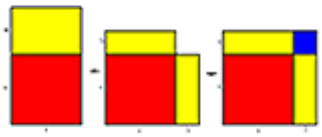
Secondary Magazine 140

National Centre for Excellence in the Teaching of Mathematics

Welcome to the first Secondary Magazine of 2017, covering the first half term of the year. Inside we have a feature on the NCETM's Secondary Mastery Specialists Programme, meeting participants at their first series of workshops. And we sample a contemporary discussion about the use of language in mathematics lessons by linking to a new blog from Jemma Sherwood.

Don't forget that all previous issues are available in the Archive.



Teaching for Mastery in Secondary

"Teaching for mastery"… what does it mean to you? Something hovering at the edge of your consciousness, or something you are trying to implement in every lesson? Most secondary teachers are somewhere between the two, but it's fair to say we are a way behind some of our primary colleagues.

Using Correct Mathematical Language

How often have you found yourself, in your classroom, subconsciously mimicking your pupils' use of language? Does it matter? Jemma Sherwood, Head of Maths at Haybridge High School, Stourbridge, thinks it does matter, and she's explained why in a recent blog, *The Importance of Vocabulary*.

And some other things to draw to your attention:

- After you've read this issue's feature Using Correct Mathematical Language, you might want to share your thoughts in our weekly Twitter #mathscpdchat discussion on **21 February**, 7-8pm, which will focus on pupils' use of mathematical language.
- A new case study in the teaching for mastery section of our website tells how a Maths Hub secondary school in London has moved away from putting pupils into ability sets in Years 7 and 8.
- In a recent blog post, the NCETM's Director, Charlie Stripp discusses the potential benefits when secondary maths teachers are timetabled to teach fewer year groups. In a guest blog, Hande Kiamil, a Secondary school Head of Maths, relates how she and her department have moved in this direction over the last couple of years.
- Finally, with support from the NCETM, the UCL-Institute of Education is running a series of conferences around the country, examining what the PISA and TIMMS results mean for school maths; you can book your free place now.

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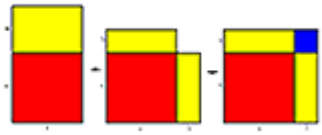


National Centre for Excellence in the Teaching of Mathematics

Teaching for Mastery in Secondary Schools

"Teaching for mastery"… what does it mean to you? Something fluttering around at the edge of your consciousness, or something you are trying to implement in every lesson? Most secondary teachers are somewhere between these two extremes, but it's fair to say we are a way behind some of our primary colleagues.

Due to a substantial national programme, aiming to reach 8400 primary schools by summer 2020, many primary schools are well advanced in introducing an approach known as 'teaching for mastery'. Taking transferable elements from high-performing jurisdictions in the Far East, teaching for mastery promotes deep, connected and secure understanding, by extending the time spent learning each topic and by breaking concepts down so that mathematical structure is exposed. Conceptual understanding and procedural fluency are developed hand in hand.

In secondary maths departments, time is often spent wondering if we have sufficiently good understanding to teach that tricky GCSE topic well, or whether we can really find ways to help our Foundation students to understand trigonometry. How much time do we spend interrogating our own (or our students') understanding of fundamental concepts? For example:

- Why does the 'bus-stop' algorithm for division, start on the left-hand side when all the other standard algorithms for the four operations, start on the right? And why does the algorithm work?
- What are we doing when we 'borrow' to subtract, and why don't we pay it back?
- Why would almost all of us, when faced with the question:

  Which is larger: $\frac{3}{7}$ or $\frac{1}{6}$?

  immediately begin finding a common denominator rather than a common numerator (ie $\frac{1}{6} = \frac{3}{18}$ so $\frac{3}{7} > \frac{3}{18}$)?

We often appreciate that it is an insecure understanding of basic concepts that holds our students back, but little of our attention is focused on how to teach these concepts to students that haven't managed to understand them in primary school.

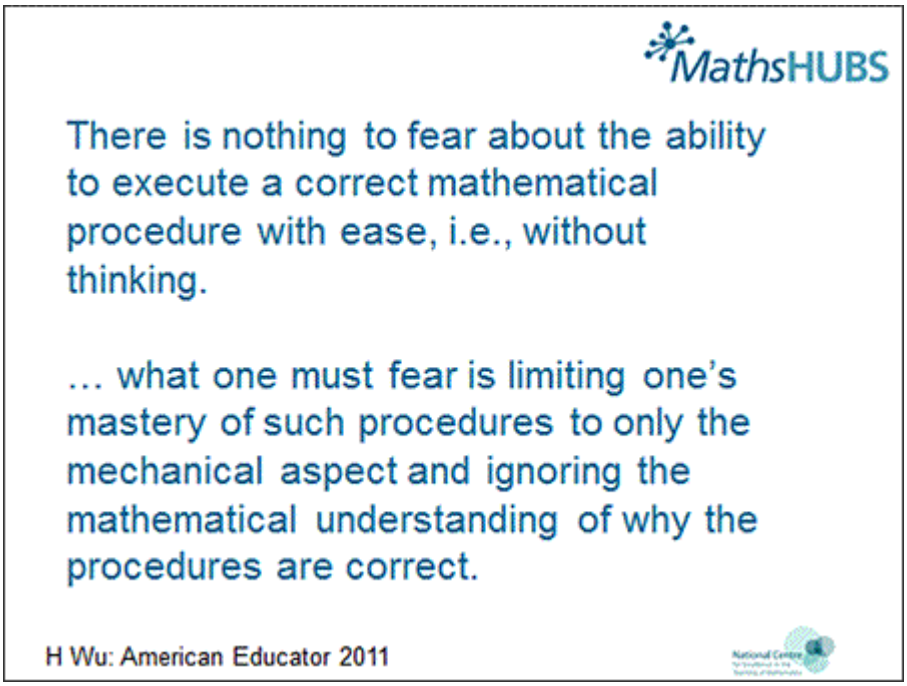
A Mastery Specialists Programme for Secondary

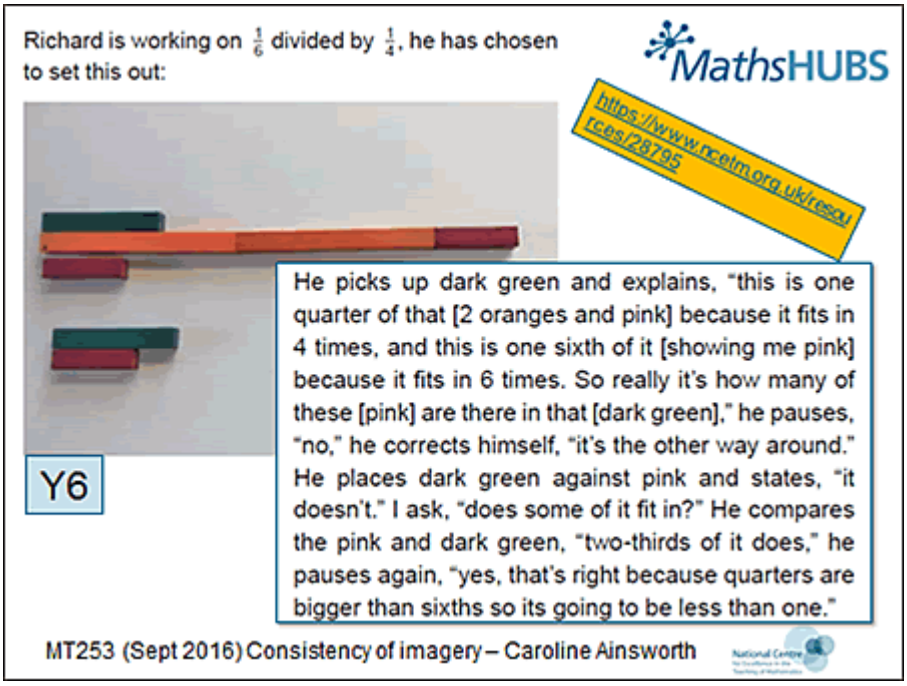
Following the success of the Primary Mastery Specialists Programme in 2015/16, where 140 primary teachers participated in a series of three residential professional development courses run by the NCETM, there was a swell of enthusiasm to provide something similar for the secondary sector. While the primary programme was driven from above, the secondary programme was the product of grassroots pressure and initiative from the Maths Hubs – particularly from those teachers that had been involved in visiting Chinese maths classrooms in autumn 2015.

The programme, which started in autumn 2016 (jointly designed and led by the NCETM and three Maths Hub Leads) describes itself as a "collaborative effort to define teaching for mastery at secondary". This is clear acknowledgement of the new territory being explored in this country, an invitation to participants to try things out and take an active role in ascertaining what seems to work in their classrooms and what doesn't, and allowing this to contribute to a building definition of teaching for mastery in the UK.

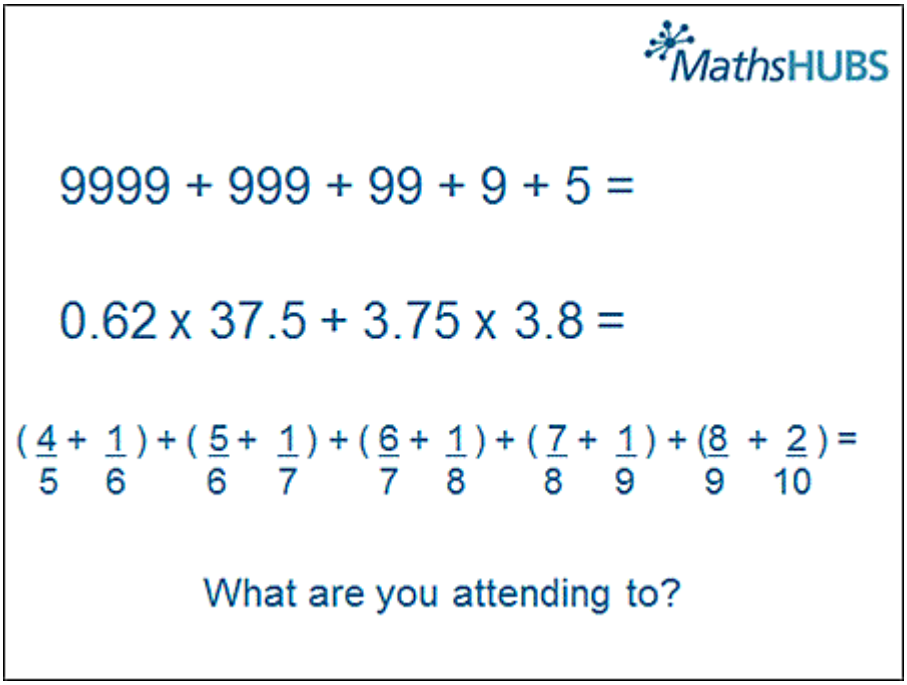
Each of the 35 Maths Hubs has up to four secondary teachers attending the residentials. Each of these teachers is expected to engage with and support colleagues in their department with trying out different features of teaching for mastery. Later in the programme they will be asked to share their learning more widely with interested colleagues in neighbouring schools.

At Residential 1, in the first term of 2016/17, participants spent time discussing what they understood by 'teaching for mastery' and then looking at how it could be used to support coherent and connected learning of mathematical concepts. An early session addressed the co-dependent requirements of conceptual understanding, and procedural fluency:





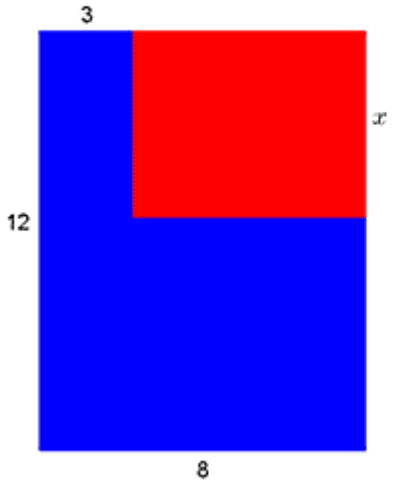
There was a session on 'variation theory' and how these ideas could be used to choose or construct examples and exercises to focus pupils' attention on specific structural features of the mathematics:



Connecting directly to the thorny area of algebra was a session using plenty of geometric imagery to expose the structure of algebraic algorithms:

MathsHUBS

What do you see?



$96-5x$

$36+5(12-x)$

$8(12-x)+3x$

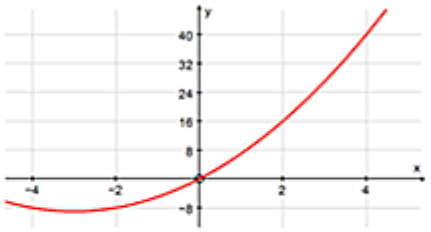
MathsHUBS

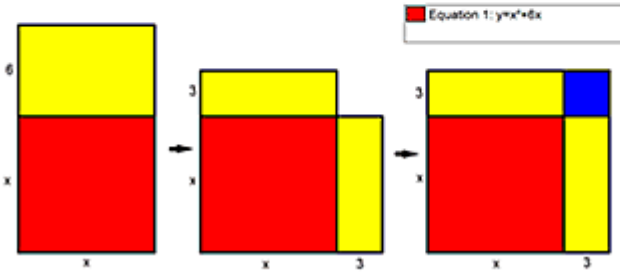
Multiple representations

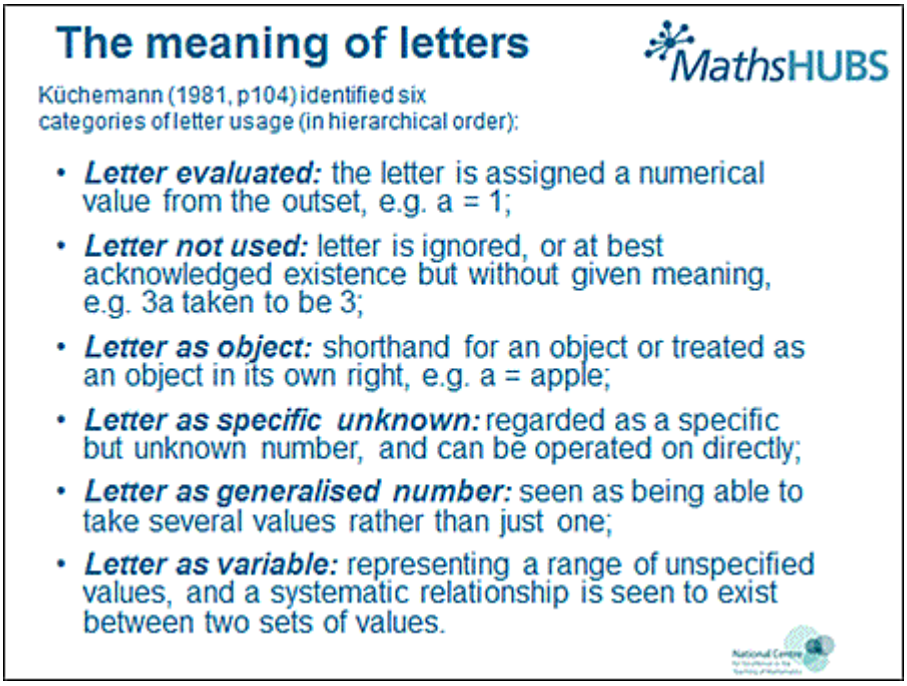
$y=x(x+6)$

$y=x^2+6x$

$y=(x+3)^2-9$







Among the teachers on the Secondary Mastery Specialists Programme, the range of experience of teaching for mastery is enormous. Some are from academy chains that have already adopted a mastery approach, written a scheme of work with supporting materials, and established strong patterns of collaborative professional learning to support the changes. Others are lone heads of department, interested in the approach and wondering about how to implement it in their own schools.

> *I applied because I think the new GCSE, with the problem-solving element has highlighted that we have very bright students but they are not able to see the bigger picture and link things together. They don't always have those connections that you would think they should have, with able students. So to me that's a failing on our part. It needed us to rethink what we did. And mastery seemed to address that – looking deeper, with more breadth, and the connections element was key. It could be challenging for my staff because they tend to think, because we have bright kids, we should push them along, but I definitely see with the students when they get to A level, that they've got gaps (Head of Department at a grammar school in Cumbria).*

> *I'm here because my head of department recognised that this is how I teach anyway, and I want to enhance this and talk to other people who value this way of teaching. I'm very visual, so concrete and pictorial is where I start. I'll invite students to use algorithms but I want them to understand what is going on. Rounding to ten for example – I see the two numbers, and then we decide where it is in terms of halfway – we don't have a procedure of 'do this, then this, then the answer's this' (teacher of 17 years' experience, Oldham).*

Finding Out More

As the Maths Hubs have made clear, it won't be long before secondary teachers begin to encounter Y7s who have had an increasingly significant diet of maths taught using 'teaching for mastery' principles. Hopefully they will be impressed by the depth of understanding the Y7s bring, and the way that this allows them to manipulate numbers in a confident and efficient way to solve problems. As this begins to happen, more and more secondary teachers will be looking for 'teaching for mastery' approaches to secondary maths topics. Contact your local Maths Hub to find out about 'teaching for mastery' events and professional development in your area.

Using Correct Mathematical Language

How often have you found yourself, in your classroom, subconsciously mimicking your pupils' use of language? 'Top/bottom number' instead of 'numerator/denominator', 'corner' when you mean 'vertex', 'line' for what is mathematically a 'line segment'; there must be many other examples.

But does it matter? Should we insist on correct use of formal mathematical language?

Jemma Sherwood, Head of Maths at Haybridge High School, Stourbridge, thinks it does matter, and she's explained why in a recent blog, The Importance of Vocabulary.

Please let us know if you have views for or against Jemma's thesis. And let us know if you have any recommendations of other maths bloggers whose views deserve a wider audience.

The ideas in Jemma's blog overlap slightly with the theme of a two-minute video that we recently published, encouraging pupils to use full sentences when answering questions in the classroom. This is the first of our Mastery Moments, a new series of video shorts attempting to capture the essence of a single feature of teaching for mastery. Although the footage is primary, we think the ideas are applicable in secondary classrooms too.

Our weekly #mathscpdchat discussion on Twitter will be focusing on pupils' use of mathematical language on **21 February** - log on and join in 7-8pm. For more information see https://www.ncetm.org.uk/mathscpdchat.