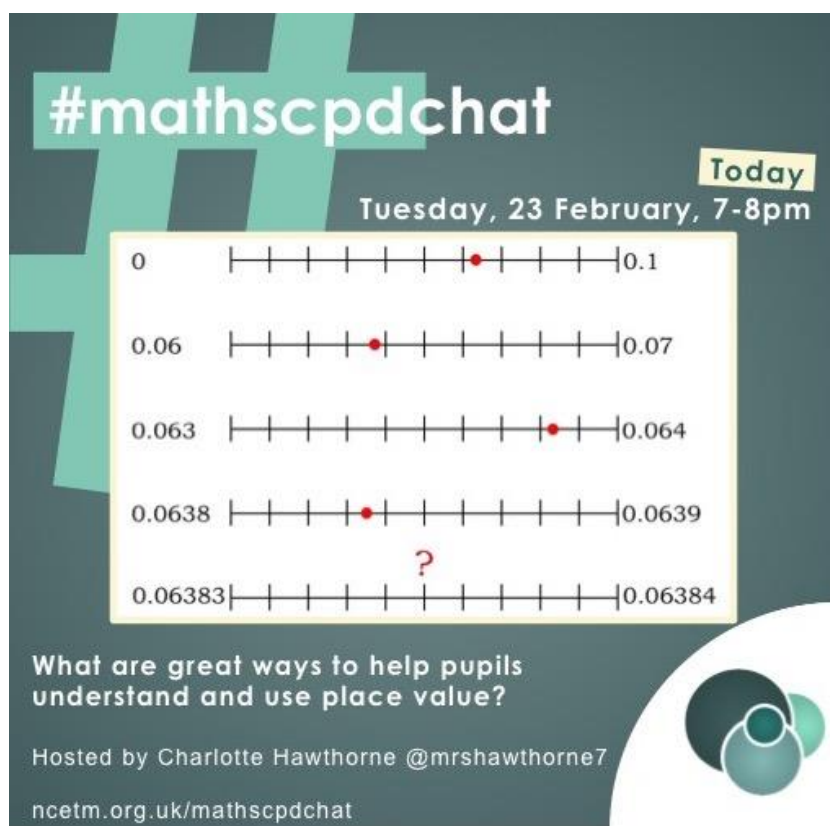


#mathscpdchat 23 February 2021

What are great ways to help pupils understand and use place value?

Hosted by [Charlotte Hawthorne](#)

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



Among the links shared during the discussion were:

[Dienes Blocks \(manipulative\)](#) which is one of MathsBot's many useful manipulatives created by [Jonathan Hall](#). It was shared by [Charlotte Hawthorne](#)

[Mr Coward Maths](#) which is a website from which you can freely download (as PDF files) tasks that are designed to help pupils work with place value in bases other than base 10. It was shared by [Charlotte Hawthorne](#)

[Arithmetic](#) which is a book by Paul Lockhart in which the author reveals arithmetic not as the rote manipulation of numbers, but as a set of ideas that exhibit the fascinating and sometimes surprising behaviours usually reserved for higher branches of mathematics. It was shared by [Simon Gregg](#)

[Planning to teach place value](#) which is one of the NCETM's *Planning to Teach Secondary Maths* videos (each with its own freely-downloadable printable guidance, which includes the PowerPoint slides used in the video) in each of which an experienced teacher provides support for the teaching of a particular topic. It was shared by [Sam Blatherwick](#)

[Exploding Dots](#) which are YouTube videos by James Tanton. It was shared by [John O Connor](#)

[Journeys on the Gattegno Tens chart](#) which is an article from NRICH by Alf Coles, in which he offers stories from a project that aimed to tackle student under-achievement in primary mathematics. It was shared by [Mary Pardoe](#)

[Activities on the Gattegno Tens chart](#) which is another article from NRICH by Alf Coles which follows on from the one above. It was shared by [Mary Pardoe](#)

[The GattegnoTens Chart \(manipulative\)](#) which is another one of MathsBot's many useful manipulatives created by [Jonathan Hall](#). It was shared by [Mary Pardoe](#)

[Factorising with Multilink](#) which is an unusual task (that involves numbers in bases other than 10) from NRICH (inspired by the ideas of Kenneth Ruthven and Paul Andrews). Students try to make rectangles to represent quadratic expressions with sets of squares-of, sticks-of and single multilink cubes. It was shared by [Dani Quinn](#)

[Can't calculate? Could place value be the culprit?](#) which is a well-illustrated Herts for Learning blog by Gill Shearsby-Fox. The author offers intervention strategies to help pupils avoid errors caused by lack of understanding of place value. It was shared by [Rachael Brown](#)

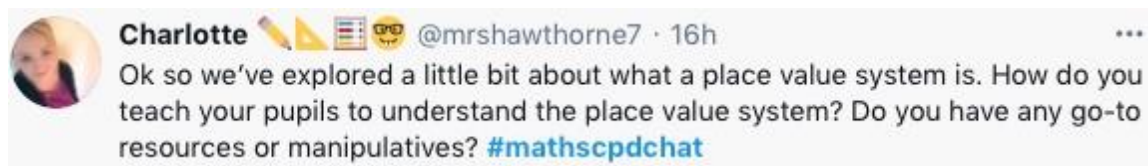
[These cups should have a place in any classroom!](#) which is a blog by Magical Educator ([Tessmaths](#)) in which an unusual and effective way to help pupils understand place value is described and illustrated. It was shared by [Julia Smith](#)

[Pi in the Sky: Counting, Thinking, and Being](#) which is a book by John D Barrow, described as a profound, and profoundly different exploration of the world of mathematics. It was shared by [Atul Rana](#)

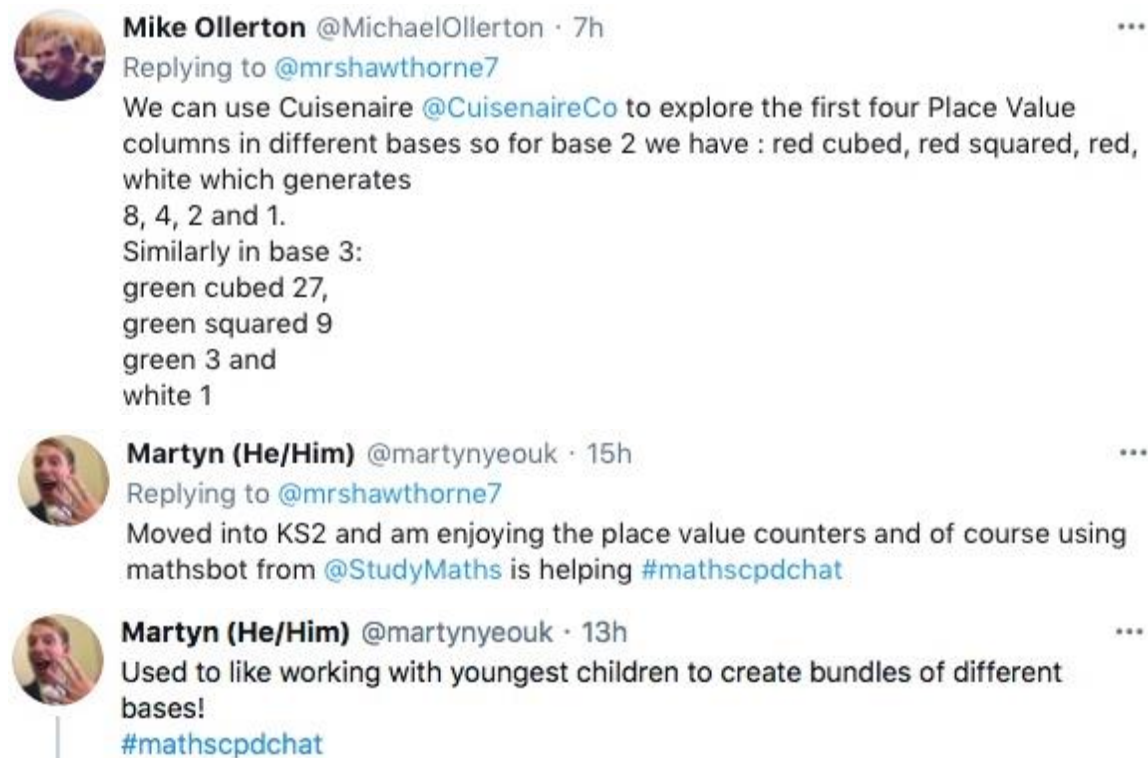
[Jake Thackray 'Molly Metcalfe'](#) which is a poem/song/talk involving a curious way of counting sheep. It was shared by [David Bedford](#)

The screenshots below, of chains of tweets posted during the chat, show parts of several conversations about the wide range of attractive materials, both online and real, that teachers use to help pupils understand and work with place value! **Click on any of these screenshots of a tweet to go to that actual tweet on Twitter.**

The conversation was generated by this tweet from [Charlotte Hawthorne](#):



and included these from [Mike Ollerton](#), [Martyn Yeo](#) and [Chris](#):





Charlotte 🖍️ 📏 📊 😊 @mrshawthorne7 · 13h

Egg boxes offer a nice context for this, possibly? #mathscpdchat

Task 1 – Egg boxes

Eggs can be packaged in a few different sized boxes, these are some of the most common:



4 egg box



6 egg box



10 egg box



12 egg box

- If you had 91 eggs, how many boxes would you need if you used only the following sized boxes (also say how many eggs you have left that don't fill a full box – this is your **remainder**):
 - 4 egg box
 - 6 egg box
 - 10 egg box
 - 12 egg box
 - Which one was the easiest to work out?



Martyn (He/Him) @martynyeouk · 13h

Love a good egg box! #mathscpdchat

these from [Mary Pardoe](#), [Jonathan Hall](#) and [Charlotte Hawthorne](#):



Mary Pardoe @PardoeMary · 14h

... there are endless possibilities for ways of using the Gattegno Tens Chart to generate thought and discussion in which place-value matters ... depends on what you want pupils to think about ... another e.g. ... #mathscpdchat



How could you combine the three 'green' numbers to make the 'white' number?

				50000					
100									
1		3							

$$(50000 - 100 \times 300) \div 10000 + 1 = 3$$

$$(50000 \div 100 - 300) \div 100 + 1 = 3$$

$$(50000 \div 500 + 100) \div 100 + 1 = 3$$





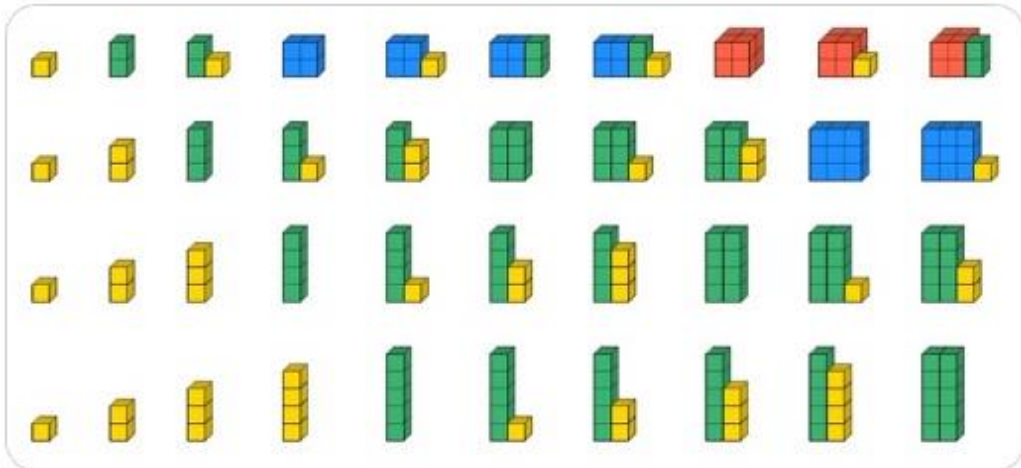
Jonathan Hall @StudyMaths · 15h

...

Replying to @mrshawthorne7

I've tweeted this at least 100 times before (base 2), but I really like counting in different bases using Dienes.

This is one to ten in base 2, 3, 4 and 5. #mathcpdchat



3

8

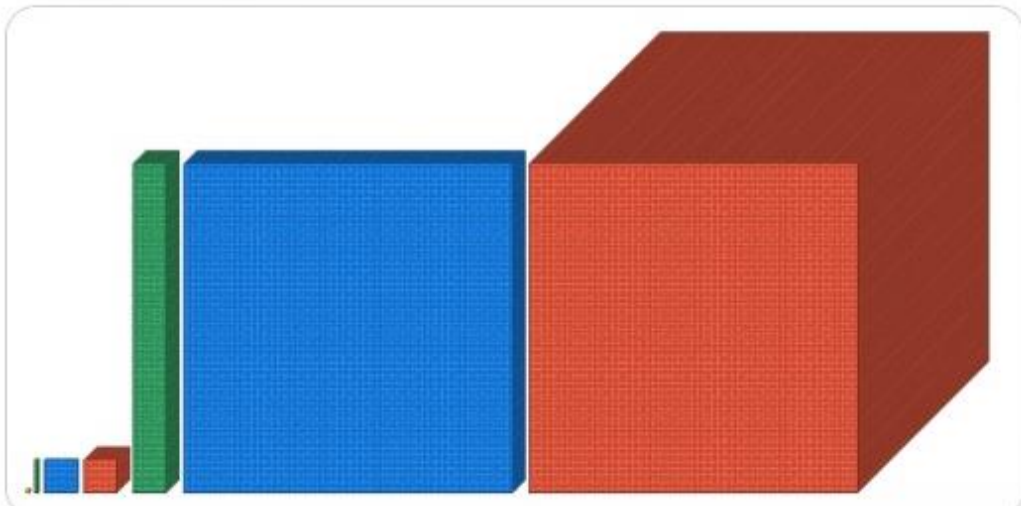
23



Jonathan Hall @StudyMaths · 15h

...

And if you zoom out enough in the Dienes I like to show the relative size of one million. #mathscpdchat



Chris @cp2242 · 15h

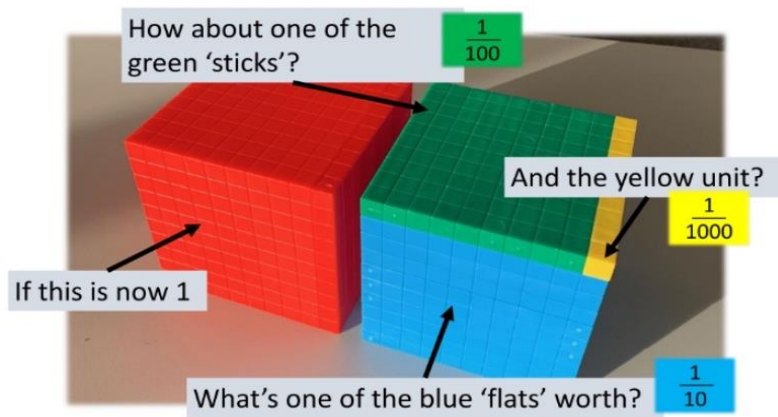
...

Replying to @mrshawthorne7

Dienes blocks definitely have a place. This year I linked place value grids to standard form and did conversions, adding and subtraction with reference back to place value grids. At the very least, confirmation bias told me it was very effective

these from these from [Charlotte Hawthorne](#) and [Catherine Edwards](#)

Charlotte 📏📐📊🧮 @mrshawthorne7 · 16h
Replying to @cp2242
Yes! I use Dienes. #mathscpdchat



Catherine Edwards @Edwards08C · 15h
I'm a big dienes block fan. The maths bot ones are great.

Charlotte 📏📐📊🧮 @mrshawthorne7 · 15h
[mathsbot.com/manipulatives/...](https://mathsbot.com/manipulatives/) They certainly are! Thanks @StudyMaths :)
#mathscpdchat

these from these from [Simon Gregg](#) and [Charlotte Hawthorne](#):

Simon Gregg @Simon_Gregg · 17h
Replying to @StudyMaths and @mrshawthorne7
Nice. Then there's Exploding dots #mathscpdchat

Simon Gregg @Simon_Gregg · Sep 10, 2018
Trying out exploding dots with Gr 3 #explodingdots
explodingdots.org/station/11S1
[Show this thread](#)

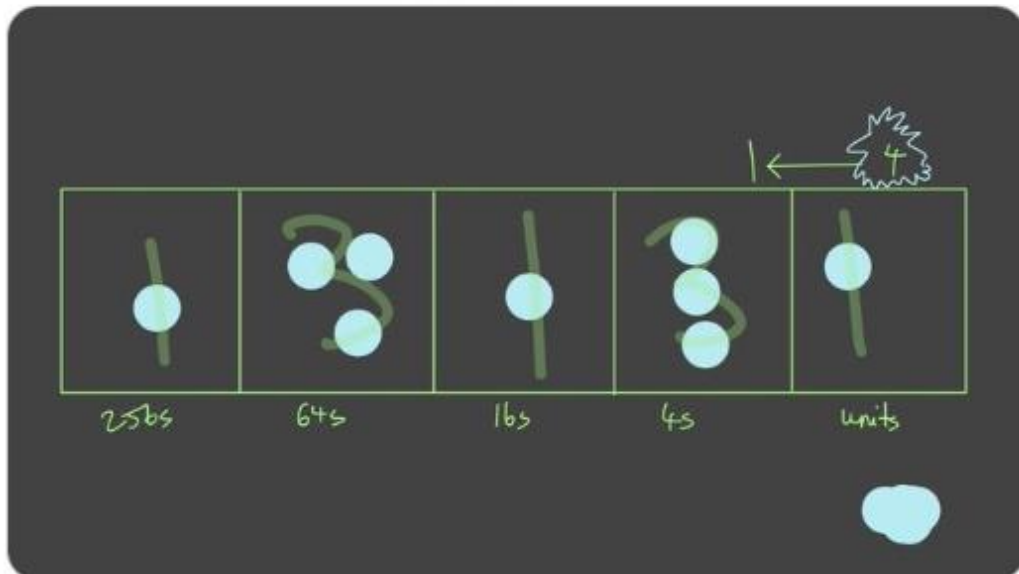


Simon Gregg @Simon_Gregg · 17h ...
Replying to @Simon_Gregg @StudyMaths and @mrshawthorne7
There's also lovely writing about teaching this in Paul Lockhart's book Arithmetic. #mathscpdchat

Charlotte 📏📐📊🧐 @mrshawthorne7 · 17h ...
One of my favourite books! "Numbers are what they are, they do what they do" #mathscpdchat

these from [Atul Rana](#), [Laura](#), [Charlotte Hawthorne](#) and [Kirsty Fish](#):

Atul Rana @atulrana · 16h ...
Replying to @mrshawthorne7
Exploding dots are my go to representation for teaching tutees about place value in various bases #MathsCPDchat



Laura @LauraWheeler5 · 16h ...
I have been teaching exploding dots in my online lessons with Year 7. I loved introducing base 2 and 3 first and then bringing in base 10 machine to see their reaction #mathscpdchat

Charlotte 📏📐📊🧐 @mrshawthorne7 · 16h ...
Replying to @danicquinn @LauraWheeler5 and @atulrana
It's great! Lots of you-tube videos by @jamestanton #mathscpdchat

Kirsty Fish @Kirstymaths · 16h ...
Replying to @Arithmeticks @danicquinn and 3 others
exploding dots is awesome!
If you get to the island of Antidotia there's a level called subtraction, where you will finally discover the sound made by a zero pair 🤪

these from [Mary Pardoe](#), [ARITHMETICA](#) and [Vicky Osborne](#):



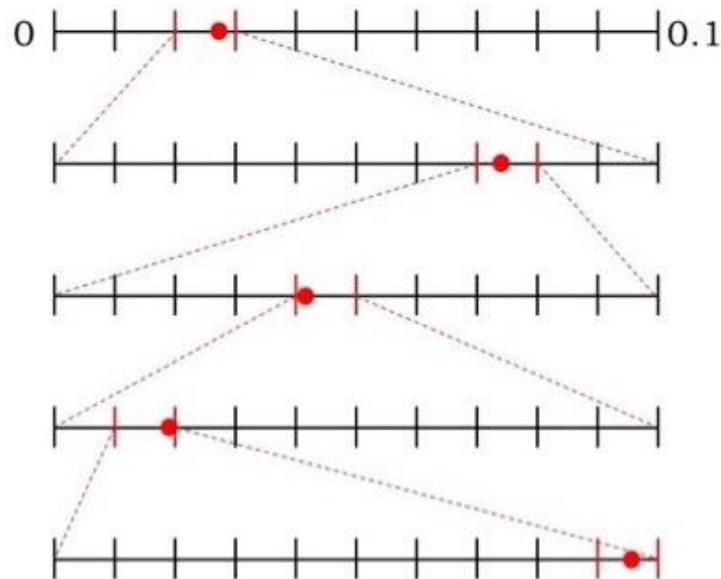
Mary Pardoe @PardoeMary · 17h

...

Students sometimes think they really understand how to use place value ... until it comes to rounding to a particular number of dp
... e.g. have you tried them on this kind of thing?

... or make-up (draw) their own similar challenges ... not as easy as it looks!

#mathscpdchat



What number correct to 6 decimal places does this represent?

What number correct to 5 decimal places does this represent?

What number correct to 4 decimal places does this represent?



ARITHMETICA @ARITHMETICA3 · 2h

...

Replying to @PardoeMary

This is a nice visual approach to representing decimal accuracy. I think it helps a lot as part of an educators tool kit.



Vicky Osborne @CheerVix · 17h

...

Replying to @PardoeMary

I use these a lot :)

and these from [Dani Quinn](#) and [Julia Smith](#):



Dani Quinn @danicquinn · 15h

...

Replying to @mrshawthorne7

So, for the most confident students (and once you have covered quadratic factorisation), this prompt/activity from Nrich is an amazing way to look at different bases and make good use of multilink and Dienes:



Tessmaths @tessmaths · 17h

Replying to @mrshawthorne7

Sorry that I missed this (kettlebell class 🏋️) - will catch up shortly.
This topic reminds me of sessions I've done with primary...great fun and great conversations for @AuthorsAbroad_ magicalmaths.org/these-cups-sha..



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

Some of the areas where discussion focused were:

the host invited contributors to 'say' what they think 'a place-value system' is:

- a well-appreciated response from one teacher was that a place-value number system is ... **'a way of using relative position to indicate magnitude'** ... that teacher had 'been talking about it a lot with my 6 yo';

- several responses were close to the following description ... **‘a way of denoting the relative size of digits in a number when working in a specified base’**;
- another popular way of stating the meaning of place value was ... **‘the value of the place, or position, of a digit in a number’**;
- some teachers think of a place value system as **‘a system of counting objects using groups of a particular size ... as in 452 in base n is 4 groups of n^2 , 5 groups of n and 2 groups of 1’**;
- many teachers reported that they had **never thought deeply before about what a place value system is**;
- discussion developed about the **number symbols and systems of various cultures in the past** ... images of symbols were shared ... for example, of Egyptian Hieratic numerals, Cistercian numerals, and Roman numerals ... teachers mentioned getting pupils to appreciate the relative complexity of calculating in some ancient number systems;
- there was a short discussion in which **money calculations in the ‘old’ pounds, shillings and pence system were compared with calculations in the present decimal system** ... the relatively cumbersome nature of calculations using non-metric units when compared with calculations using metric units was also briefly discussed;
- the extent to which pupils understand the meanings of, and **can or can’t distinguish between, ‘number’, ‘numeral’ and ‘digit’** was mentioned;
- teachers discussed the fact that ‘many a student can tell me the names of the columns but their understanding of the relevant magnitude and links to powers of 10 is lacking’ ... that sometimes **students ‘think place value is babyish’**;

the host prompted contributors to discuss whether/how in their teaching they focus on number systems other than the base 10 place-value system:

- several teachers mentioned ‘pebbles in a bowl’ and other curious **ways of counting sheep** (link to a ‘song’ is provided above);
- there were some more tweets about using **Roman numerals**;
- the **discussion focussed for some time on teaching and learning about place value systems in which the base is not 10** ... ‘I LOVE looking at other bases with all my classes’ ... ‘used to like working with youngest children to create bundles (and bundles of bundles) of different bases’ ... ‘I think we need some experimentation with bases other than decimal’;
- that egg boxes of different sizes are useful as materials to help pupils **explore the representation of numbers in various different bases**;
- a teacher mentioned that pupils’ knowledge of, and **ability to work in, bases other than base 10 is not presently formally assessed in the UK** ... but also wrote ‘if it helps them grasp that the columns are more than just bigger and smaller, but growing by a defined multiple each time, then I think it has a benefit’;

how teachers use resources and manipulatives to help pupils understand the place value system:

- some teachers like pupils to use **Dienes** blocks to explore counting in different bases as a way of helping them understand place value;
- there was a long discussion about ways in which teachers use the idea of '**Exploding dots**' (link provided above) to introduce pupils to, and to help them explore, place-value number systems with different bases ... 'I have been teaching exploding dots in my online lessons with Year 7. I loved introducing base 2 and 3 first and then bringing in base 10 machine to see their reaction' ... 'I found the younger my pupils were the easier it was for them to grip multi-base';
- teachers discussed 'excellent **place value tasks**' that **help pupils think about how place value 'works' while the teacher sees what pupils do or don't understand** ... for example, 'write a five-digit number with thirteen tens';
- teachers who use the **Gattegno Tens Chart** (particularly an online interactive one – link provided above) find that it provides endless possibilities for challenging pupils in ways that generate thought and discussion 'in which place value matters';
- teachers repeatedly stated that they find that **exploring place value with different bases** helps pupils grasp the significance of 'the columns' ... how their values 'grow';
- a teacher mentioned that pupils can use **Cuisenaire® rods** 'to explore the first four place value columns in different bases' ... for example 'for base 3 we have: green cubed, green squared, green, white, which generates 27, 9, 3, 1';
- some teachers challenge pupils to represent numbers rounded to various decimal places by **drawing images of (connected) number-line segments in which the scales are progressively 'magnified'** ... 'students sometimes think they understand how to use place value until it comes to rounding to a particular number of decimal places';
- a teacher directed attention to a task in which pupils use multilink cubes to focus in an unusual and interesting way both on the **factorising of quadratic expressions and the possibility of using different number bases for a place-value number system** (link provided above);

ways of challenging pupils to think more deeply about place value, and of supporting those who seem to be struggling:

- that 'so many things link in' to the idea of place value ... 'I've been **using it with the metric system a lot more, looking at links between prefixes and place value**';
- working with the **Gattegno Tens Chart** was discussed again;
- that exploring the '**1089 task**' (pick a 3-digit number, reverse it, take the smallest number from the largest, repeat until the result eventually is 1089) in various different bases can be illuminating;

- a useful task is generated by presenting students with the number **987,654,321** and challenging them to write in order the next ten largest numbers that can be made using all the digits from '1' to '9' each once only;

the host asked for 'top tips' for teaching place value:

- be clear and consistent in the way that you use the words '**number**', '**digit**' and '**numeral**';
- **use 10^n (... 10^{-3} , 10^{-2} , 10^{-1} , 10^0 , 10^1 , 10^2 , 10^3 , ...)** for **column headings** 'instead-of/as-well-as the names ... thousands, hundreds, tens, ones/units, tenths, hundredths ... there was some discussion about whether to use 'ones' or 'units' as the heading of the first column to the left of the decimal point;
- explore place value using **Dienes blocks** and '**exploding dots**';
- 'look at place value in **multiple bases**';
- 'definitely **don't rush it** – it builds into so many things'.