Why do we teach mathematics?
A professional development module

Overview

This unit addresses the question of why we teach mathematics and, in doing so, will explore what you believe mathematics is. The unit starts by looking at what mathematics is involved in a simple puzzle and then looks at different types of mathematical understanding as identified in an article by Richard Skemp and their place in the classroom. The unit closes by returning to the original question, by attempting to construct a definition of mathematics, and with some suggestions for further reading.

There are some large and challenging questions posed and the aim of this unit is not to provide you with definitive answers but rather to provide you with an opportunity to continue to develop the understanding and the answers that you already have.

Where are you now?

Individually for a minute or so then in pairs or small groups consider the question why do we teach mathematics? How do you answer the student who asks “why do I need to know about simultaneous equations?”

Take feedback from each pair or group.
Activity 1

Make a start on the attached mini Sudoku puzzles (handout 1). After a few minutes, individually at first and then in pairs or small groups, consider the skills that are involved in attempting a Sudoku. It may be useful to provide a list of possible skills such as:

- Representing
- Reasoning
- Selecting
- Analysing
- Justifying
- Eliminating
- Interpreting
- Calculating
- Proving
- Deducing
- Modelling
- Communicating

Many Sudoku puzzles come with a ‘disclaimer’ which says something like “there’s no maths needed to solve this puzzle, just problem solving and logical thinking”. In pairs or small groups discuss whether the Sudoku puzzle is a mathematical activity and, if so, what mathematics is involved.

Activity 2

Read the text on handout 2 taken from *Relational Understanding and Instrumental Understanding* by Richard R Skemp (first published in Mathematics teaching 77, 1976) and then, in pairs or small groups, give examples of relational and instrumental understanding in your classroom.

Activity 3

In pairs or small groups, considering both the Sudoku activity and the Skemp article, discuss the question: *What does it mean to get better at mathematics?*

Gather responses and consider what this suggests that the group believe mathematics to be.

Activity 4

In pairs or small groups cut out the cards on handout 3 and consider the type of understanding that the student on each card needs to work on to help them overcome their difficulty. How would you help them to achieve this?
Reflection

Consider the following quote from “Making Mathematics Count”, the report of Professor Adrian Smith’s Inquiry into Post-14 Mathematics Education (February 2004)

\[ \text{Mathematics provides a powerful universal language and intellectual toolkit for abstraction, generalization and synthesis. It is the language of science and technology. It enables us to probe the natural universe and to develop new technologies that have helped us control and master our environment, and change societal expectations and standards of living. Mathematical skills are highly valued and sought after. Mathematical training disciplines the mind, develops logical and critical reasoning} \]

Individually at first then sharing and refining your idea in pairs or small groups try to complete the sentence:

Mathematics is…

and consider how this might inform the answer from the year 11 student about why they need to know about simultaneous equations.

Implementing and continuing to learn

Individually complete the attached sheet (handout 4) giving strategies or ideas that you may use to continue your understanding of what mathematics is and why we teach it.

Further Reading

Making Mathematics Count

Mathematics and the mind gym

Don’t worry: you don’t need to know any maths to read this article; just problem solving and logical thinking!
Handout 1 - Mini Su Doku

Insert the digits 1, 2, 3, 4 so that every row, column and 2 x 2 box contains each of the digits only once

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1  4
4  3
  
4  1

1  2
4  

1  4
4  

1  4
4  

3  4
1  

3  
1  3

2  
2  1
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Handout 2 - Relational Understanding and Instrumental Understanding

Richard R Skemp

One of these is ‘understanding’. It was brought to my attention some years ago by Stieg Mellin-Olsen, of Bergen University, that there are in current use two meanings of this word. These he distinguishes by calling them ‘relational understanding’ and ‘instrumental understanding’. By the former is meant what I have always meant by understanding, and probably most readers of this article: knowing both what to do and why. Instrumental understanding I would until recently not have regarded as understanding at all. It is what I have in the past described as ‘rules without reasons’, without realising that for many pupils and their teachers the possession of such a rule, and ability to use it, was what they meant by ‘understanding’.

Suppose that a teacher reminds a class that the area of a rectangle is given by $A = L \times B$. A pupil who has been away says he does not understand, so the teacher gives him an explanation along these lines. “The formula tells you that to get the area of a rectangle, you multiply the length by the breadth.” “Oh, I see,” says the child, and gets on with the exercise. If we were now to say to him (in effect) “You may think you understand, but you don’t really,” he would not agree. “Of course I do. Look; I’ve got all these answers right.” Nor would he be pleased at our devaluing of his achievement. And with his meaning of the word, he does understand. We can all think of examples of this kind: ‘borrowing’ in subtraction, ‘turn it upside down and multiply’ for division by a fraction, ‘take it over to the other side and change the sign’, are obvious ones; but once the concept has been formed, other examples of instrumental explanations can be identified in abundance in many widely used texts.

Skemp, Richard R

*Relational Understanding and Instrumental Understanding*

*Mathematics Teaching 77 (1976)*
Handout 4 – Implementing and continuing to learn

Tomorrow
You might want to spend a few minutes at the end of the day thinking about a lesson or two and writing down what mathematics the students were engaged in during that lesson.

Next week
Spend a few minutes at the end of a lesson with students discussing what mathematics they feel that they’ve been engaged in during the lesson.

Next year
Consider ways in which you can try to ensure that all students you teach have a varied mathematical diet and thoroughly understand the diverse nature of mathematics.

Handout 3 - Cards for use with activity 4

A motivated Year 7 student who achieved level 4 at KS2 who is struggling with multiplying a 2-digit number by a 3-digit number

A motivated Year 11 C/D borderline student is struggling with multiplying a 2-digit number by a 3-digit number

A Year 8 student who is working at level 5 who is able to work out half of an amount and a quarter of an amount but cannot calculate a third of an amount

A Year 12 student who achieved a B grade at GCSE but is finding the algebra at A-level challenging

A demotivated Year 10 student who achieved a level 7 at the end of KS3 but who is likely to fall behind at KS4 due to a lack of effort and who thinks that “maths is boring”

A student who has a good grasp of their tables but who “can’t do division”