



## Asking questions that challenge thinking: fractions

## Elementary Maths

# Asking questions that challenge thinking: fractions

## Contents

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What this unit is about	3
What you can learn in this unit	3
1 What's so difficult about fractions?	3
2 Developing an understanding of fractions	5

## What this unit is about

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In this unit you will think about how to introduce fractions to your students.

Some students can see fractions as a very difficult topic to understand. There are many reasons for this, but making sure that your students have rich and varied experiences of working with fractions will help them to develop their understanding.

In this unit you will explore the fact that a fraction only has meaning when looked at in relation to a whole, and consider how to help your students to get to know about different ways to read the symbolic representations of fractions.

Through activities you will also think about the value of asking your students interesting and challenging questions, of getting your students to ask questions themselves and talking about fractions.

## What you can learn in this unit

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- How to ask effective questions that are interesting and challenging.
- Some ideas to help your students construct their own understanding of fractions.
- Some ideas to help your students talk about fractions.

This unit links to the teaching requirements of the NCF (2005) and NCFTE (2009) outlined in Resource 1.

## 1 What's so difficult about fractions?

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One of the reasons fractions can seem so difficult is that there is a lot to understand. For example, half of something can be smaller than a quarter of something else. An example of this is 'half of six is three' and 'a quarter of sixteen is four'. So learning about fractions by folding pieces of paper or by dividing circles may mislead students, especially if the paper is always the same size. Students must be taught to ask 'A fraction of what?'

Developing an understanding of fractions is not so different from learning to understand other mathematical concepts. For example, very young children are offered many different experiences as they learn to generalise the concept of 'three'.

Despite being older when they learn about fractions, elementary students similarly will need a great many rich and varied experiences if they are to begin to develop a good understanding of fractions.

Many students will have had experiences that help them to develop some understanding of fractions. In her research, Nunes (2006) found that primary school students already have insights into fractions when solving division problems:

They understand the relative nature of fractions: if one student gets half of a big cake and the other gets half of a small one, they do not receive the same amount. They also realise, for example, that you can share something by cutting it in different ways: this makes it 'different fractions but not different amounts'. Finally, they understand

the inverse relation between the denominator and the quantity: the more people there are sharing something, the less each one will get.

## Talking fractions: using the language

Encouraging the students to talk about fractions and use the vocabulary will help them understand some of the difficult vocabulary associated with fractions. The questions you use should show the students how important the correct vocabulary is, so that everyone knows what is being referred to.

First, model some ways of talking about fractions and drawing attention to how words are used. Then focus on getting your students talking. The more the students use the words themselves, the more they will build their understanding of fractions. Asking the students to make up questions to ask one another is a good way to get them talking. Another way is to ask the students to explain the reasoning they used to arrive at their answers.

The first activity is for you to think about issues of learning fractions in your classroom.

### Activity 1: Thinking about your students learning fractions

Think about what your students need to know about fractions, and make some notes on the different ideas. Use your textbooks. If you have a multigrade class, you will need to think about what different students need to know about fractions:

- how to find out a fraction of a quantity
- what fraction one quantity is of another
- how to add fractions together.

For each of the ideas associated with fractions, write down how the vocabulary associated with those ideas and the way it is used to express ideas. For example 'half of ten' means 'divide 10 by 2', but it can also mean 'multiply 10 by  $\frac{1}{2}$ '. The students might also see  $\frac{10}{2}$ , which has the same outcome and is thus equivalent in meaning but which may also be expressed as '10 divided by 2' or '10 shared between 2 people'.

Think about some specific students in your class. What activities might help them to understand the different ways that fractions can be expressed and the different meanings given to those interpretations?

## 2 Developing an understanding of fractions

The second activity focuses on students physically representing the concepts of fractions. This is also called embodiment. You will ask them to use their bodies to represent mathematical ideas. If the students move themselves to make fractions of a whole, they will begin to develop their concept of what a fraction is and how they can work with fractions.

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 a learner's experiences, which can, in turn, influence your teaching and your experiences as a teacher.

### Activity 2: Physically representing fractions

#### Preparation

First create a space, and ask eight students to come to the front of the class or somewhere where the rest of the class can see them.

#### The activity

- Ask your students to arrange themselves into a rectangle.

- Ask someone else to divide the group into half.
- Reform the rectangle, then ask another student to divide the group in half in a different way.
- Ask the students what is the same and what is different about the new half of the group.
- Now ask another student to divide the eight students into quarters (fourths). Again ask whether there is a different way to do this division, and what is the same and what is different about the new way of dividing into quarters.
- Now change the number of students and go through the process above again. It may be that dividing into quarters is difficult but depending on the chosen number, continue asking for ,, and so on, until a fraction that cannot be done is reached. Ask the students why you cannot find that fraction of these students. Dividing one student into bits is not allowed!
- Ask the students to work in groups of 12. You could appoint a leader in each group to note down ideas if the class does not split evenly into groups of 12. Ask them to work out all the fractions they can divide 12 students into.



**Video: Using questioning to promote thinking**

## Case Study 1: Mrs Rawool reflects on using Activity 1

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

First, I invited eight students to come to the front of the class and to form themselves into a rectangular shape where the rest of the class could see them. I then asked student Anoushka to come and divide these eight students in half, which was easy to do.

I then asked the class if the group of eight students could be divided in half in another way. This proved to be a little challenging, as the students were used to mathematics questions having just one answer, so they wondered at first if Anoushka was wrong. They needed clarification about what 'different' meant here. Of course, whichever way they divided the students in half, there were always four students in each half. Since this was the answer I was looking for, I gave them time to talk about these ideas.

Next, I asked student Nita to come to the front and divide the group into quarters. This time the students were able to suggest different ways to achieve this, and they were happy there would always be two students in each part.

I then asked another group of students to come to the front, this time with six students. This time I asked them to divide themselves into half in two ways. I asked 'Do you always get the same answer?' 'Yes sir!' they said. Then I asked 'What other fraction can you divide yourselves into?' They tried to divide themselves into quarters but they could not, but what they did find was that they could divide themselves into three parts and discussed what this fraction was called.

I then put the class into groups of 12 and asked them what fractions they could embody in their groups. One group came up with twelfths, but most worked happily on halves, quarters, thirds and sixths.

## Reflecting on your teaching practice

When you do such an exercise with your class, reflect afterwards on what went well and what went less well. Consider the questions that led to the students being interested and being able to progress, and those you needed to clarify. Such reflection always helps with finding a 'script' that helps you engage the students to find mathematics interesting and enjoyable. If they do not understand and cannot do something, they are less likely to become involved. Use this reflective exercise every time you undertake the activities, noting as Mrs Rawool did some quite small things that made a difference.

