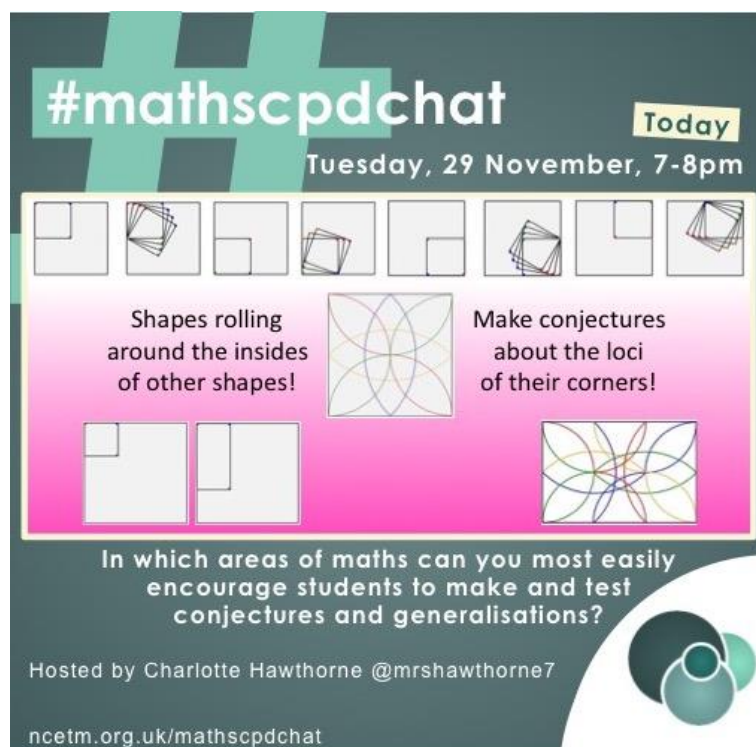


## #mathscpdchat 29 November 2022

In which areas of maths can you most easily encourage students to make and test conjectures and generalisations?

Hosted by [Charlotte Hawthorne](#)

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



**#mathscpdchat** Today

Tuesday, 29 November, 7-8pm

Shapes rolling around the insides of other shapes!

Make conjectures about the loci of their corners!

In which areas of maths can you most easily encourage students to make and test conjectures and generalisations?

Hosted by Charlotte Hawthorne @mrshawthorne7

ncetm.org.uk/mathscpdchat

The links shared during this discussion were:

[Gattegno Tens Chart - Structured Variation Grid](#) which is an interactive *MathsBot* grid of cells containing numbers (integers displayed in the upper part of each cell as the product of a single digit and a power of 10, and in the lower part as a single number) created by [Jonathan Hall](#). Users can set the visible part of the infinite grid, hide or show the entries, and move up/down and left/right across the grid. This grid is one of several [different kinds of mathsbot grid](#). It was shared by [Charlotte Hawthorne](#)

[Noticing and Attention](#) which is one of the [ATM CPD videos](#). This one is by John Mason, who looks into the role of noticing and attention in the mathematics classroom. It was shared by [Tazreen Kassim-Lowe](#)

[Expressing Generality](#) which is one of the booklets in the Open University *Update* series that was created, by a team under the leadership of John Mason, to support mathematics education courses. It contains a paragraph in which John Mason explains/describes the kind of learning environment in which there exists a 'conjecturing atmosphere'. It was shared by [Mary Pardoe](#)

[Dealing with cognitive load through procedural variation](#) which is an article by [Jay Timotheus](#) in Mathematics Teaching 282. The author explores ways to empower learners to think mathematically. It was shared by [Jay Timotheus](#)

[Always, Sometimes, Never](#) which is an resource created by [Andrew Jeffrey](#). Users sort cards, each containing a mathematical statement, into categories according to whether they believe the statement on the card to be always, sometimes or never true. Detailed advice and guidance is provided. It was shared by [Matt Hawes](#)

An illustrated summary of the discussions in this #mathsCPDchat follows.

The host's first main question ...



**Charlotte Hawthorne** @mrshawthorne7 · 17h



Welcome to tonight's #mathsCPDchat

Let's kick things off with the title question...

Which areas/topics in maths do you feel you can most get students to make conjectures or generalise in?

Which topics are harder to do this with?



... prompted a comment from Helen Konstantine, which was not a direct reply to the question, but which anticipated a long discussion which is shown further on:



**Miss Konstantine** @giftedHKO · 19h

...

I'm thinking of the topics I've been looking at and all have involved some. Factors and multiples, area and perimeter, solving equations, probability. It's part of the fun of maths - predicting, seeing connections proving etc  
[#mathsCPDchat](#)



**Charlotte Hawthorne** @mrshawthorne7 · 19h

...

Replying to [@giftedHKO](#)

I was trying to think of everything I've taught recently too and where it would be difficult to do these things but I struggled. I think sometimes we can forget to do this, with other pressures perhaps. [#mathsCPDchat](#)

The host's initial question directly generated two conversations. In this one some helpful prompts were mentioned ...



**MrHawesMaths** @HawesMaths · 17h

...

Replying to [@mrshawthorne7](#)

Is this something you could explore with 'always, sometimes, never'?  
[#mathscpdchat](#)



**MrHawesMaths** @HawesMaths · 19h

...

Replying to [@mrshawthorne7](#) and [@ATMMathematics](#)

Hoping this link works [drive.google.com/file/d/13mRZFy...](https://drive.google.com/file/d/13mRZFy...)  
[#mathscpdchat](#)



[drive.google.com](https://drive.google.com/file/d/13mRZFy...)  
[Always\\_Sometimes\\_Never.pdf](#)



**Charlotte Hawthorne** @mrshawthorne7 · 16h

...

Replying to [@HawesMaths](#)

A great prompt! [@mrbartonmaths](#) had some lovely structures at his last mathsconf presentation too, such as give an example, and another, and an interesting one, and one no one in the room would think of, and ... etc.  
[#mathsCPDchat](#)



**Charlotte Hawthorne** @mrshawthorne7 · 19h

...

A lovely prompt for mathematically thinking... do you have any other favourites?

I like "change one thing about ... so that ..."

Many of them from @ATMMathematics "Thinkers" or "Questions and Prompts"

#mathsCPDchat



**Susan Whitehouse** @Whitehughes · 19h

...

Replying to @mrshawthorne7 and @ATMMathematics

I like "Give me an example of..." and also "What's the same, what's different?" #mathscpdchat

... and, in the following long conversation, the incorporating of conjecturing and generalising into all maths learning was discussed ...



**MathsFin** @MathsFin · 17h

...

Replying to @mrshawthorne7

Isn't every area of maths well-suited to conjecturing and generalising? As the disciplinary skills of mathematics (along with justifying and analysing) and natural thinking powers of all learners, are they not what we should be expecting in every maths lesson? #mathscpdchat



**Mary Pardoe** @PardoeMary · 17h

...

Replying to @MathsFin and @mrshawthorne7

Yes ... and John Mason made this point (among many others) in 'Asking Mathematical Questions Mathematically' ...

#mathscpdchat

If the exercises are routine, there may only be routine interaction; if the exercises involve the student reflecting, generalising, setting their own 'similar' tasks (in particular, or generalised), the student is supported in shifting into examining mode, taking the initiative to show that they truly understand.



**Charlotte Hawthorne** @mrshawthorne7 · 17h

...

Replying to @PardoeMary and @MathsFin

Yes, similar to 'there are no rich tasks, only tasks used richly'

Even a seemingly 'boring' set of questions could be used interestingly.

#mathsCPDchat



**Mary Pardoe** @PardoeMary · 17h

...

Replying to @mrshawthorne7 and @MathsFin

He 'said' these things too ... #mathscpdchat

The seeing of similarities is a natural part of how human beings function, but in the context of school, it often needs nurturing and fostering. The expression of those similarities, as generalities, is more difficult. To ease those difficulties, it helps to have attention drawn to the wide range of ways in which people have expressed similarities and generalities in the past, and so to become familiar with what an expression of generality can look like. Furthermore, it is helpful to be aware that in some situations, detecting and expressing a general rule can be extremely complicated, if not impossible. For example, the number of different shapes that can

The move to generality is perfectly natural, even for very young children, because it is the essence of language, and the basic mechanism by which we make sense of the world. Words are abstractions. Nouns like 'horse' or 'table' are used to refer to specific things, but apply to a whole class of objects. When young children are learning to speak, they have to sort out which features of what they see mean that 'horse' is accepted by adults, and which features require the word 'cow'. They have to discover, from listening, how verbs work, how they change (depending on singular or plural subjects) and how they vary (depending on past, present or future).




**Tazreen Tershanah** @tershanah · 17h

...

Replying to @PardoeMary @MathsFin and @mrshawthorne7

Speaking of John Mason #mathscpdchat.



youtube.com

**Noticing and Attention - with John Mason**

A look into the role of noticing and attention in the mathematics classroom; presented by John Mason,...

... with the conversation continuing in the following slightly different way from MathsFin's tweet:



**MathsFin** @MathsFin · 17h

...

Replying to @mrshawthorne7

Isn't every area of maths well-suited to conjecturing and generalising? As the disciplinary skills of mathematics (along with justifying and analysing) and natural thinking powers of all learners, are they not what we should be expecting in every maths lesson? #mathscpdchat



**Charlotte Hawthorne** @mrshawthorne7 · 16h

...

Replying to @MathsFin

How might you convince fellow maths teachers of this, if they weren't already? (You may not have an answer for this) #mathsCPDchat



**Mary Pardoe** @PardoeMary · 16h

...

Replying to @mrshawthorne7 and @MathsFin

This might be useful ... also from 'Expressing Generality'? #mathscpdchat

- To demonstrate that *expressing generality* lies at the heart of mathematics teaching and learning, and indeed that it is not confined to mathematics.
- To support an approach to mathematics in which those who are unsure are particularly encouraged to try to express their ideas and thoughts out loud, with the specific intention of modifying them: in other words, to provide a *conjecturing* atmosphere.
- To foster a sense of *generalising*, an awareness of what is involved in the act of seeing and then expressing a generality, and an appreciation of its importance throughout mathematics.
- To provide situations in which the *recording* of generalities (in pictures, words, shortened words and symbols) leads to a sense of having captured a statement that applies to a whole class of situations.
- To offer situations in which a conjectured generality needs an argument to *convince* someone (first yourself, then a friend, then a skeptic) that the generality is valid.
- To establish an attitude which values the struggle to *express* what is seen as part of the process of seeing more clearly.
- To suggest that the manipulation of letters associated with algebra arises naturally from the wish to be able to manipulate expressions of generality.
- To help develop confidence that symbols and notation are useful devices which anyone can employ, and which actually contribute to clearer thinking.



**Mary Pardoe** @PardoeMary · 16h

...

Replying to @PardoeMary @mrshawthorne7 and @MathsFin

#mathscpdchat Link to 'Expressing Generality' ...

[open.edu/openlearncreat](https://open.edu/openlearncreat)



**MathsFin** @MathsFin · 16h

...

Replying to @PardoeMary and @mrshawthorne7

The idea of a conjecturing atmosphere can be supported through the focus on oracy - not just as a mode of learning but in its central belief that learners can drive their own learning through talk and listening thoughtfully to others.



**MathsFin** @MathsFin · 16h

...

Replying to @mrshawthorne7

There is much explicitly stated in our national curriculum aims, purpose and spoke language parts of introduction to Maths PoS.

I would encourage all teachers of maths (primary and secondary) to join ATM.

1/2



**MathsFin** @MathsFin · 16h

...

Replying to @MathsFin and @mrshawthorne7

In schools I work with, we are building confidence with a Habits of Mind framework based on John Mason's description of natural powers, starting with reasoning (classifying & characterising, conjecturing & convincing & generalising).



**Cem Kandemir** @bfcembf · 15h

...

Replying to @MathsFin @PardoeMary and @mrshawthorne7

His paper on questioning changed the way I speak to my pupils



**Charlotte Hawthorne** @mrshawthorne7 · 17h

...

Replying to @MathsFin

One of my favourite quotes is from John Mason.

“A maths lesson without an opportunity to generalise is not a maths lesson”

Is this the reality in most classrooms though?

How do you encourage it in your lessons?

[#mathscpdchat](#)



**MathsFin** @MathsFin · 16h

...

Replying to @mrshawthorne7

Hard to say what the reality is in most classrooms, although teachers don't always get the encouragement they need due to assessment regimes and predominance of behaviourist theories of learning in the educational landscape at the moment. 1/2



**MathsFin** @MathsFin · 16h

...

Replying to @MathsFin and @mrshawthorne7

[@ATMMathematics](#) publications such as Q&Ps or Thinkers are all full of great questions to get learners being mathematical.

Recent growth in understanding around oracy (e.g. APPG report 2021) is helpful...as teachers we need to say less and listen \*to\* learners more.



**Charlotte Hawthorne** @mrshawthorne7 · 21h

...

I can't recommend these books enough. You'll use them again and again!

[#mathsCPDchat](#)



**Charlotte Hawthorne** @mrshawthorne7 · 21h

...

What advice would you give to anyone looking to add more opportunities for students to conjecture and generalise in maths lessons?

[#mathsCPDchat](#)



**MathsFin** @MathsFin · 21h

Replying to @mrshawthorne7

Isn't every area of maths well-suited to conjecturing and generalising? As the disciplinary skills of mathematics (along with justifying and analysing) and natural thinking powers of all learners, are they not what we should be expecting in every maths lesson? [#mathscpdchat](#)

The host tweeted a poll ...



**Charlotte Hawthorne** @mrshawthorne7 · 19h

...

Here's the first poll for [#mathsCPDchat](#) tonight.

Which of these best describes your maths lessons:

Students have the opportunity to make conjectures and generalise...

...every lesson

11.7%

...most lessons

20.4%

...some lessons

47.6%

...rarely in my lessons

20.4%

103 votes · Final results

... which prompted a reply:



**Jay Timotheus** @jaytimotheus · 19h

...

Replying to @mrshawthorne7

John Mason famously said that a lesson without opportunity to generalise is not a mathematics lesson!



**Charlotte Hawthorne** @mrshawthorne7 · 20h

...

One of my favourites, and a guiding principle of mine. I fall short too often... but I always try [#mathsCPDchat](#)

Charlotte tweeted images of some books that have helped and inspired her:





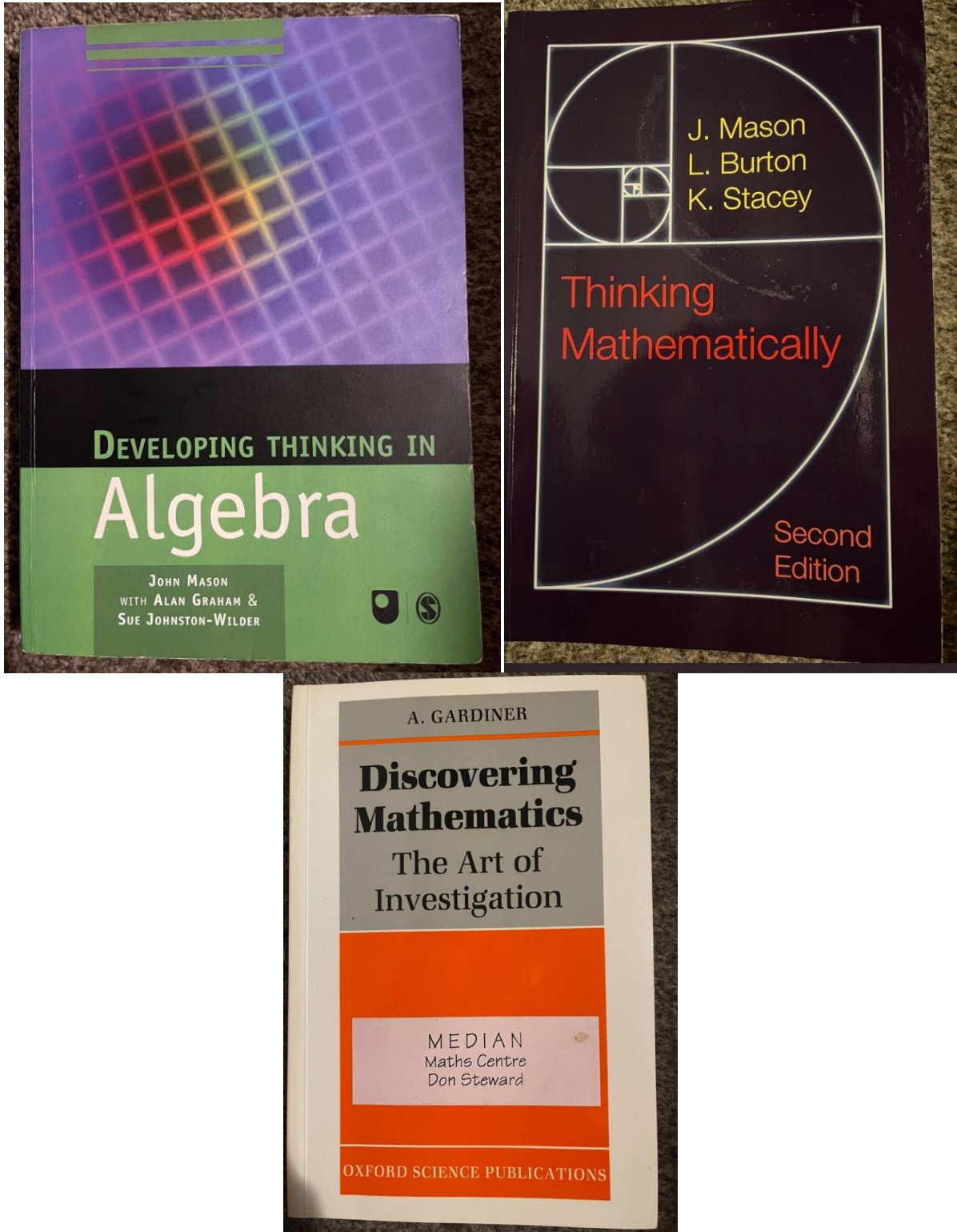
**Charlotte Hawthorne** @mrshawthorne7 · 19h

Inspiration for giving students opportunities to generalise.



A small selection of my sources of inspiration below.

What are some of your favourites? [#mathsCPDchat](#)



The host's ([Charlotte Hawthorne](#)'s) next three main questions addressed ways of encouraging students to make and test their own conjectures, and some tasks that may particularly provide such opportunities. The sequence of (linked-to-Twitter) screenshots below show all responses to those questions.

In those replies and conversations **only** you can **click on any screenshot-of-a-tweet to go to that actual tweet on Twitter.**

The second main question from [Charlotte Hawthorne](#) ...



**Charlotte Hawthorne** @mrshawthorne7 · 19h

Here's a challenge for you...

...think of a lesson where you think it might be tricky to bring in generalisation.

Let's see if together we can think of ways to adapt things to get more conjecturing and generalising going on. [#mathsCPDchat](#)



... generated this conversation between [Jay Timotheus](#) and [Charlotte Hawthorne](#) ...



**Jay Timotheus** @jaytimotheus · 19h

Replying to @mrshawthorne7

The OU's MGA cycle is key to this. What is it the generalisable property here? What can we vary/manipulate so students get-a-sense-of this? What articulation will then capture the emerging generalisation?

### **The M-G-A cycle**

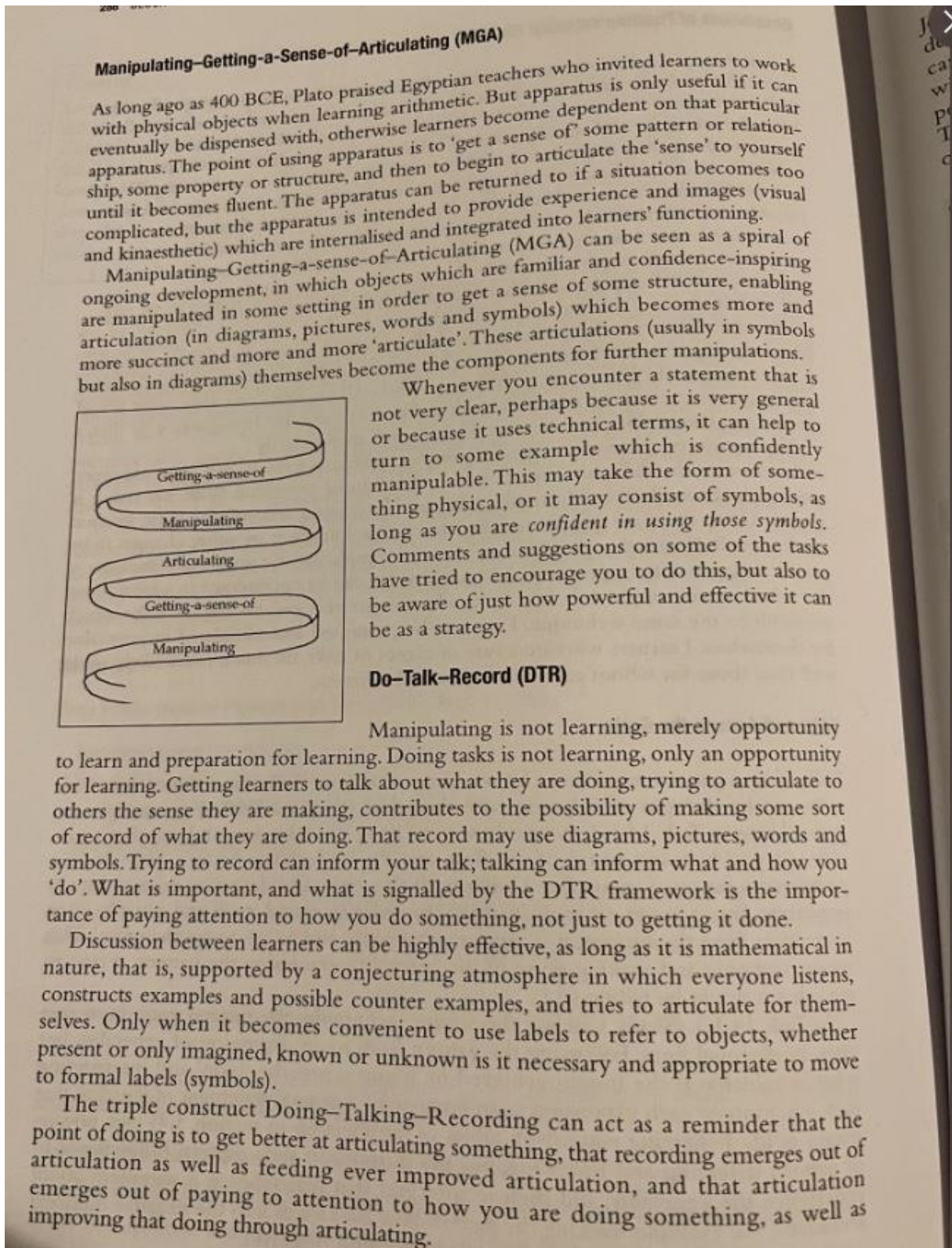
Some readers might recognise the previous paragraph as drawing upon the three-part framework provided in the Open University Mathematics Education courses, which provides a cyclical model of what happens as humans learn mathematics: We **manipulate** the mathematical situation, to **get-a-sense-of** its structures and relationships, in order to reach a point where we can **articulate** what we now know. And although the M-G-A cycle was probably



**Charlotte Hawthorne** @mrshawthorne7 · 19h

Replying to @jaytimotheus

Absolutely. This picture is from 'Developing thinking in Algebra' by Mason et al. It's a lovely structure #mathsCPDchat





Jay Timotheus @jaytimotheus · 19h

Replying to @jaytimotheus and @mrshawthorne7

So this is something I wrote in 2009 that brings generalisation into the teaching of constructing triangles...

**given** **Constructing triangles of given lengths – 3**

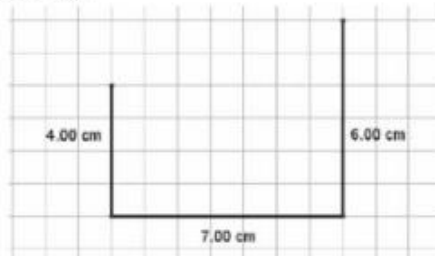
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*The teacher identifies mathematics software that enables him or her to make the variation explicit and plans an activity around this.*

There are a number of computer software applications in which geometric figures can be constructed and manipulated. In this example I use *Geometers' Sketchpad*. However, when working with students on constructing triangles I often begin by giving my students three side lengths (for example 7cm, 6cm and 4cm) and then ask them to draw the triangle described in their exercise books. The next ten minutes or so are spent with the students busily drawing triangles with their pencils and rulers, and finding, in most cases, that it is quite difficult to achieve three sides all with the required lengths. There is soon a sense in the room that 'this is actually harder than we thought.' It is at this point that a sense of 'need' has been created to find a better way.

2/5

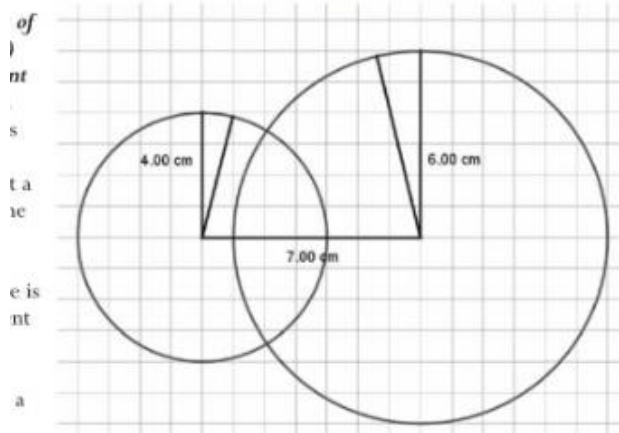


This figure is then constructed by drawing three line segments that 'snap' to the grid..

The teacher can then use the 4cm and 6cm lines as radii and construct two circles as shown. Two further radii are then drawn which are rotated by dragging until a triangle is formed.

**given**

See: [www.atm.org.uk/mt213](http://www.atm.org.uk/mt213).



There is something about the construction of this image that is powerful in a way that cannot be conveyed on the printed page. As the two radii are dragged towards the intersection of the circles, the triangle is suddenly apparent and I have found that this always provokes an excited response from many students in the room. Suddenly they see that these (round) circles have in fact allowed us to rotate the lengths and to make the very same triangle (with straight sides!) that seemed so difficult to construct earlier with a (straight) ruler and a pencil. I find it helpful to try and channel the generated excitement at this point by asking further questions.

- Is this the triangle we wanted?
- How do we know?
- Is there another triangle that will also have the same side lengths?
- Why did we draw circles?
- ...?



**Charlotte Hawthorne** @mrshawthorne7 · 19h



Replying to @jaytimotheus

This is nice. And a topic I might have suggested was hard to do this with!  
[#mathsCPDchat](#)



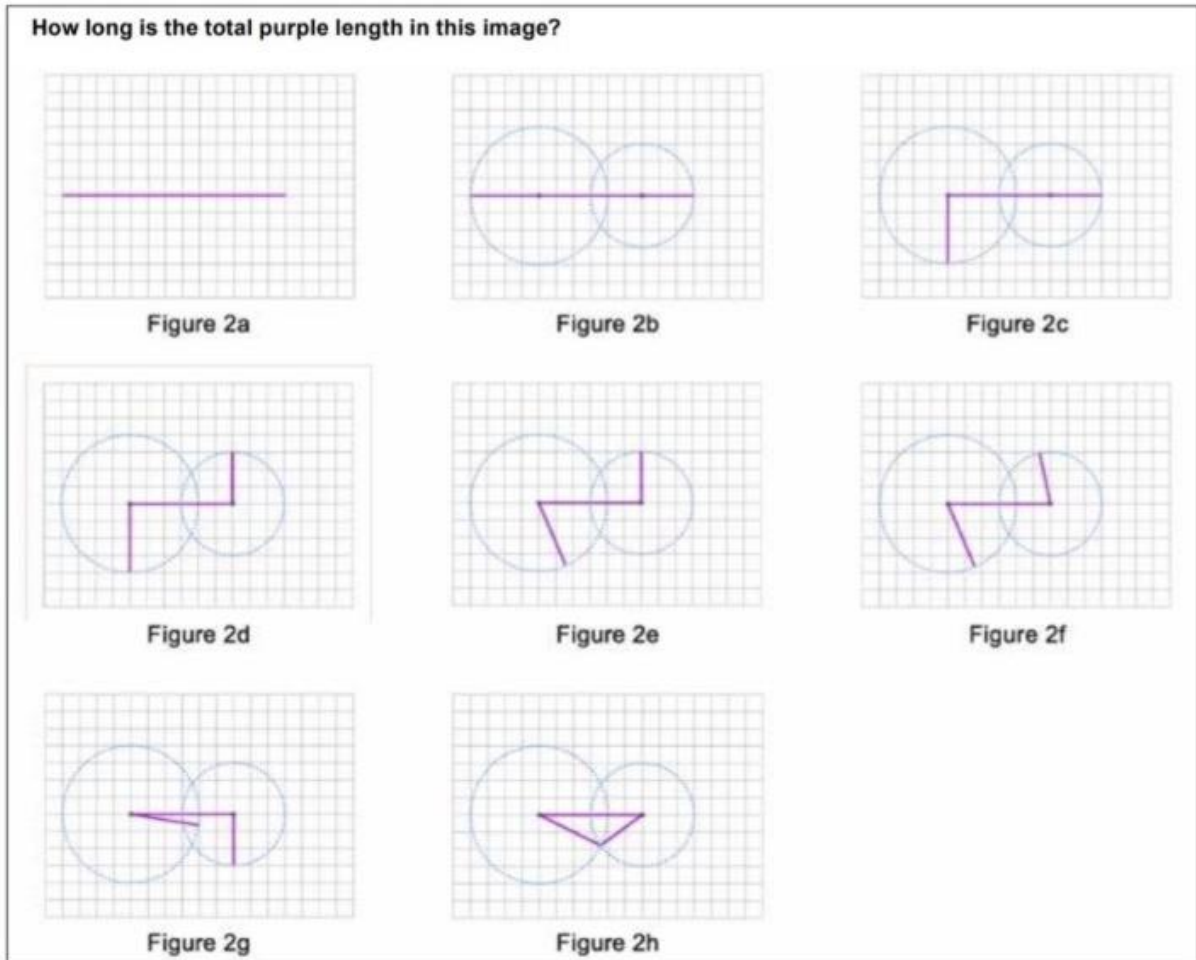
**Jay Timotheus** @jaytimotheus · 19h



Replying to @mrshawthorne7

My most recent attempt to provoke thinking and generalisation with the same topic is this... [atm.org.uk/write/MediaUpl..](http://atm.org.uk/write/MediaUpl..) [#mathscpdchat](#)

(link provided above)



... and this single reply from [Mary Pardoe](#):



**Mary Pardoe** @PardoeMary · 19h

...

Replying to [@mrshawthorne7](#)

... a lesson in which misconceptions are evident perhaps? This is from 'Expressing Generality' (will try to find the link) ... [#mathscpdchat](#) (forgot hashtag!)

Pupils are rarely wilful in getting wrong answers. Often the error comes about quite naturally, as the result of expressing an inappropriate generality. An awareness of the *processes* involved in generalising can help in understanding how such errors arise, and in their correction.

The host's ([Charlotte Hawthorne](#)'s) third main question ...



**Charlotte Hawthorne** @mrshawthorne7 · 20h

Not that 'investigation-style' activities are the only way to encourage conjecturing and generalising in maths lessons, but some of my favourite lessons are ones where we look at:

How many handshakes?

How many squares on a chessboard?

What are your favourites? #mathsCPDchat

... prompted [Matt Hawes](#), [Mr Taylor](#), [Nilam Patel](#) and [Mark Williams](#) to share some 'favourites' with [Charlotte Hawthorne](#):



**MrHawesMaths** @HawesMaths · 20h

Replying to @mrshawthorne7

I'm a fan of King Arthur's problem.

King Arthur was a happy king in Camelot who had all those knights and a round table. He loved inviting those knights over for parties around his round table.

If there was something pleasant he could only give to one knight, (an extra dessert, the hand of his daughter in marriage, a dragon to chase, etc.) he had them play a game, and it went like this.

First, King Arthur numbered the chairs around the table. At the start every chair was occupied by a knight. (King Arthur himself did not sit at the table.)

Then he stood behind the knight in chair one and said "You're in." Next he moved to the knight in the second chair and said "You're out." And the knight left his seat and went off to stand at the side of the room and watch the rest of the game. Next, he moved to the knight in chair three and said "You're in." Then he said "You're out." To the knight in chair four, and the knight left his seat and went to the side of the room.

He continued around the table in this matter. When he came back to the knight in chair one, he said either "You're in." or "You're out." Depending on what he said to the last knight. (If the last knight was "in", then the first knight was now "out", and vice versa.)

The king kept moving around and around the table saying "You're in." or "You're out" to the knights that remained at the table. (If the chair was now empty, he just skipped it.) He continued until only one knight was left sitting at the table. That knight was the winner.

Here is the question:

Which chair number would you try to sit at King Arthur's table?

Of course, you may want to know how many knights were at the table to begin with. Well that was always changing. So figure out a general rule, in terms of the number of knights. Your rule does not have to be a formula; it may be a clear set of directions that will give the proper answer.

⊗ Aim to work logically

⊗ Devise a strategy and go with it

⊗ Get some good data

⊗ Produce a solution based upon the information you have worked out.

⊗ Present findings neatly and concisely  
Maybe even 'graph' your findings to produce a visual representation.

An example

5 knights

⊗ ⊗ 3 ⊗ ⊗

Seat 3 wins

An example

10 knights

⊗ ⊗ ⊗ ⊗ ⊗  
⊗ ⊗ ⊗ ⊗ ⊗

Seat 5 wins



**Charlotte Hawthorne** @mrshawthorne7 · 21h ...

This looks interesting!

Who else has got some favourite maths problems they like to use in class?

[#mathsCPDchat](#)



**MrTaylorMaths** @MrTaylorMaths2 · 20h ...

Replying to @mrshawthorne7

I like doing a load of examples and MWB whole class questions.

Then can you make one on your MWB that doesn't work. Now one that never works. Finally one that never works.



**NILAM PATEL** @nilampatel86 · 19h ...

Replying to @mrshawthorne7

leap frogs, mystic rose, T totals on hundred squares... so many!



**Mark Williams** @markuk73 · 21h ...

Replying to @mrshawthorne7

How many fences to separate the cows?

The host's ([Charlotte Hawthorne](#)'s) last main question ...



**Charlotte Hawthorne** @mrshawthorne7 · 21h ...

Students may not be used to maths lessons where they conjecture... how do you build a conjecturing atmosphere in your lessons?

How do you encourage students to try things out rather than give up and say they don't get it? [#mathsCPDchat](#)



... generated a discussion between her and [Jonathan Hall](#):





**Jonathan Hall** @StudyMaths · 21h

Replying to @mrshawthorne7

Gave Y7 this today and just said “what do you reckon the rest are?”

Ended up at standard form by the end of the lesson.

				50				
				5	6			

Charlotte shared the link to the grid above, and the link to other grids at [mathsbot.com](https://mathsbot.com), all of which are created by [Jonathan Hall](#), and the conversation continued:



**Charlotte Hawthorne** @mrshawthorne7 · 21h

Replying to @PardoeMary and @StudyMaths

[mathsbot.com/grids/gattegno](https://mathsbot.com/grids/gattegno)

And more: [mathsbot.com/gridMenu](https://mathsbot.com/gridMenu)



**Charlotte Hawthorne** @mrshawthorne7 · 21h

Replying to @StudyMaths

This is my go to for standard form now it’s worked so well on several occasions.

You have some other lovely resources like this too...yes? 😊

[#mathsCPDchat](#)



**Jonathan Hall** @StudyMaths · 21h

Replying to @mrshawthorne7

I do like “how many squares on a chessboard”

Which generalises and extends in different dimensions to how many cubes in cube, lines on a line and points on a point etc with satisfying results for each.



**Charlotte Hawthorne** @mrshawthorne7 · 21h

Replying to @StudyMaths

Ooo, you've reminded me of how many different lengths in a  $n$  by  $n$  dotted grid. I like doing this as an investigation in it's own right, then bringing it back when we've learnt about Pythagoras' theorem and then simplifying surds #mathsCPDchat



**Jonathan Hall** @StudyMaths · 21h

Replying to @mrshawthorne7

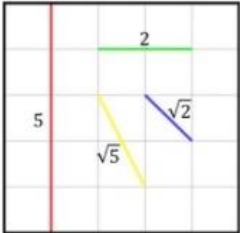

One of my favourites.

Triangle numbers popping up unexpectedly yet again.

How many lengths?

### How many different lengths can you draw on a $5 \times 5$ grid?

Straight lines only! Try to work systematically.  
What do you notice?  
How might you count them all efficiently?  
Now try a  $4 \times 4$  or  $6 \times 6$  grid.  
Can you generalise to an  $n \times n$  grid?  
What about an  $n \times m$  grid?  
How many different lengths exist inside a cube?

Complete Mathematics CLASSROOM Page 90

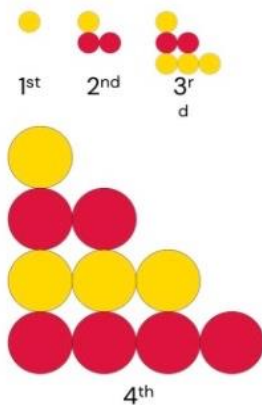


**Charlotte Hawthorne** @mrshawthorne7 · 20h

Replying to @StudyMaths



I think most of my lessons involve your tasks to be fair. I used this one recently #mathsCPDchat

Zero Pairs – Growing Patterns



The image shows the first four terms of a growing pattern.  
If yellow is  $+1$  and red is  $-1$ :

- Work out the sum of the  $4^{th}$  pattern.
- Work out the sum of the  $10^{th}$  pattern.
- Work out the sum of the  $n^{th}$  pattern.

Generate some patterns of your own.  
For example:  or 

Complete Mathematics CLASSROOM Page 145

The host's ([Charlotte Hawthorne](#)'s) last main question also prompted [Matt Hawes](#) to share this ...



**MrHawesMaths** @HawesMaths · 21h

Replying to [@mrshawthorne7](#)

One of our subject strands that we assess on covers perseverance: leading to logical and analytical approaches. [#mathscpdchat](#)




**MrHawesMaths** @HawesMaths · 21h

Replying to [@HawesMaths](#) and [@mrshawthorne7](#)

Found it [#mathscpdchat](#)

19:44 Tue 29 Nov 32%

Maths subject strands



## Perseverance : Logical and analytical approaches (leading to independence)

<b>Emerging</b>	Immediately raises hand and seeks support before even considering the question or problem; rarely makes use of materials on offer to think independently about a problem.
<b>Evolving</b>	Still a little over-reliant on help but has begun to spend a brief period considering the question before asking for help
<b>Expected</b>	Is beginning to spend time thinking about and experimenting with a problem and knows when it is advisable to seek some help
<b>Exceeding</b>	Shows a determination to work through a problem independently, using many skills and ideas, seeks help effectively
<b>Exceptional</b>	Has developed an enjoyment of being stuck and has developed mathematical strategies to help further understanding. Is happy to research ideas independently to further own understanding. Is interested in small indicators to help but is eager to reach a final solution as independently as possible.


... and prompted a short conversation between [Mr Taylor](#) and [Charlotte Hawthorne](#) ...


 **MrTaylorMaths** @MrTaylorMaths2 · 21h ...  
Replying to [@mrshawthorne7](#)  
2 biggest things for me:  
1. Culture  
2. MWB  
[#mathsCPDchat](#)

 **Charlotte Hawthorne** @mrshawthorne7 · 21h ...  
Replying to [@MrTaylorMaths2](#)  
Any tips for either of those?  
I know culture can be down to whole school but I spend a lot of time letting my students get stuck and not helping them straight away. They hate it for a bit but they get used to it and are better for it then [#mathsCPDchat](#)

 **MrTaylorMaths** @MrTaylorMaths2 · 21h ...  
Replying to [@mrshawthorne7](#)  
Aim for understanding not ticks.  
Culture of error.  
Everyone matters.  
[#mathsCPDchat](#)


... and an interchange between [Jay Timotheus](#) and [Charlotte Hawthorne](#) ...

 **Jay Timotheus** @jaytimotheus · 21h ...  
Replying to [@mrshawthorne7](#)  
I guess it's how we model 'expertise'. Mathematicians ask questions, make conjectures and generalise. Pupils need to see us modelling thinking like mathematicians. [#mathscpdchat](#)

 **Charlotte Hawthorne** @mrshawthorne7 · 21h ...  
Replying to [@jaytimotheus](#)  
Great tip! Model the mathematical behaviours we want to see  
[#mathsCPDchat](#)

... and another short conversation, this time between [Mr B](#) and [Charlotte Hawthorne](#) ...

 **Mr B Maths** @MrBMaths3 · 21h ...  
Replying to [@mrshawthorne7](#)  
I think use of mini whiteboards as part of normal 'working' definitely seems to encourage students to attempt things, even if not 100% confident. One of the few good things to come out of covid teaching! [#mathscpdchat](#)

 **Charlotte Hawthorne** @mrshawthorne7 · 21h ...  
Replying to [@MrBMaths3](#)  
Absolutely! Such a great tool! Also great for generalising as you can keep changing parts of something and look at what is happening in general.  
[#mathsCPDchat](#)



**Mr B Maths** @MrBMaths3 · 21h

...

Replying to @mrshawthorne7

Totally agree. So easy to change a question without feeling like it needs crossing out in books #mathscpdchat

... and a comment from [Dr Elise van der Jagt](#):



**Dr Elise van der Jagt** @DrElisevdJ · 12h

...

Replying to @mrshawthorne7

Co-constructing classroom norms! Intentional Talk by Kazemi & Hintz suggest including "In this class we remember it's ok to make mistakes and revise our thinking"...then putting it into practice! Let students see discussions where the teacher takes student ideas seriously

The host closed this #mathsCPDchat:



**Charlotte Hawthorne** @mrshawthorne7 · Nov 29

...

Well I was afraid I'd be all alone tonight but thank you SO MUCH to all of you who have joined me for #mathsCPDchat tonight.

I love to think about how we encourage more conjecturing and generalising in maths lessons!

Good night all!



**mathscpdchat** @mathscpdchat · Nov 29

...

Replying to @mrshawthorne7

VERY many thanks, Charlotte, @mrshawthorne7, for hosting #mathscpdchat tonight ... and thanks so much to all contributors!!! (Score is 0-0 it seems.) Look out for a summary.



**Charlotte Hawthorne** @mrshawthorne7 · Nov 29

...

Replying to @mathscpdchat

There was football on? Who knew 🤔😂



**Jonathan Hall** @StudyMaths · Nov 29

...

Replying to @mrshawthorne7 and @mathscpdchat

Apparently England waited until #mathscpdchat was over.



**Charlotte Hawthorne** @mrshawthorne7 · Nov 29

...

Replying to @StudyMaths and @mathscpdchat

I had a word. Ha.