What's 25% of 48?

***Tony Attwood** investigates how the dyscalculic student can be expected to make sense of percentages*

It is estimated that fewer than half the adult UK population can work out percentage questions of the type at the top of this article. And yet being able to handle such maths is a pre-requisite of secondary school success. Which raises the question: if a large number of people who have no special needs in maths fail to grasp the finer points of percentages, what chance has the dyscalculic student got?

In fact, most dyscalculic students who follow a fairly simple programme in maths can learn all they need to know about such issues as shapes, fractions and percentages. But there is a pre-requisite; they have to be taught in a certain way. Whenever one works with dyscalculic students, there are three key factors that must always be kept in mind:

- **Multiple workings**. Never assume that after one run through the student has understood what's going on. And just because a problem can be solved on Monday, don't assume it will be on Tuesday
- **Multi-sensory approaches**. We ask students to work out loud, to write everything down in English, and write it down as a mathematical equation. Wherever possible, we also bring in shapes and counters which give a physical reality to the abstract maths
- **Everything proceeds in logical order**. Percentages are only introduced after fractions and shapes have been examined, and both of those come after a full mastery of the four basic functions of addition, subtraction, multiplication and division.


Tony Attwood

In our work with students we always use counters in four colours (red, blue, green, yellow) and go through various activities which establish that ten reds equal one blue, ten blues equal one green, and so on. The example below shows how this works when teaching percentages.

We start with a circle, remind the student that each blue counter is worth 10 reds, and get the student to put ten blues in the middle of the circle, establishing that there are the equivalent of 100 reds there. The student talks through the activity as we proceed, perhaps saying, "I've drawn a circle, and I am putting ten blue counters in the circle. Each blue counter is worth ten red counters." We then encourage the student to write down "10" and "ten" again, while saying them out loud.

Next, the student cuts the circle in half (this helps to show that the student has grasped "half", and if they haven't, we need to go back and revise that point). We then take the two sides of the circle and put them back to back to make sure they are equal, which again emphasises the meaning of half.

Now we have the problem of putting an equal number of counters in each of the two halves. How can we do that? The

answer, of course, is to put one in the left half and one in the right half, and to keep going until all are used up. Then we get the student to explain what's happened, pushing for the explanation that we have fifty reds in each half. Everything is written down.

Now we introduce the written convention. Each part of the circle has the equivalent of fifty reds in it, out of a total of 100. We can write this as: $\frac{50}{100}$

This follows on from earlier teaching that ½ means one out of two.

Now for the shorthand way of writing: we take the line across the middle and draw it as a computer slash, and put a "0" either side: hence %. We call it per cent, and it means out of 100. Thus, the student now writes 50% and "fifty percent" and says it and repeats that it means fifty out of 100. We take ten blue counters (representing 100) and remove seven, asking the student what is left as a percentage. If there's a problem we go back to 50%.

Next, we can turn to a square which is cut into four equal sections. The counters are allocated equally, with the last two blues being traded for reds so we can put 25 in each section. Since we started with 100, we can say that each section contains 25%. From here on, we can keep on working with shapes cut up in all sorts of ways. We can take a square, cut it in half, and then cut each half into fifths, to give ten equal units. Putting the blue counters down, we get one in each section, and so we have 10%.

Now we move on. We have been saying that each of our four equal sections of a square or circle contains 25 counters, and these 25 counters represent 25%. Let's remind ourselves of how else 25% can be written in maths. This, in fact, involves going back over the ground that we covered when "per cent" was introduced. 25% is in fact 25 out of 100 (the % represents the two zeros of 100): $\frac{25}{100}$

If we want to know the full number of counters we are going to have, we will have to say "25% out of 100". We already have 25% written as 25 over 100, but we still have to show that this is "out of an original selection of 100" so we have to multiply in the original 100.

The easiest way to start is through 50% of 100 which is $\frac{50}{100} \times 100$

Using the multi-sensory technique of writing this down, working it out, moving counters around and saying it, we get the answer, which is, of course, 50. But supposing we started not with 100, but with the number in our example: 48. What then? This is now easy to work out:

50% is still written in the same way as 50/100. The final "out of" number is changed, so our sum is $\frac{50}{100} \times 48$

Then it is back to the circle. We put four blue and eight red counters in the middle of one circle to represent the 48. In another circle we set out the 50% of 100 problem and ask the student what has to be done. The student follows the routine, saying and writing as always. Then back to our problem: 50% of 48 is, indeed, 24. 25% of 48 is 12.

The process is slow and repetitious and it is hard to work with more than three students at a time. It looks tedious, but it is not, because so many variant questions are available. And above all else, it works. S

Tony Attwood's book, *Maths for the Dyscalculic Pupil: Shapes, Percentages and Fractions*, is available from the publisher First and Best in Education. For details go to **www.dyscalculia.me.uk**