement was most useful? Why?

Ask the students to present their findings to the whole class. Not all students have to agree. As long as their reasoning is based on mathematical properties and on logic, then all arguments are acceptable.

Case Study 1: Mrs Meganathan reflects on using Activity 1

This is the account of a teacher who tried Activity 1 with her elementary students.

To get ideas for a list of objects the students had used the day before, I started with writing 'glass' and 'book' on the blackboard and said I had used these yesterday. Because asking them what objects they had used yesterday would be rather unusual for me to do, I thought it would help focus their minds.

They came up with lots of examples, which I wrote on the blackboard. To be honest, some of them would be really awkward and complicated to calculate the volume of, for example a bicycle! I could have left such examples on the blackboard for them to work with later in the activity but I was not sure how I would handle that as a teacher. So I said that I would now pick six of these objects, and picked the ones for which the three dimensions were easier to estimate. I think next time I actually will feel more confident in leaving the 'awkward' examples on the blackboard as well.

I put the students in groups of four or five – this I can do easily by asking every other row of students to turn around, so putting them into groups does not take too much time or hassle.

I drew the table on the blackboard as it says in the activity and wrote all the questions at once on the blackboard. I had been thinking whether to do that one step at a time but thought that having them all on the blackboard at once would:

- give the students an idea of how the activity would develop
- give more learning time to the students because they would not have to wait for others to finish each question.

This worked well, apart from at one stage, where I felt I was really running from one group to another to answer their questions, like 'How do we do this?' or 'What do we do next?' So I did stop the class after some time and said that if they had a question, please first check with the neighbouring group whether they knew. It became much more manageable for me after that!

The question about the worth of the object if it was made of gold did make them think about ideas to do with volume and capacity, without actually using those terms. The presentations and the discussions that followed developed these ideas further and proved very good scaffolding to lead to the thinking required in Activity 2.