

Session Plan

Secondary Mastery Big Idea: Mathematical Thinking

This professional development module is one of a suite of six modules designed to introduce secondary maths trainee teachers to the NCETM's Teaching for Mastery 5 Big Ideas. Each module shares a rationale, key messages and at least one practical strategy suitable for novices to adopt. Together, the modules form an introduction to teaching for mastery for the novice.

Goals	To help trainee teachers (TT) to: <ul style="list-style-type: none"> <input type="checkbox"/> understand the what, why and how of mathematical thinking <input type="checkbox"/> consider some practical examples of how to provoke mathematical thinking <input type="checkbox"/> practise creating tasks that provoke mathematical thinking.
Starting points	TT will have seen the teaching for mastery diagram with the 5 Big Ideas in the Introduction module. They may have formed preconceived ideas of what it means to 'think mathematically'.
Materials required	PC & projector Whiteboard or flipchart & pens Group set of mini whiteboards & pens Sort cards for the session handout
Time needed	One – two hours (dependent on how many different task types TT are tasked with creating).
Room layout	Room layout should accommodate TT working in pairs and groups of four.
Suggested approach	Share Teaching for Mastery Framework (S2) and highlight that this session will explore Mathematical Thinking.

Starter (5 minutes)

(S3) Ask TT to discuss what they believe it means to 'think mathematically' (could use think – pair – share to structure).

Mathematical Thinking activity (10 minutes)

TT undertake a task (S4) whereby they are asked to generate examples in pairs for each of:

- Give me an example of a fraction that is equivalent to $\frac{2}{3}$
- Give me a really peculiar example
- Give me a general example

Once the task is completed ask TT if they feel they are 'thinking mathematically'.

Does it fit their definition from the starter task? Allow time for discussion.

N.B. This task is taken from the ATM book *Thinkers*. You may wish to share this from the book with your TT:

“Thinking about the peculiar can help with thinking about the general. To create more and more peculiar examples we need to double any number for the numerator and treble it for the denominator. For example 2 billion over 3 billion or 2×3.22 over 3×3.22 or 2π over 3π . In the classroom learners can compete to make the examples more and more peculiar – numerator and denominator can be integers, decimals, fractions, algebraic expressions...

From here it is a short step to an expression of the general: ‘2 times something over 3 times something is a fraction equivalent to $\frac{2}{3}$ ’ or ‘ $\frac{2x}{3x}$ is equivalent to $\frac{2}{3}$ for any value of x other than zero’.” (p.9)

Defining ‘Mathematical Thinking’ (5-10 minutes)

Share the NRICH definition (S5) and the key messages (S6), allowing TT time to read (key messages are on page 1 of handout). Share thoughts.

Practical application: card sort task (10 minutes)

We will explore the five task types created by Malcolm Swan and team that were created to provoke mathematical thinking.

The late, great, Malcolm Swan led a project that sought to design better learning experiences to foster conceptual understanding. The outcomes of this project were twofold. Firstly, five task ‘types’ were proposed to inform the design of practice tasks. Secondly, a suite of materials, called the Standards Unit: Improving learning in mathematics, were created that not only exemplified these task types for various topics but also described how they might be used with students – providing materials that are ripe for use as part of a learning episode. We can also use these five task types to create our own tasks.

Give TT card sets labelled T (task type), D (description) and E (example) and ask them to sort them.

Solutions

Task type (T)	T1	T2	T3	T4	T5
Description (D)	D5	D3	D2	D1	D4
Example (E)	E6	E2	E4	E1 & E3	E5

Practical application: create own (25 minutes)

In pairs, ask TT to choose one task type, do the example task and then create their own example. If TT require more worked examples, provide the Standards Unit resources for teaching for them to refer to (physically or via <https://spiremaths.co.uk/ilim/>). Share examples created by TT using a visualiser.

Becoming better thinkers (S8)

Challenge the misconception that only higher attaining students can learn to think mathematically. All students can – and must – be challenged and supported to learn mathematical habits of mind.

Optional additional tasks (S9) from NCETM Mathematical prompts for Deeper Thinking materials.

Ask TT to explore the question ‘Which is bigger: $3n$ or $n+3$?’ themselves, and then to discuss possible student responses.

Watch video ‘ $3n$ or $n+3$ ’ www.ncetm.org.uk/classroom-resources/secmm-mathematical-prompts-for-deeper-thinking-videos/

Use the associated PowerPoint slides (same webpage) as prompts to generate further discussion.

Summary

Returning to the key messages (S10), discuss in pairs how the five task types address these.

Close by encouraging TT to connect with the NCETM and their local Maths Hub (S11-12).

What TT might do next

Practise creating examples of each of the task types.