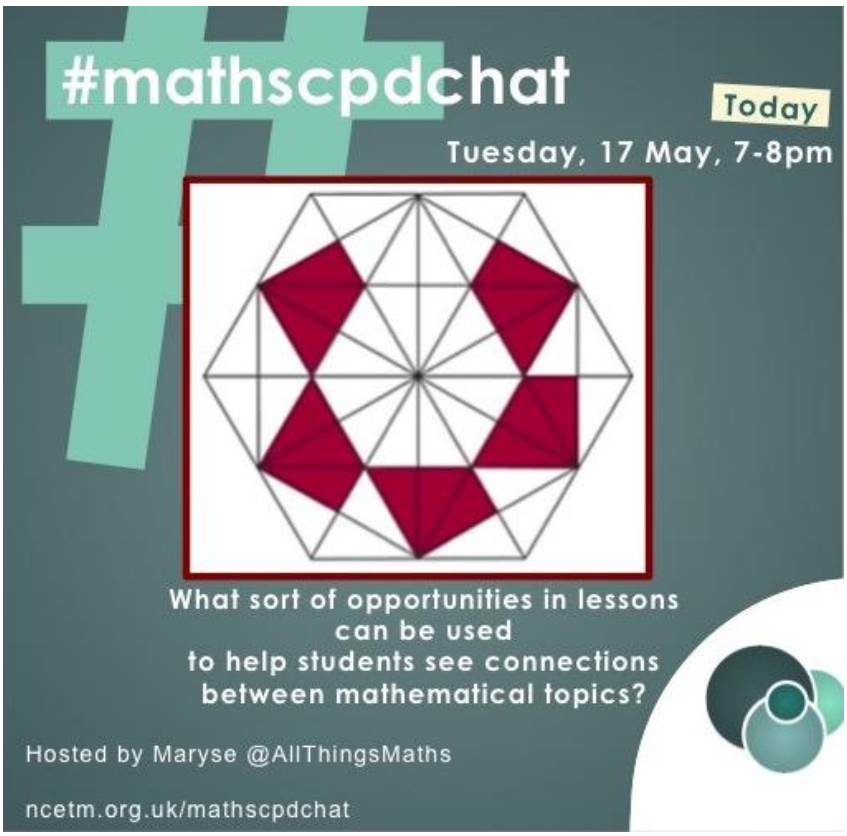
#mathscpdchat 17 May 2022

What sort of opportunities in lessons can be used to help students see connections between mathematical topics?

Hosted by Maryse Dare

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



The links shared during this discussion were:

National Curriculum Resource Tool which are NCETM materials to support teachers and schools in embedding the National Curriculum. This link takes you to the section *KS3 – Ratio and Proportion and Rates of Change*. It includes a sub-section about 'Making connections to other topics within Key Stage 3' (maths). It was shared by Maryse Dare

Tour of Mathematical Connections which is a YouCubed video in which Jo Boaler 'shows the connected nature of maths highlighting number sense, geometry, and algebra, under the big idea of ratio and proportion. It was shared by Maryse Dare

Maths topics poster which is a free downloadable PDF poster by William Emeny from *Great Maths Teaching Ideas*. It was shared by Maryse Dare

Interwoven Maths which is a website designed by Nathan Day containing sets of 'questions and tasks that bring together multiple different topics from mathematics (i.e. interweaving those topics). It was shared by Maryse Dare

Underground Mathematics which are resources developed by the University of Cambridge to support teachers of mathematics to post-16 students in the classroom. 'They help students build firm foundations for mathematical understanding by ***connecting ideas*** and developing techniques.' It was shared by Susan Whitehouse

Ratio Tables Across the Curriculum which is a beautifully illustrated detailed recent blogpost by Kathryn Darwin about using ratio tables as a tool for multiplicative thinking. It was shared by Nathan Day

Key Ideas in Teaching Mathematics: Research-Based Guidance for Ages 9-19 which is a book by Anne Watson, Keith Jones and Dave Pratt. The authors address the big ideas in the mathematics curriculum for older students, especially those that are hard to learn and hard to teach. They show how students' understanding can grow as their learning builds on their earlier ideas. It was shared by Mary Pardoe

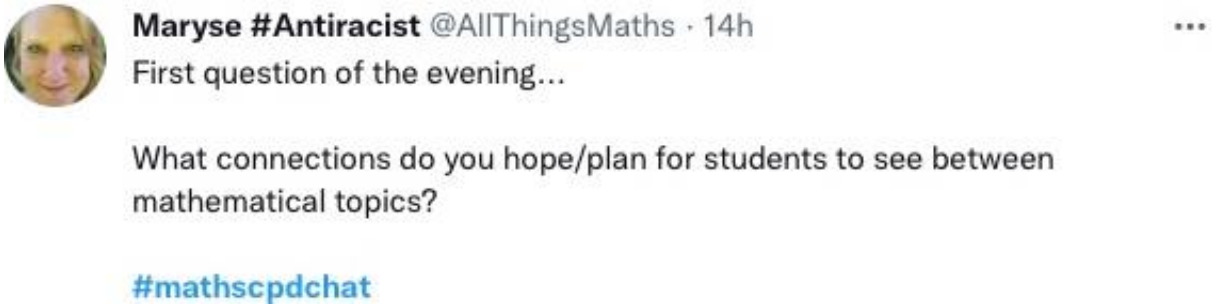
Using ATM MATs which is a resource from the Association of Teachers of Mathematics (ATM). It includes 'Activities to try using Triangles' and 'Activities to try using Triangles and Squares' both of which are free-to-download PDF documents. There is also a video providing guidance about making models with MATs. It was shared by Mary Pardoe

Working with rods and why which is a free PDF booklet from the Association of Teachers of Mathematics (ATM). It brings together inspirational writings on the theory of reforming mathematics education together with articles by teachers who exemplify the Cuisenaire-Gattegno approach. It was shared by Mary Pardoe

Focus on...Dudeney's Greek cross dissection puzzles which is a 'Focus On…' article in the archived Secondary Magazine 61 produced some years ago by the NCETM. It was shared by Mary Pardoe

A full illustrated summary of the discussions in this #mathsCPDchat follows.

The host's first question …



… prompted many replies. Maryse's comments generated thoughts about A-level teaching …

Maryse #Antiracist @AllThingsMaths · 14h

Replying to @AllThingsMaths

One of my favourite topics to teach is transformation of curves. Linking it to completing the square.
#mathscpdchat

Maryse #Antiracist @AllThingsMaths · 14h

One way I approach it is to give expressions in completing the square that I return to later when we do transformations... and it all ties up!
#mathscpdchat

Susan Whitehouse @Whitehughes · 14h

Replying to @AllThingsMaths

Transformations of curves links to so many things. I like to look at equations of straight lines using transformations #mathscpdchat

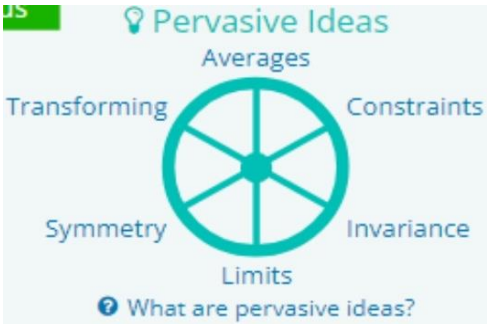
Maryse #Antiracist @AllThingsMaths · 14h

Yes!!! Love it! I've hinted at it but I tend to use tables of values to show the transformation alongside parallel lines moving. I've consciously tried to mirror language with sequences this term too.
#mathscpdchat

Susan Whitehouse @Whitehughes · 14h

Replying to @AllThingsMaths

I find the @UndergroundMath pervasive ideas very useful at A-level. I think about these six things for every topic I teach and see what links I can make
#mathscpdchat



Maryse #Antiracist @AllThingsMaths · 14h

Replying to @Whitehughes and @UndergroundMath

I need to go back and look at these! It's been a while since I've had A level but I remember loving the resources here.
#mathscpdchat

Susan Whitehouse @Whitehughes · 14h

Yes, I sometimes need to be reminded to highlight connections when teaching A-level so it's really helpful to me to have something that I can do as a matter of routine in my planning #mathscpdchat

Maryse #Antiracist @AllThingsMaths · 14h

It was A level teaching (I had C1 & C2 in my first year of teaching) that really opened my eyes to how the topics synthesised. I then explored in earlier years and back tracked the topics right through to EY. It was fascinating. #mathscpdchat

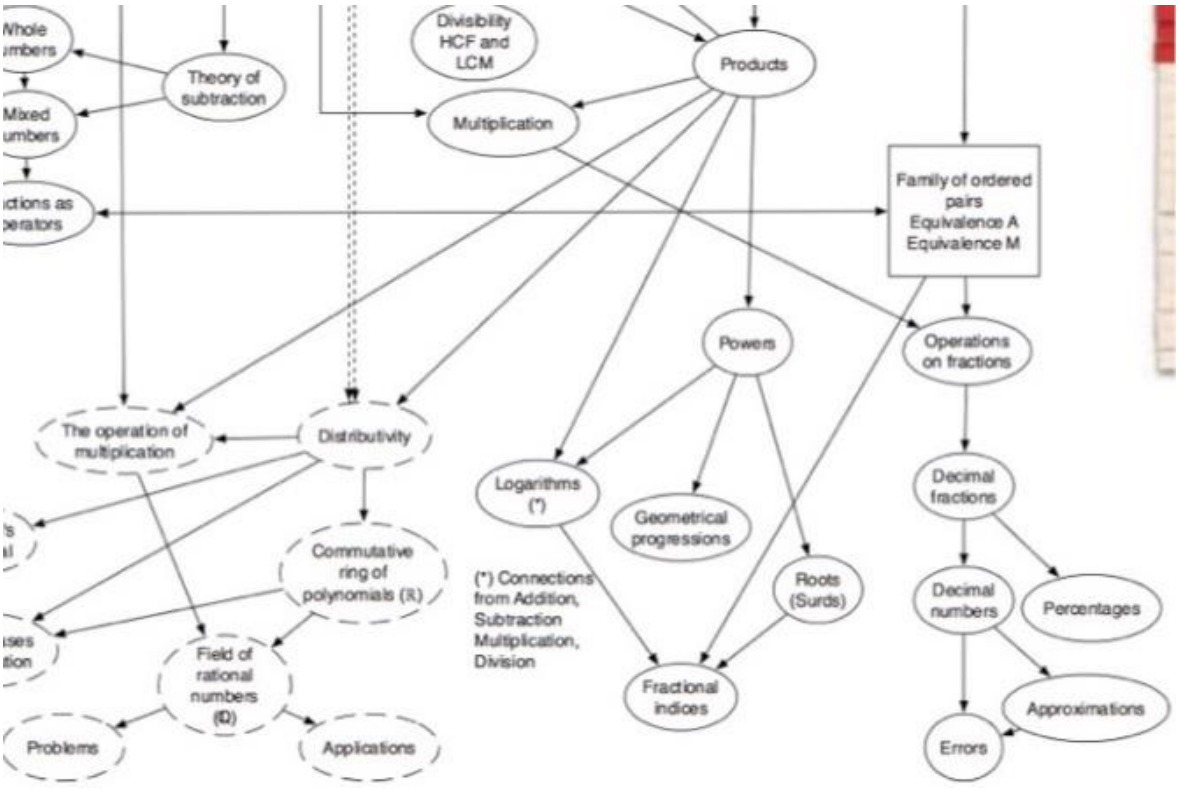
… and there was also a different kind of reply to Susan's tweet about *Underground Maths*:

Mary Pardoe @PardoeMary · 14h

And it's amazing what links between ideas working with Cuisenaire rods can reveal/lead-to!

This is a part of one of Gattegno's own diagrams, reproduced in ATM's (free) 'Working with rods and why', which is here: atm.org.uk/Working-with-R...

#mathscpdchat



A reply from Nathan Day to the host's first question generated much discussion …

Nathan Day @nathanday314 · 14h

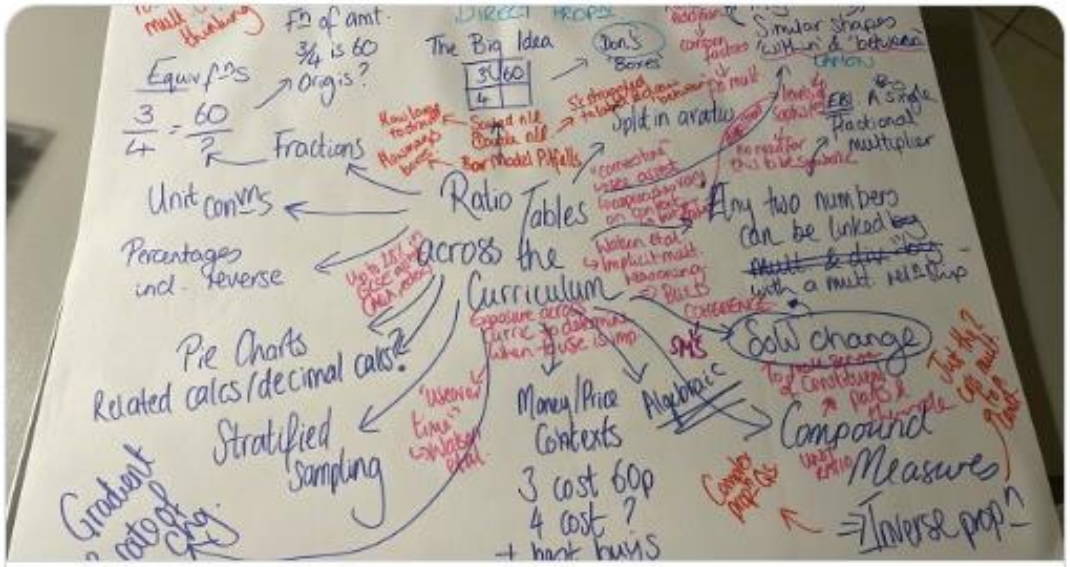
Replying to @AllThingsMaths

The multiplicative and proportional relationships underpinning *everything*!

Ratio, proportion, %ages, fractions, gradients, compound measures, similarity, unit conversions, value for money, trigonometry, wages,…

arithmaticks.wordpress.com/2022/03/13/rat… (@Arithmaticks)

#mathscpdchat



arithmaticks.wordpress.com

Ratio Tables Across the Curriculum

Yesterday, at MathsConf28 in Gloucester, I shared my obsession with Ratio Tables as a tool for multiplicative thinking. It followed on from m…

Maryse #Antiracist @AllThingsMaths · 15h

Replying to @nathanday314 and @Arithmaticks

This is fantastic! Do you actively plan to include this within your lessons? #mathscpdchat

Nathan Day @nathanday314 · 15h

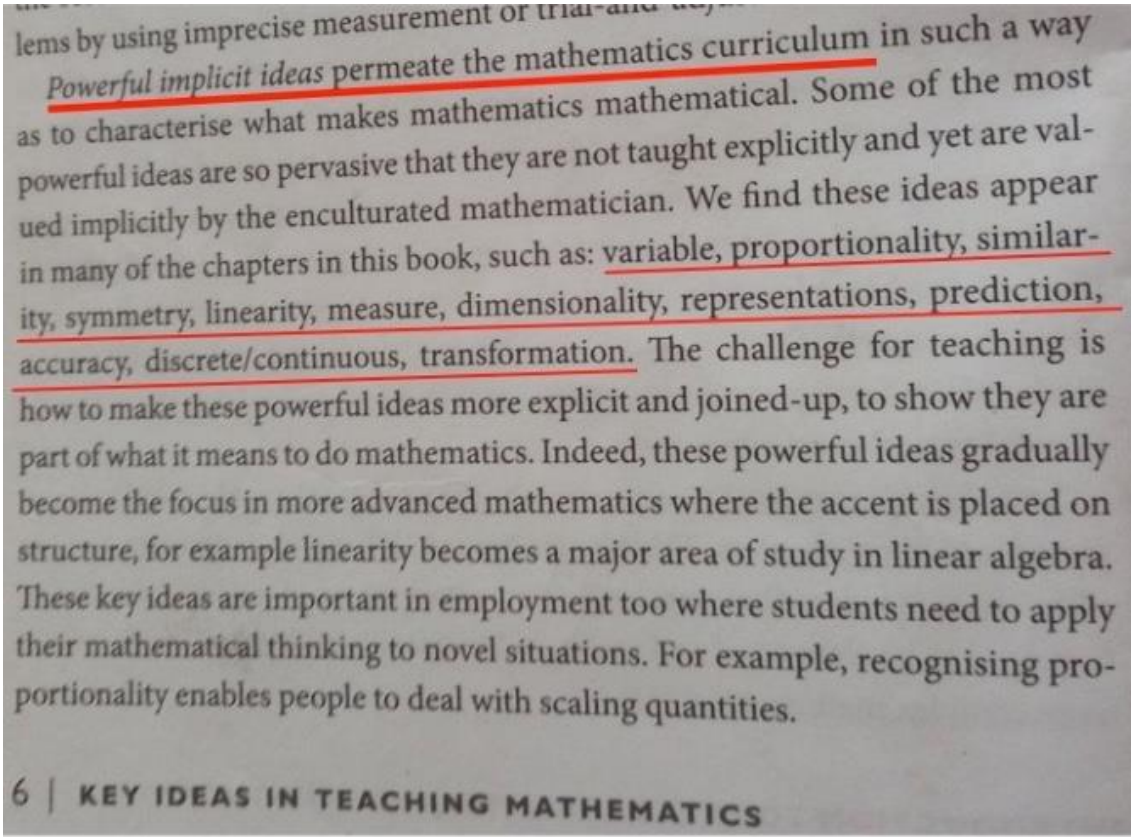
Every opportunity I get.
Nary a lesson goes by without us drawing a ratio table or two!

What I want to do more is use questions simultaneously from those different topics that explicitly call to attention their common underlying structures.

Maryse #Antiracist @AllThingsMaths · 15h
Drawing attention to core concepts and approaches?
#mathscpdchat

Mary Pardoe @PardoeMary · 15h
...and to ideas that permeate all mathematics?

E.g ... from 'Key Ideas in Teaching Mathematics', here: amazon.co.uk/Key-Ideas-Teac...
#mathscpdchat



lems by using imprecise measurement or trial-and-[illegible]

Powerful implicit ideas permeate the mathematics curriculum in such a way as to characterise what makes mathematics mathematical. Some of the most powerful ideas are so pervasive that they are not taught explicitly and yet are valued implicitly by the enculturated mathematician. We find these ideas appear in many of the chapters in this book, such as: variable, proportionality, similarity, symmetry, linearity, measure, dimensionality, representations, prediction, accuracy, discrete/continuous, transformation. The challenge for teaching is how to make these powerful ideas more explicit and joined-up, to show they are part of what it means to do mathematics. Indeed, these powerful ideas gradually become the focus in more advanced mathematics where the accent is placed on structure, for example linearity becomes a major area of study in linear algebra. These key ideas are important in employment too where students need to apply their mathematical thinking to novel situations. For example, recognising proportionality enables people to deal with scaling quantities.

6 | KEY IDEAS IN TEACHING MATHEMATICS

Kathryn MCCT @Arithmaticks · 14h
I love love love this book

Mary Pardoe @PardoeMary · 14h
Yes ... it is SO very, very helpful and useful! Also great for suggesting research ideas for teachers' own classroom research!
#mathscpdchat

... for example, Maryse's question above set off some instant creativity that prompted yet more comments:

Maryse #Antiracist @AllThingsMaths · 15h

Drawing attention to core concepts and approaches?
#mathscpdchat

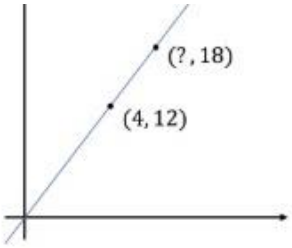
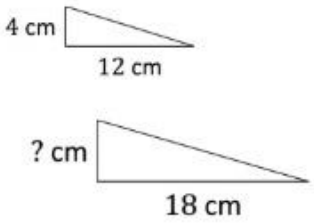
Nathan Day @nathanday314 · 15h

Replying to @AllThingsMaths and @Arithmaticks

Something like this, perhaps, but not written in 20 minutes on a Tuesday evening!

'Find two ways of answering each question!'

(#mathscpdchat !)

$\frac{4}{12} = \frac{?}{18}$	Maryse walks 12 miles in 4 hours. How long does it take her to walk 18 miles?	
Kathryn earns £12 for every 4 trees she plants. How much does she earn for planting 18 trees?		4 yards is equal to 12 feet. How many yards are there in 18 feet?

Nathan Day @nathanday314 · 15h

Replying to @nathanday314 @AllThingsMaths and @Arithmaticks

With a bonus (unintended) 'Which is the odd one out?'!

Mr Graham @MrGraham_Maths · 15h

Replying to @nathanday314 @AllThingsMaths and @Arithmaticks

love this ... currently doing proportion with Y9, which has followed on from similar shapes. Trying my best to get them to see links so this will be perfect. Thank you!

There was another very positive reply to Nathan's initial reply to Maryse's main question …

Nathan Day @nathanday314 · 14h

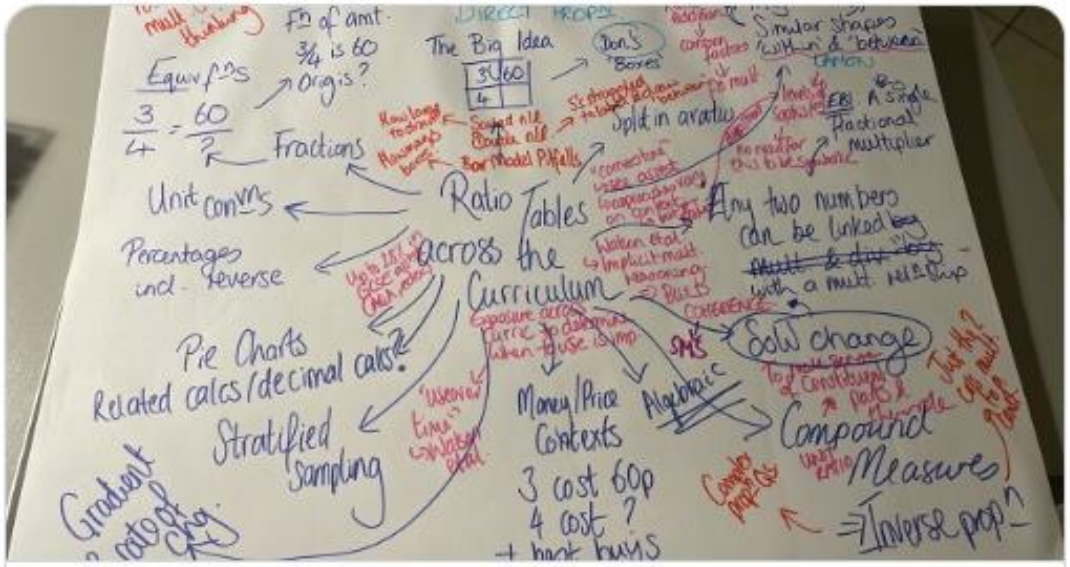
Replying to @AllThingsMaths

The multiplicative and proportional relationships underpinning *everything*!

Ratio, proportion, %ages, fractions, gradients, compound measures, similarity, unit conversions, value for money, trigonometry, wages,…

arithmaticks.wordpress.com/2022/03/13/rat… (@Arithmaticks)

#mathscpdchat



arithmaticks.wordpress.com

Ratio Tables Across the Curriculum

Yesterday, at MathsConf28 in Gloucester, I shared my obsession with Ratio Tables as a tool for multiplicative thinking. It followed on from m…

Mr J Habimana @Mr_JHabimana · 13h

Replying to @nathanday314 @Arithmaticks and @AllThingsMaths

I have been thinking about this this whole week and weekend. As a non mathematician who is infiltrating this has changed my thinking. Wish I had attended this one at the conference.

… and also this comment in response to it:

Mary Pardoe @PardoeMary · 15h

Replying to @nathanday314 @AllThingsMaths and @Arithmaticks

Yes! Even when making, looking-at, and thinking about, say, ATM MATs!
atm.org.uk/Using-ATM-MATs
#mathscpdchat
E.g. …

If you have made a larger Tetrahedron, look at its edge lengths, and its faces. What ratios are to be found here? What ratio will there be between the volumes?

Use this knowledge to work out the ratio of the volume between a Regular Tetrahedron and a regular octahedron made from the same sized Equilateral Triangles. Knowing that the Regular Octahedron is a Square-based pyramid doubled, what can you find out about the ratio of volumes between the Square-based pyramid and Regular Tetrahedron?

Information: Regular Tetrahedra and Octahedra fit together into a Honeycomb that fills all of the space – like a 3D Tessellation.

Knowing that, imagine you have a supply of (T) Regular Tetrahedra, (O) Regular Octahedra, and (S) Square Pyramids that are half a Octahedron. How many of each polyhedron will be needed to make larger versions of these?

The first main question from the host also prompted a conversation in which the sharing of ideas and approaches was mentioned …

Catherine Edwards @Edwards08C · 15h

Replying to @AllThingsMaths

I've been really starting to embed place valur and start making the links to standard form, index laws and metric units right from the beginning #mathscpdchat

Maryse #Antiracist @AllThingsMaths · 15h

Place value is so important. I am noticing it more this year with Y7, maybe because of the disruptions before. I often still use the columns to show value with SF etc. Do you plan for this across the dept? #mathscpdchat

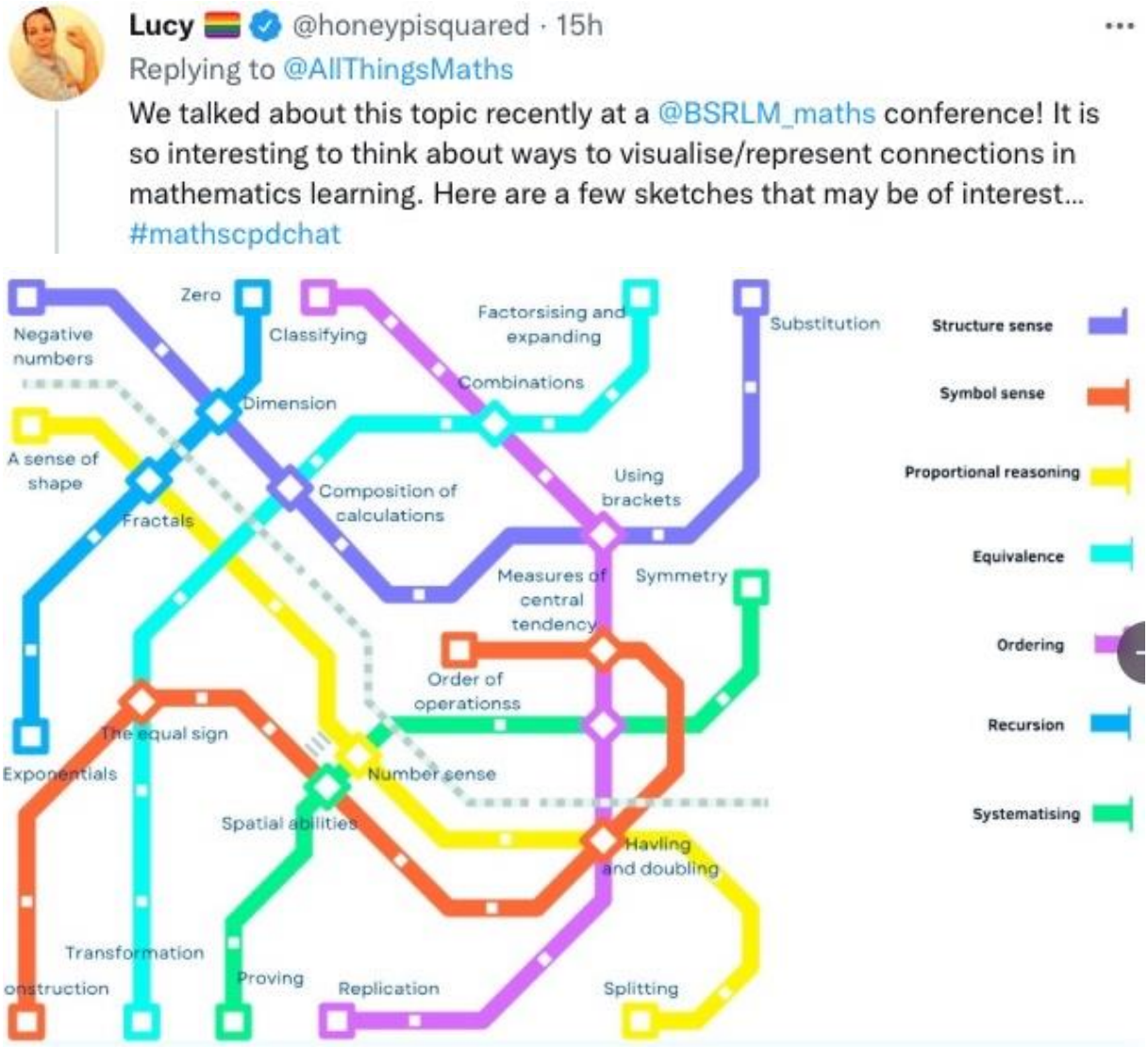
Catherine Edwards @Edwards08C · 15h

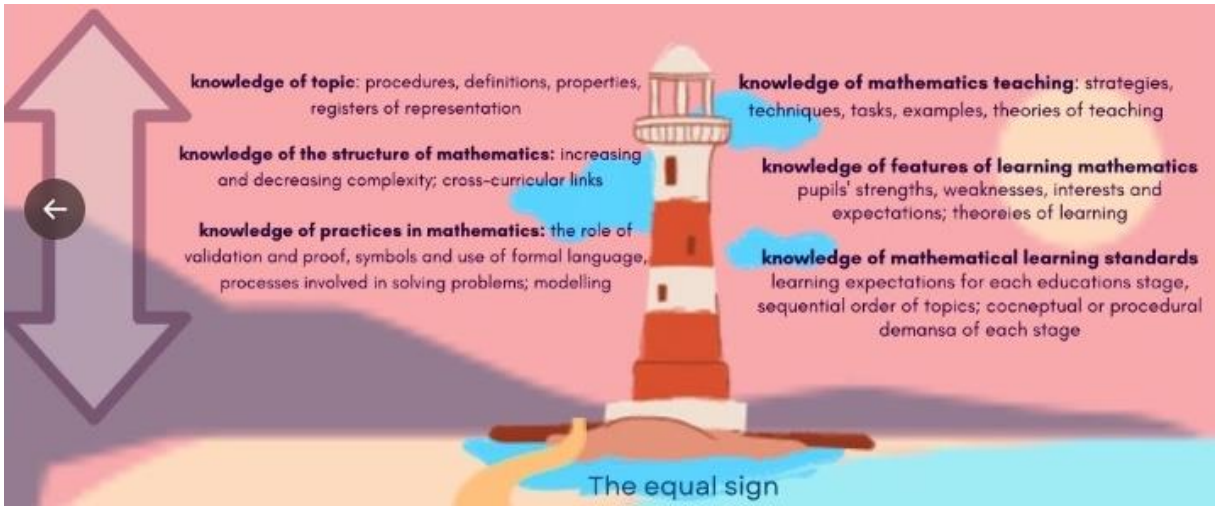
Just me at the moment... although if they use my resources it's all on there #mathscpdchat

Maryse #Antiracist @AllThingsMaths · 15h

It all starts somewhere I sometimes find it helps to share things I've already done with others. Shows the benefits and folks can learn from what I've done already! #mathscpdchat

… and these comments and images:





The host's first question also prompted interesting comments from a teacher who, unusually, has recently moved from primary school teaching to teaching maths in a secondary school:

Rob Shaw @TheEvolvingTchr · 14h

Good question. At this stage I'm not sure how to answer that one 😂

What I will say, is that I think I know the primary maths curriculum well, so it has been eye opening to see the drop off for those Y7s and even Y8s from where they might have been at the end of Y6.

Maryse #Antiracist @AllThingsMaths · 14h

I've become increasingly aware of the work done in primary in maths and that drop off has always been a bugbear.

#mathscpdchat

Maryse #Antiracist @AllThingsMaths · 15h

Replying to @TheEvolvingTchr

I've been exploring ratio, simplifying fractions and enlargement recently. The skills and concepts are very transferable.

How do you make sure the students don't "get mixed up" between topics?
#mathscpdchat

Rob Shaw @TheEvolvingTchr · 15h

Ensuring chn work with the topic on more than one occasion. They see follow up Q's as part of our 5 a day (to start the lesson), days and weeks later. We also have a quiz every 4 weeks or so to understand what learning has been retained. A green pen lesson follows this.

Maryse #Antiracist @AllThingsMaths · 15h

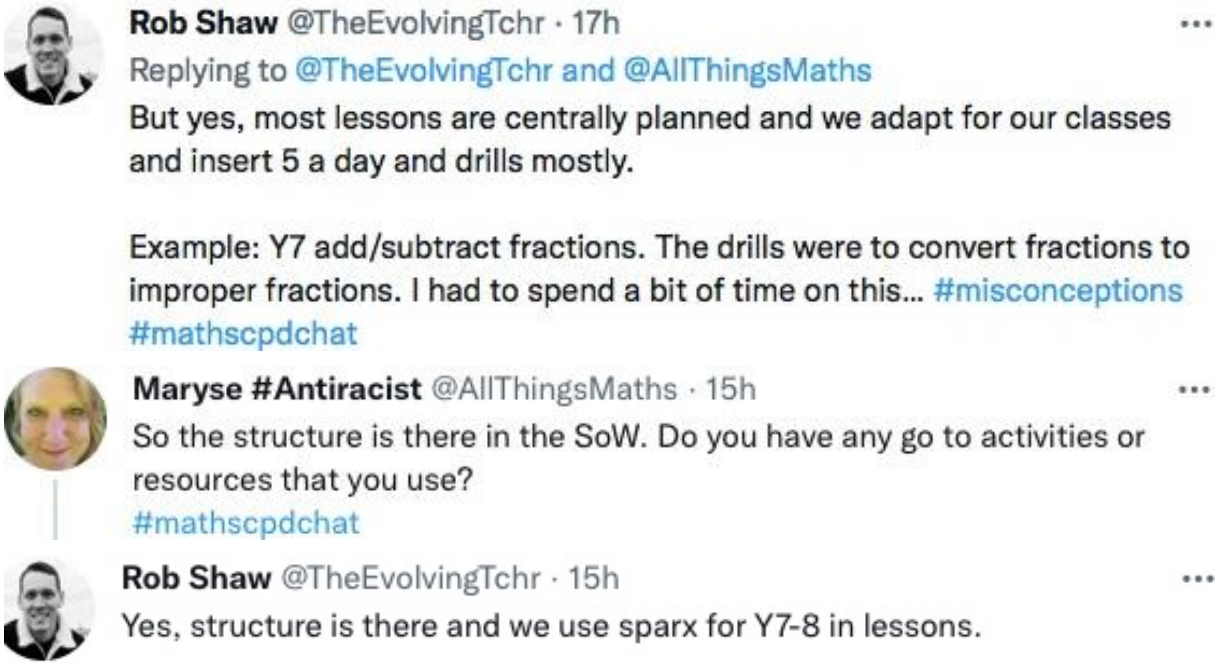
So this is aiding retention and fluency also! Is this all planned into your SoW centrally?
#mathscpdchat

Rob Shaw @TheEvolvingTchr · 15h

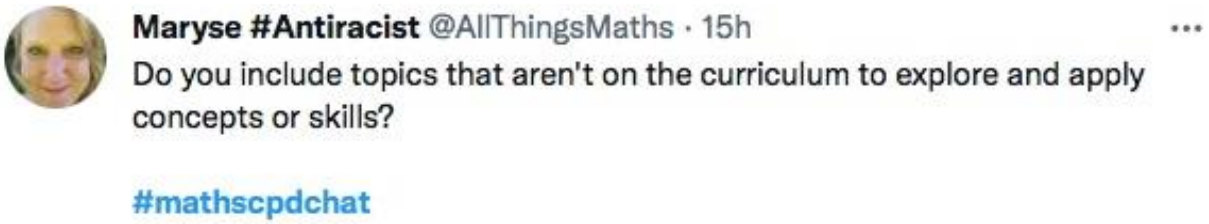
Each Cycle 12 weeks. Mid-cycle quiz week 3 and 7 and end of cycle quiz week 11/12. Six or so Qs... mix of easy and hard.

All 5 a day and drills are part of each lesson and this gives us a chance to recap content and enable chn to feel successful #fluency

#mathscpdchat



There were no replies to the host's second question …



… or to her third question …

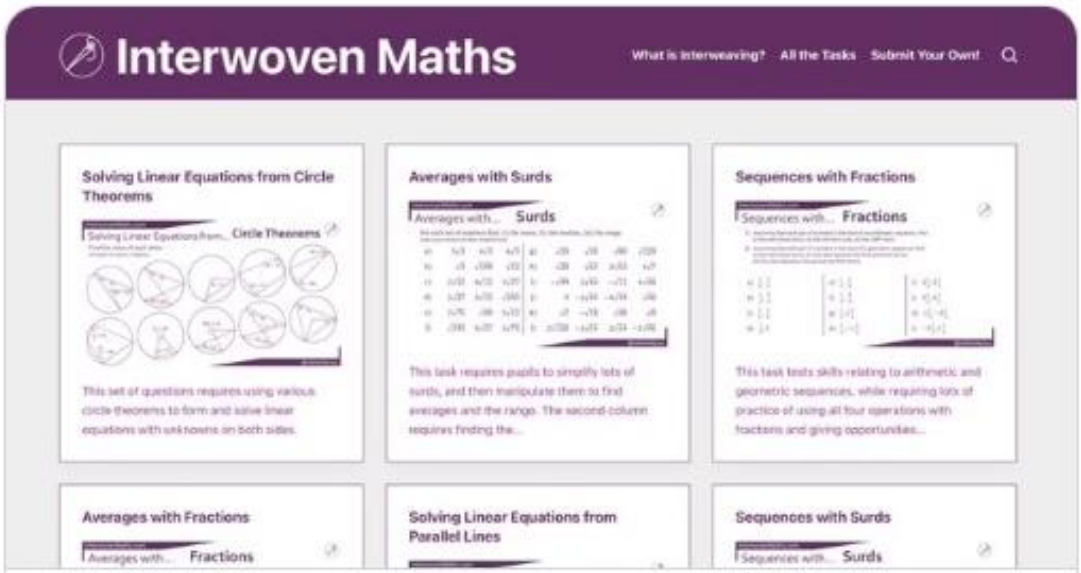
Maryse #Antiracist @AllThingsMaths · 17h

Do you have any "go to" resources for making connections? I've had a look at these questions, which apply skills in different topics but give an opportunity to embed and practise.

interwovenmaths.com

#mathscpdchat

Thank you @nathanday314



interwovenmaths.com
Interwoven Maths
Tasks interweaving different topics and ideas, and exploring the fundamental interconnectedness of all things mathematical.

… there was one reply to her fourth main tweet …

Maryse #Antiracist @AllThingsMaths · 17h

There are some great ideas for links between topics on the @NCETM website. Here's one example: ncetm.org.uk/in-the-classro..

#mathscpdchat

ncetm.org.uk
National Curriculum Resource Tool
National Curriculum Resource Tool

Oonagh Kelleher DDSL #Antiracist MCCT @OonaghKelle... · 16h

Replying to @AllThingsMaths and @NCETM

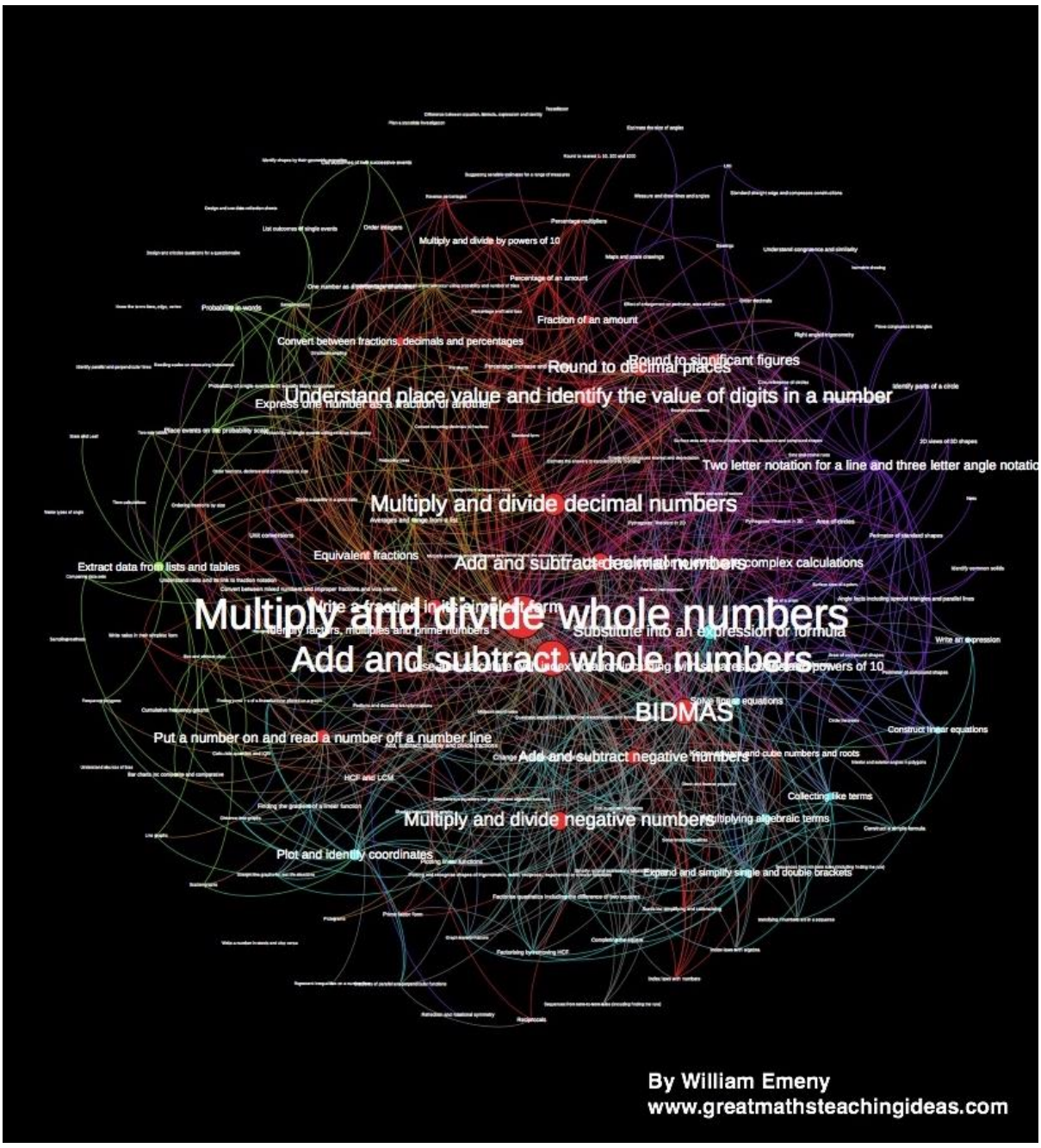
I love teaching maths- one of my happy places. Thanks for sharing

… but there were no replies to this fifth general comment from the host:

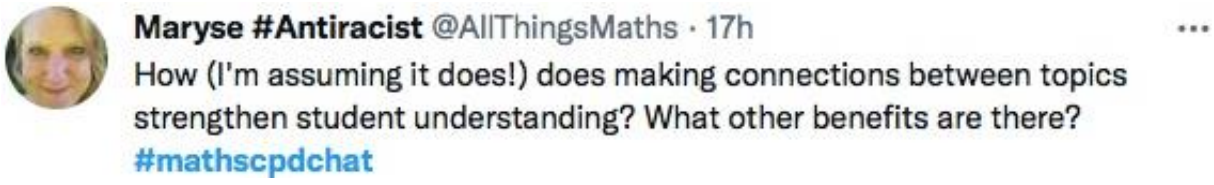
Maryse #Antiracist @AllThingsMaths · 17h

greatmathsteachingideas.com/wp-content/upl...

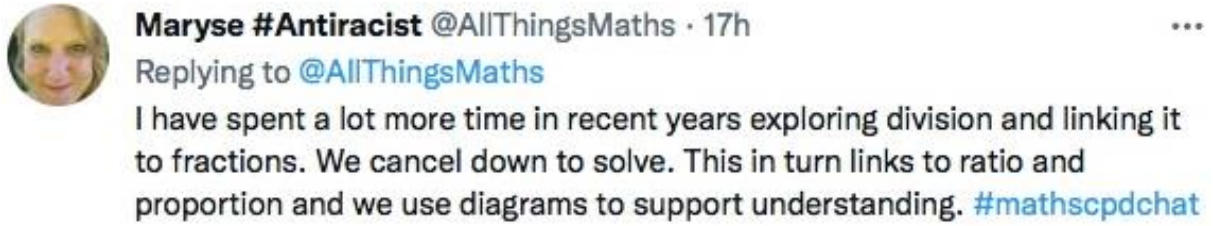
This was one resource I used with the department when starting this conversation. We couldn't stay doing one skill forever so how could we use links to be more efficient with time.



The (linked-to-Twitter) screenshots below show replies and conversations generated by the host's fourth question. Click on any screenshot-of-a-tweet to go to that actual tweet on Twitter. That is, the following conversations and replies were in response to this question from the host Maryse Dare …



… to which she replied with this tweet:



This short conversation was between Marc, Susan Whitehouse and Maryse Dare:

A longer conversation was initiated by Susan Whitehouse, and also included comments from Maryse Dare and Tazreen Kassim-Lowe:

Susan Whitehouse @Whitehughes · 17h

Yes, a virtuous circle with the two things reinforcing each other #mathscpdchat

Maryse #Antiracist @AllThingsMaths · 17h

Replying to @Whitehughes and @tershanah

Thank you! You've voiced the mist of that idea in my head! (What came first???). Virtuous circle!

#mathscpdchat

Susan Whitehouse @Whitehughes · 17h

I think that we need our students to expect Maths to make sense and many of them don't at the moment. But this building and reinforcing of their own mathematical landscapes is a very important part of making that happen #mathscpdchat

Maryse #Antiracist @AllThingsMaths · 17h

I think it's harder to get away with drilling students for exams too. We need them to understand their maths and not just be exam oriented. However, that investment pays off IMO, and for maths beyond GCSE too.

#mathscpdchat

A comment by Susan Whitehouse in the conversation above generated a short discussion between Susan, Maryse Dare and Mary Pardoe:

Susan Whitehouse @Whitehughes · 17h

So, in that way, I think it's essential if we're to develop students' problem-solving skills. But I also think it's very empowering and builds students' confidence - every time that an idea clicks into place with another one, Maths makes a bit more sense to them #mathscpdchat

Maryse #Antiracist @AllThingsMaths · 17h

Replying to @Whitehughes

Yes! I have found spending time on enlargement and trig really useful to ensure concrete understanding. #mathscpdchat

Susan Whitehouse @Whitehughes · 17h

Yes, all the tying together of enlargement, similar triangles, Pythagoras and trig is very powerful #mathscpdchat

Mary Pardoe @PardoeMary · 17h

Students may do that if they respond to tasks like those in here? ... atm.org.uk/Shop/Exploring... #mathscpdchat

Exploring Geometry with a 9 Pin Geoboard, Book and Download

A book to introduce your students to geometric reasoning, from visualising to calculating angles in shapes drawn on a circular 9 pin geoboard. Written by Geoff Faux. KS3 & KS4. Available from £16.50.

Non-Member Price: £22.00
Member Price: £16.50

Quantity 1 Add to cart

Exploring Geometry with a 9 Pin Geoboard Pack

A brilliant book to introduce your students to geometric reasoning. From visualising to calculating angles in shapes drawn on a circular 9 pin geoboard, this book covers the rigour of deductive reasoning With clear diagrams that can be projected or copied and a narrative that opens up the problems for any reader, Geoff Faux has written a book that deserves a place in the collection of every maths teacher.

The ideas included encourage problem solving while covering many areas of mathematics including angles, geometry, proof, justifying and reasoning.

Another comment by Susan Whitehouse (in the conversation about reasoning and 'noticing patterns across topics') prompted a conversation between Susan and Maryse Dare about developing teaching approaches together as a team:

Susan Whitehouse @Whitehughes · 17h

I think that we need our students to expect Maths to make sense and many of them don't at the moment. But this building and reinforcing of their own mathematical landscapes is a very important part of making that happen #mathscpdchat

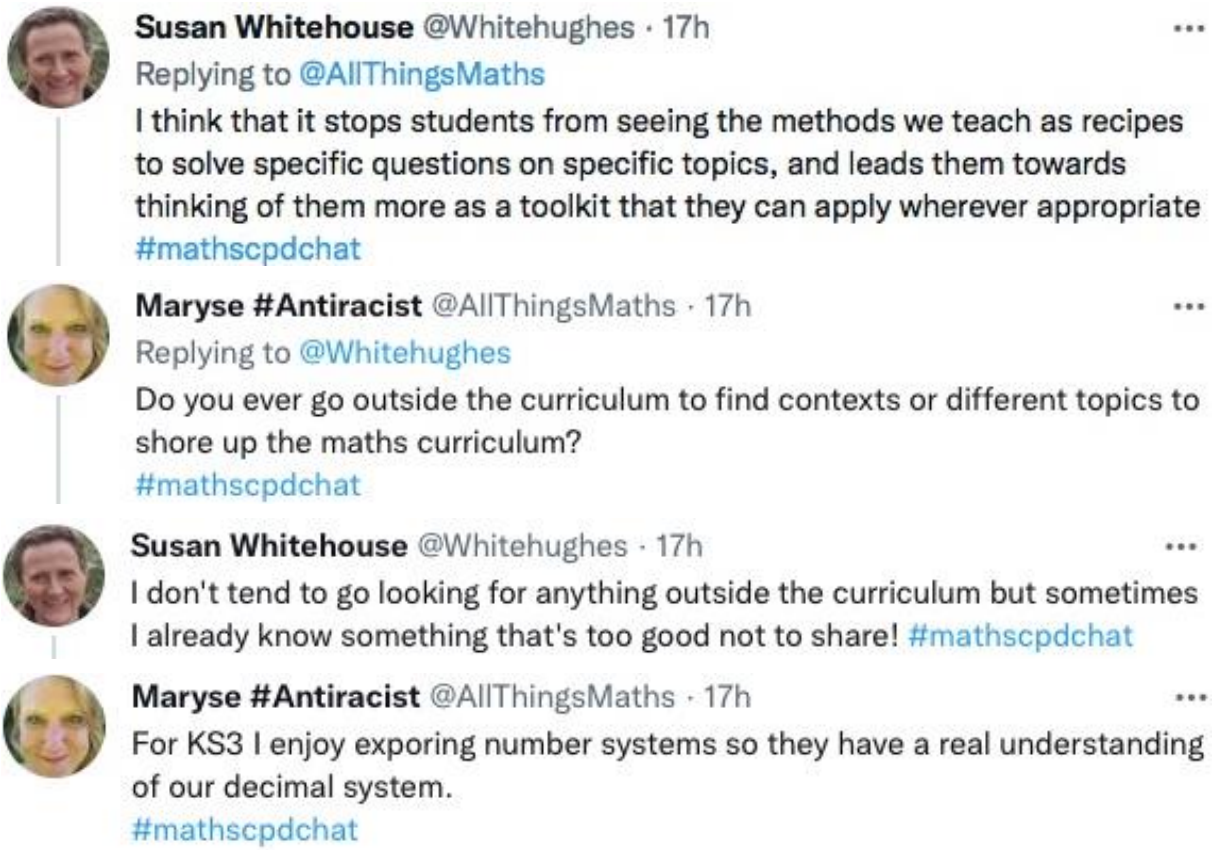
Maryse #Antiracist @AllThingsMaths · 17h

Replying to @Whitehughes and @tershanah

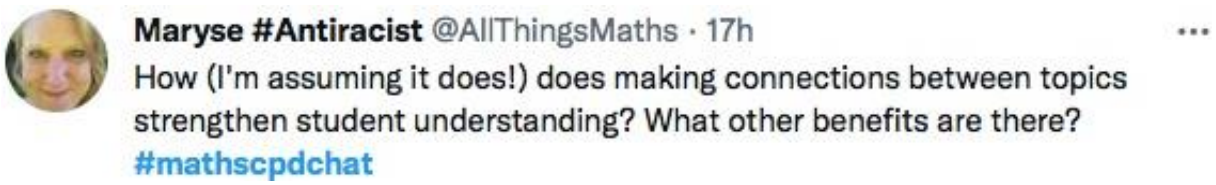
This is such an important point. And perhaps requires a bit of courage to take the time to do so. I truly believe (inc 5 years as HoD) that it's time efficient.

#mathscpdchat

Susan Whitehouse's original reply to the main question from the host, Maryse Dare, also prompted this interchange between the two of them:



This shows Nathan Day's reply to the main question from the host, Maryse Dare:



Nathan Day @nathanday314 · 17h

Replying to @AllThingsMaths

It forces/allows students to see tree as well as its fruits. (Apologies for the metaphor, I can't think of any other words to express what I want to say!)

#mathscpdchat

Maryse #Antiracist @AllThingsMaths · 17h

It's such a simple idea (when you see it - I haven't extended my own thoughts to doing it so thank you for sharing) with such huge potential and impact.

#mathscpdchat

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

There were no replies to this information-tweet from the host …

Maryse #Antiracist @AllThingsMaths · 17h

I found this video in the week. It threw up some thinking points for me.

youcubed.org/resources/tour...

youcubed.org

Tour of Mathematical Connections - YouCubed

This short tour shows the connected nature of math highlighting number sense, geometry, and algebra, under the big idea of ratio and ...

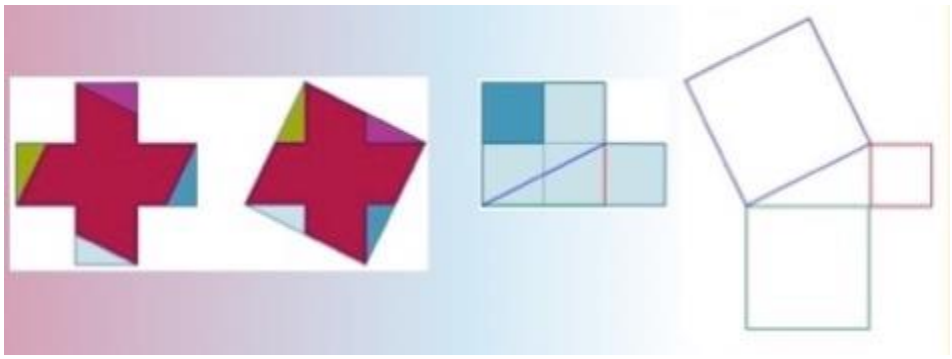
… but this tweet from the host generated a short interchange …

Maryse #Antiracist @AllThingsMaths · 17h

Some of my "go to" links…
I teach Pythagoras through area and cut out squares so students can fit 3^2 and 4^2 into 5^2
#mathscpdchat

Mary Pardoe @PardoeMary · 17h

Replying to @AllThingsMaths
Might also do that using some of Dudeney's Greek cross dissections?!!
#mathscpdchat
Article here: ncetm.org.uk/resources/24971 (not sure if it still works.)



Maryse #Antiracist @AllThingsMaths · 17h

Oooh - that's one to read later on!
#mathscpdchat

Maryse #Antiracist @AllThingsMaths · 17h

Replying to @AllThingsMaths
I also use area for expanding brackets although students often start to "short cut" to expanding without grids.
#mathscpdchat

… and there were two replies to the host's last question. We will let Susan have the final say in this summary!

Maryse #Antiracist @AllThingsMaths · 17h

We're entering the last 5 minutes of **#mathscpdchat** and I've got loads I'm taking away with me! I hope others have to.

If we think linking topics and applying concepts is the way forward, how can we support other staff to do this?

Maryse #Antiracist @AllThingsMaths · 18h

Replying to @AllThingsMaths

One idea came through this evening that we can model first to support staff. The questions from @nathanday314 could be easily shared too #mathscpdchat

Susan Whitehouse @Whitehughes · 18h

Replying to @AllThingsMaths

Joint planning looking for links between topics, and not testing every five minutes, spring to mind! I think you are so right about it needing to be the ethos of the Department #mathscpdchat