

#mathscpdchat 26 March 2019

What kinds of question facilitate mathematical learning?

Co-hosted by [Rob Smith](#) and [Chris McGrane](#) for [La Salle Education](#)

This is a brief summary of the discussion – to see all the tweets, follow the hashtag #mathscpdchat in Twitter

#mathscpdchat
TONIGHT - Tuesday, 26 March, 7-8pm

'On the board I drew this:'

I could find immediately only four different coloured pens, that were red, blue, green and yellow. So I invited a learner to come to the board and create some coloured tiles using only the four colours that we had. The learner coloured copies of the square in these ways:

'What can you find out?' I asked the class.

What kinds of question facilitate mathematical learning?

Co-hosted by Rob Smith and Chris McGrane for @LaSalleEd

nctm.org.uk/mathscpdchat

Some of the areas where discussion focussed were:

- that questioning is effective if it contributes to **focussing the pupil's attention appropriately**;
- recognising and **reducing the use of questions to control pupils** ... that they obstruct mathematical thinking ... e.g. 'We don't do that, do we?';
- establishing a **learning atmosphere in which all students are comfortable responding to, and asking, questions** ... all pupils knowing that whatever is said is said as a conjecture that they may later modify;
- probing questions that **provide opportunities for pupils to reason** and to reveal/demonstrate their reasoning;

- asking questions to **expose pupils' problem-solving strategies** ... e.g. 'Those of you who were initially stuck, what did you do to help yourselves?' ... 'Can you solve it another way?' ... 'What tells you to get started in this way?';
- asking questions with the aim of **revealing the extent of pupils' 'example spaces'** ... e.g. 'Give me an example of ... and another ... and another ...' ... 'Give me one that doesn't work';
- how questions that promote mathematical thinking often allow pupils to **make decisions about what to assume**, and to reflect on implications of the assumptions;
- questions that are **alternatives to 'Why?'** when the aim is to find out what a pupil understands ... e.g. 'Where did that come from?' ... 'How do you know?';
- using **'Ask me a question about ...!'** to prompt thought, and to reveal pupils' understandings and knowledge;
- **questions that provide opportunities for pupils to generalise**, and express generalisations algebraically;
- challenging pupils to **convince others**;
- **mathematical 'habits of mind'** (such as 'pattern sniffing', experimenting, visualising, conjecturing, ...) ... showing these 'habits of mind' by being mathematical in sight of, and with, pupils ... e.g. **'I'm seeing it like this ... how are you seeing it?'**;
- **avoiding** asking questions that cause pupils to try to **guess what's in the teacher's mind**;
- **pupils generating their own example-questions** ... e.g. by asking pupils ... 'What other questions would answering this question help you to answer?' ... 'Can you give me another question with the same answer?' ... 'Make up a more interesting question!' ... pupils making questions more challenging in various different ways ... e.g. 'How can you make a harder question than this one without just making the numbers harder?';
- **enculturing pupils into using (asking of themselves) particular questions to facilitate/make-more-mature their doing-of-mathematics** ... e.g. 'What do I know?', 'What do I want?', 'Can I simplify the problem first?' ... meta-questioning that encourages/enables pupils to reflect on what they have-done/are-doing/are-about-to-do;
- questioning to provide opportunities for pupils to reflect on their **emotions when they are doing mathematics** ... e.g. 'How did you feel when you were stuck ... and when it was sorted?';
- when pupils are 'stuck' encouraging them to **direct some questions at an object** (such as their ruler) ... because in articulating what is 'blocking' them pupils often become 'un-stuck';

- **asking questions in a way that makes the questions ‘open’** ... pupils understanding that there is not a single ‘right answer’;
- asking **questions about a particular question** ... e.g. ‘How challenging is this question ... at first, second and third look?’ ... ‘Does this question ask you to evaluate anything?’ ... ‘Do you agree that this is the question?’;
- using a visualiser to share pupils’ work ... asking **questions to generate pupils’ thoughts about, and discussion of, each other’s work** ... e.g. ‘Why do you think that I think this is a really interesting example?’;
- **interpreting ‘answers’ in ‘real-life’ contexts** ... for example, understanding implications of remainders when solving problems involving division (e.g. needing an extra bus to accommodate ‘remaining’ passengers);
- **categorising questions** ... e.g. questions that: probe assumptions, probe implications and consequences, probe reason and evidence, are about viewpoints or perspectives, are about questions, are about clarification;
- finding opportunities in lessons to ask ... ‘Is this **always true, sometimes true or never true?**’ ‘**What is the same, and what is different?**’ ... ‘**What would happen if ...?**’
- **expanding the meaning of ‘question’** to include any action or object that generates what someone regards as an ‘answer’!

In what follows, click on any screenshot-of-a-tweet to go to that actual tweet on Twitter.

An interesting ‘conversation’ of tweets, about pupils generating their own questions, and teachers ‘being mathematical’ in front of and with their pupils, followed from this tweet by [Gillian Mathewson](#):



including these from [Mr Allan](#) and [Gillian Mathewson](#):





Gillian Mathewson @gmathewson1 · 14h

My extension to this is to get them to make questions more challenging in different ways - so rather than just making the numbers more difficult, what else can you do?



Mr Allan @mrallanmaths · 14h

Can you come up with a question that looks dead hard but is actually dead easy? Can you come up with a question that looks dead easy but is actually dead hard?

these from [Rob Smith](#) and [Geoff Wake](#):



Robert J Smith @RJS2212 · 15h

Replying to @mrallanmaths @gmathewson1

Wonder if @geoffwake1 has any thoughts about students generating questions... #mathscpdchat



Geoff Wake @geoffwake1 · 14h

Well, I used this PowerPoint slide yesterday in our design conf.

So I'm certainly in favour of students asking questions - indeed, we should aim to encourage them to do so, and might consider we are failing if they don't

#mathsCPDchat

University of Nottingham

Mathematical habits of mind....

Students should be:

- Pattern sniffers
- Experimenters
- Describers
- Tinkerers
- Inventors
- Visualisers
- Conjecturers
- Guessers

Cuoco, A., Goldenberg, E. P., & Mark, J. (1995)

these from [Chris McGrane](#) and [Heather Scott](#):



Chris McGrane @ChrisMcGrane84 · 14h

I think it's really important that we model these habits of mind by being mathematical in front of our pupils and being mathematical with our pupils.

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Heather Scott @MathsladyScott · 14h

Yes, when working together I might say "I'm thinking this ... what are you thinking?" #mathscpdchat

these from [Heather Scott](#) and [Lee Overy](#):

 **Heather Scott** @MathsladyScott · 14h
#mathscpdchat I also like "I'm seeing it like this how are you seeing it." The sort of principle is to create an 'equal' conversation where we are learning together ... they are learning how to do the mathematics and I am learning how they are learning to do the mathematics

 **Lee Overy** @Lwdajo · 14h
Similar, "Can you tell me what I am going to write/say next?", or, "What am I thinking?" #MathsCPDchat

and these from [Heather Scott](#) and [Maths Locke](#):

 **Heather Scott** @MathsladyScott · 18h
I like asking "How are we going to get started? followed up with "what tells you to get started in this way? #mathscpdchat

 **Maths Locke** @mathsmuse · 18h
Replying to @MathsladyScott
I observed a teacher who followed that up with: those of you who were stuck initially but then got somewhere, what did you do to help yourselves?

Powerful question to expose strategies. #MathsCPDchat

(to read the discussion-sequence generated by any tweet look at the 'replies' to that tweet)

Among the links shared were:

[Questions and Prompts for Mathematical Thinking](#) which is an e-book from the ATM (Association of Teachers of Mathematics) written by Anne Watson and John Mason. The authors provide a collection of questions designed to tease out mathematical structures and concepts, together with a framework for generating your own effective questions and prompts. It was shared by [La Salle Education](#)

[Effective Questioning and Responding in the Mathematics Classroom](#) which is a very helpful article by John Mason (2010). It was shared by [Mary Pardoe](#)

[Thinkers](#) which is a book from the ATM (Association of Teachers of Mathematics) written by Chris Bills, Liz Bills, John Mason and Anne Watson. It is a source of inspiration for any mathematics teacher aiming to support learners in being mathematical. It was shared by [Corinne Angier](#)

[Flowchart Investigations](#) which is a book from the MA (Mathematical Association) by Colin Foster aimed at all teachers of mathematics at Key Stages 3 and 4, although KS2 teachers will also find it to be useful. The flowcharts are visually engaging ways of describing mathematical processes and can offer a starting point for rich mathematical activity. It was shared by [La Salle Education](#)

[foster77 mathematics education](#) which is Dr Colin Foster's website. It contains much original and interesting material that all maths teachers will find useful, including a link to his *Mathematical Etudes* (imaginative and effective ways to help learners develop fluency in mathematical procedures, which provide a welcome alternative to traditional tedious exercises). It was shared by [La Salle Education](#)

[How to Teach Mathematics for Mastery](#) which is a book by Dr Helen Drury. It is a research-informed guide to teaching maths for mastery, with examples of the approach in action in UK secondary schools. It was shared by [Gerry McNally](#)

[Risps](#) (Rich starting Points for A Level Mathematics) by Jonny Griffiths, which is a collection of forty open-ended investigative activities for the A-level Pure Mathematics classroom. It was shared by [La Salle Education](#)

[Jill Mansergh - Tables with a Number Stick](#) which is an ATM (Association of Teachers of Mathematics) video in which Jill Mansergh demonstrates a very enjoyable, original and effective way to help people (of all ages!) 'learn their times-tables'. (Do you know your 17-times table?) It was shared by [Mr Allan](#)

[Standards Unit Improving learning in mathematics: challenges and strategies](#) which includes a CPD section, *PD5: Developing questioning*, to encourage participants to reflect on reasons for questioning in mathematics teaching, ways of making questioning more effective, and different types of 'thinking questions' that may be asked in mathematics. It was shared by [SteveL](#)

[Kangaroo Maths](#) which are schemes of work for mathematics in Key Stages 1 to 4. It was shared by [SteveL](#)

[100 questions that promote Mathematical Discourse](#) which is a webpage offering 100 questions by Dr Gladis Kersaint, advisor for 'Ready Mathematics', devised with the aim of promoting mathematical thinking and classroom discourse. It was shared by [Karla Pearce](#)