



A Whole School Approach to Teaching, Learning and Understanding Times Tables

Year-Long Maths Hub Innovation Project (2016-Current Day)

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'Nine-year-olds should recite times tables by heart ... with an emphasis on memorising' (2014)

Schools Minister Nick Gibb



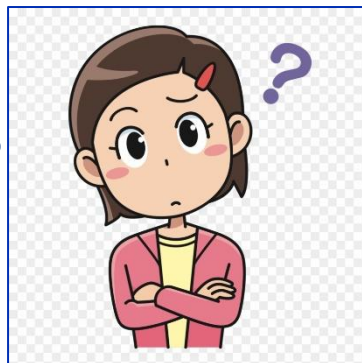
1. Not more *'timed'* maths tests...even worse... *'individually timed'* questions!

National curriculum assessments

Key stage 2

Multiplication tables check assessment framework

My Initial Thoughts



3. Schools might focus on rote learning without understanding

2. Could I get 25/25 with 6 seconds per questions??

5. SCHOOLS NEED MORE SUPPORT

4. This will cause more anxiety an increase negative attitudes?



All that said ...

I do believe Times Tables (multiplication bonds) are an important tool. Knowing and *understanding* them (*fairly* quickly) could ease cognitive load, allow children to manipulate numbers and get on to more interesting maths.

Do schools have a structured approach?
Have schools considered how they teach tables?

'Frequently children arrive in upper KS2 with very poor knowledge of multiplication facts.'

Part of this may be due to ... the reticence of some teachers to dedicate time for the teaching and learning of these facts within school time.

Times tables are often viewed as the equivalent of spelling in Literacy – it is a homework task, to be supported by parents'

Richards, A. MA Primary Mathematics Journal 2015



<http://saimagesutaswa.blogspot.com/2015/10/free-images-elephant-in-room.html>

Yet over the years I have heard many teachers say in despair ... *'if only they knew their times tables!'*

So, what might be a good approach?

Recent PISA research (2019) for mathematics highlighted that in the UK children reported that they were more than twice as likely to use memorisation over elaboration:

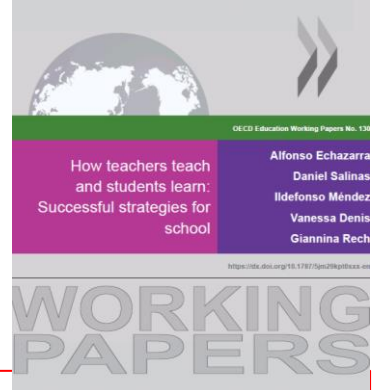
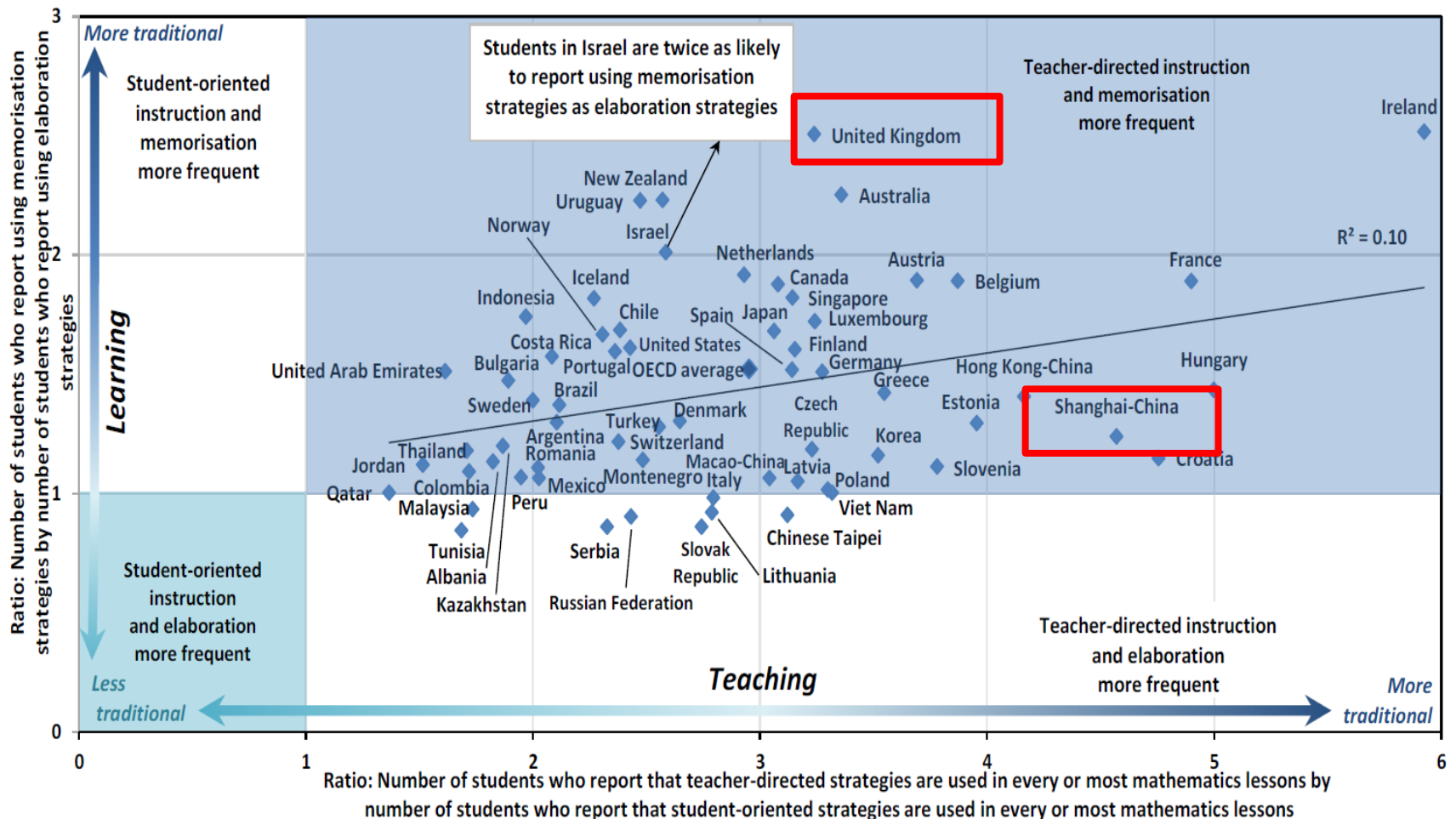


Figure 1.2. Traditional and modern mathematics teaching and learning



What do these words mean to you?

'rote learning'

'knowing off by heart'

'memorization'



Tweet David Martin (2019)

If we only want people who can recite multiplication facts, then use flash cards ... but what if we want more? Transferability?

Watched a student tell me $12 \times 13 = 156$ then asked her 1.2×13

She responded '*we don't do those*'

Does she need more flashcards?'

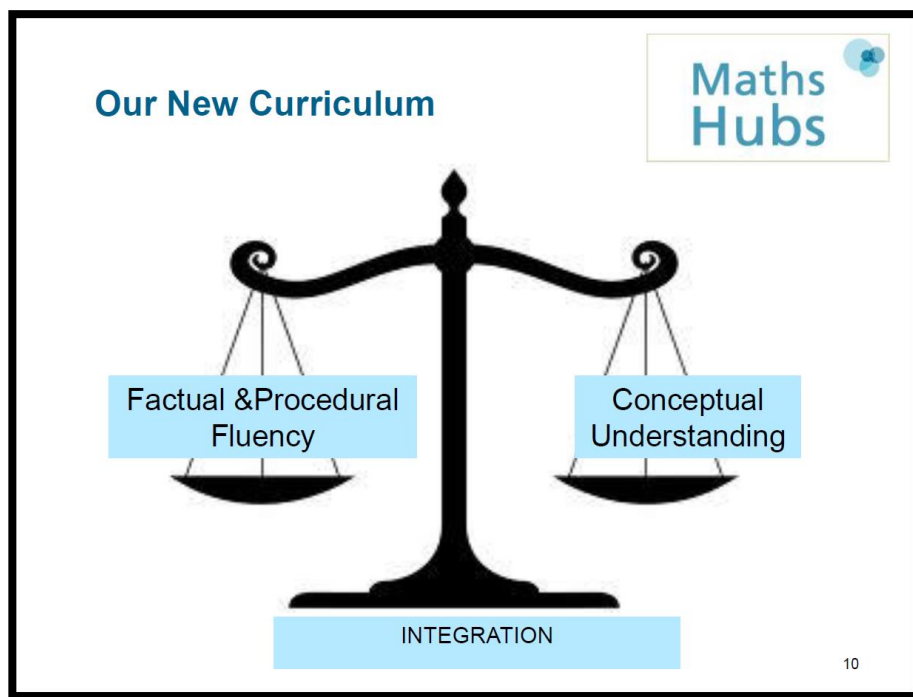


Which leads me back to the 'Aims' of the NC

1. Fluency
2. Reasoning
3. Problem Solving



Jane Jones HMI, Ofsted National Lead for Maths until 2018



Describes fluency as a *'blend of conceptual understanding and procedural flexibility'*

NCETM blog November 2014

Perhaps we need a different word - automaticity?

Memorization or Automaticity?

'Memorization of basic facts usually refers to committing the result of operations to memory so that thinking is unnecessary'

*'Teaching facts for **automaticity** in contrast relies on thinking. Answers to facts must be automatic, but thinking about the relationships among the facts is critical.*

A child can then think of 9×6 as $(10 \times 6) - 6$ '

Twomey Fosnot, C. and Dolk, M. (2000:p85)

The Project I designed for the London South East+ Maths Hub was based on this definition of automaticity.

To be *'fairly quick'* ... but for the foundation of this knowledge to be built on reasoning about properties, relationships, connections and patterns

Approached in ways which enable *'the Explored'* to become *'the Known'*



Year-Long Action Research Project

**Whole School Approaches to
Teaching, Learning and Understanding Times Tables**
Focus on a Consistent Approach across School

Maths Leads attend 4 half days over the year
Gap Tasks: Practical things to do in school between training
Professional Log completed before each session
Blended Learning: A repository of materials and a support forum

Qualitative and Quantitative Data Gathered across the Year

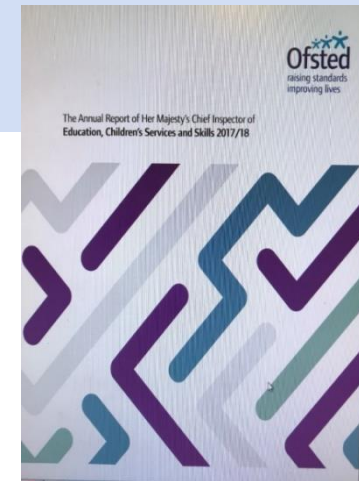
So far
4 Cohorts - circa 140 Maths Leads
5 Local Authorities and 3 Large Academy Trusts



Delivery

- Focus on Deep Understanding and Mastery
- Research Driven
- Focus on conceptual understanding, leading to automaticity
- Advocates progression and consistency across the school
- Supports schools in taking control of their own curriculum

New Ofsted Inspection Framework (2019):
more focus on research based curriculum design



Project comprises 4 PRE-REQUISITES followed by 8 WHOLE SCHOOL STEPS

2 COMPONENT APPROACH

1. Dedicated Times Tables Practice Time

High quality activities for automaticity, 10 mins 3 days per week (or 5 mins 5 days per week)

AND

2. Specific Whole Maths Lessons

Approx. three lessons per half term focussed on a new times table for exploration and mastery

Researchers (e.g., Baroody, 1999; Steel & Funnell, 2001) believe that the development of multiplication recall is in part related to the frequency with which problems and opportunities for repeated practice are provided. However, it is not simply repetition that leads to improved performance.

Brief overview of content ...



4 PRE-REQUISITES

1. Unitizing

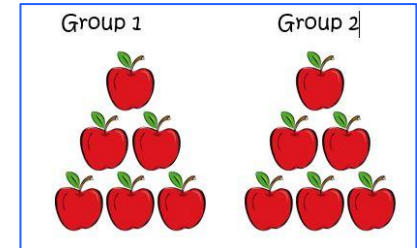
'First being able to consider many as one, such as one group, one basket of thing'

MA and Kessel (2018) *Building the Foundations*



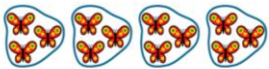
2. Bringing together more than one unit

Counting in groups and seeing each group as one unit



3. Understanding Equal and NOT Equal Groups

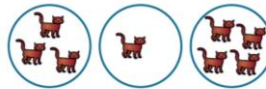
2.2 Multiplication: equal groups Step 1:3



Equal groups ✓

Unequal groups

2.2 Multiplication: equal groups Step 1:3



Equal groups

Unequal groups ✓

2.2 Multiplication: equal groups Step 1:3



Equal groups

Unequal groups ✓

NCETM Spine Resources

4. Understanding the early relationship between + and ×

8 WHOLE SCHOOL STEPS

Step 1

Decide the order in which your school will teach times tables, which tables and why.

The National Curriculum

This is not well considered in this respect

MULTIPLICATION & DIVISION FACTS					
Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
<i>count in multiples of twos, fives and tens</i> (copied from Number and Place Value)	<i>count in steps of 2, 3, and 5 from 0, and in tens from any number, forward or backward</i> (copied from Number and Place Value)	<i>count from 0 in multiples of 4, 8, 50 and 100</i> (copied from Number and Place Value)	<i>count in multiples of 6, 7, 9, 25 and 1 000</i> (copied from Number and Place Value)	<i>count forwards or backwards in steps of powers of 10 for any given number up to 1 000 000</i> (copied from Number and Place Value)	
	recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers	recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables	recall multiplication and division facts for multiplication tables up to 12 × 12		



A Possible Plan of Coverage

Focus on **one 'new' times table each half term** – with opportunities to practise those learnt previously every half term.

Why focus on one table for 8 weeks? Plasticity of the brain

Neuroscientists tell us it takes approximately **2 months of repetition and practice** to form a new neural pathway which is strong enough to form habit and automaticity

YEAR	First half term	Second half term	Third half term	Fourth half term	Fifth half term	Sixth half term
Year 1	Experience of counting in 1s, 2s, 5s, 10s					
Year 2	1x	(1x) 2x	5x	(5x) 10x	0x and revision	revision
Year 3	(2x) 4 x	(4x) 8 x	3x	(3x) 6x	(6x) 12x	revision
Year 4	(x3) (x6) 9x	7x	11x	Squares	revision	Test: June



Step 2

Decide on whole school **Presentation and Language**

Step 3

Begin by building each 'new' table systematically with the children, considering what they **already know and previously met**.

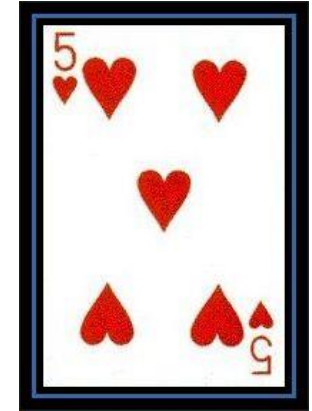
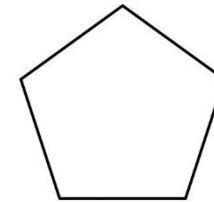
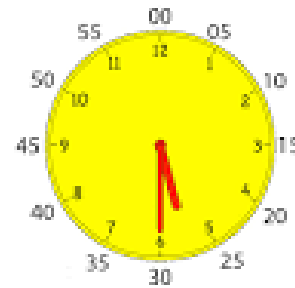
Step 4

Introduce a new times table by first making clear conceptual **links to the real world** – half termly display of 'what comes in ...'.



WHAT COMES IN 5s?

Make a class display for half a term of children's ideas, photos and resources



1. Conceptual understanding
2. Great source for word problems
3. Keep adding to it – focus on one table each month

Step 5 (happening alongside the other Steps)

Regular retrieval practice to develop fluency (5-10 minutes 3-5 times a week)

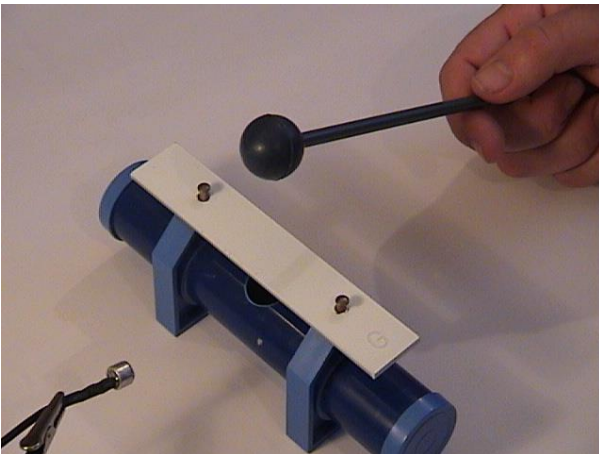
Provide teachers across school with a 'Bank of high-quality activities for retrieval'

Include conceptual support (at least initially)

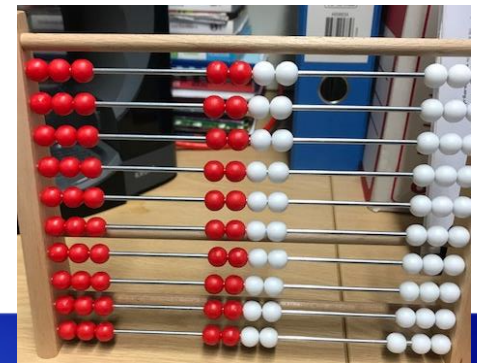
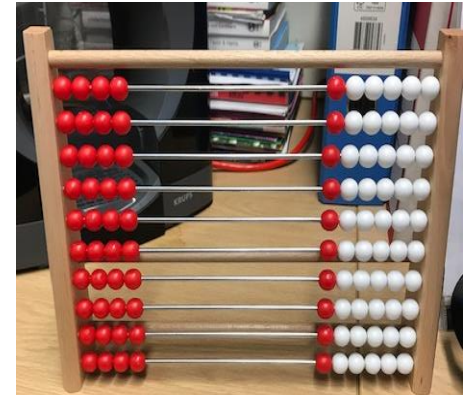
Include full verbal patterning (saying whole calculation) and also step counting

First **in order, forwards and backwards** then **out of order**

Build in tests but **NOT** as the main activity



What's the same?
what's different?



Step 6

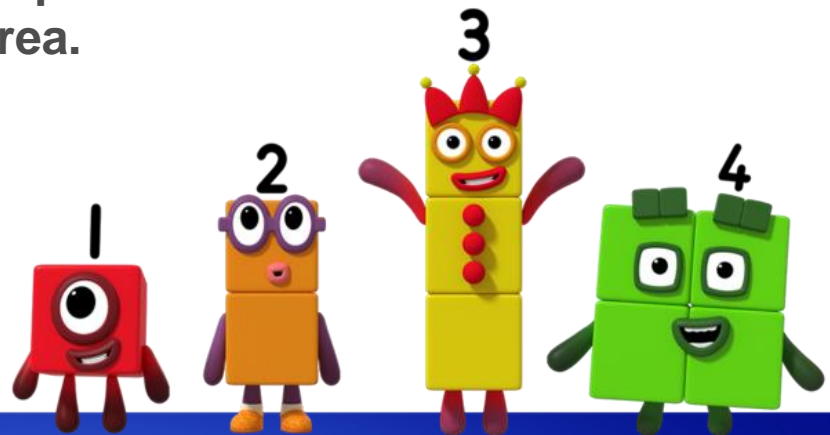
The Array as a Key Representation for tables, to expose properties and laws of multiplication and enable deeper understanding of relationships and connections

Choice of representation is **not about quantity of models, but about quality and progression.**

Research by Barmby et al (2009) exposes the power of the array
Further research undertaken by Huntley (2019:7) states that '*greater exposure to arrays will offer significant benefits*'.

A key finding from my research has been that Numberblocks appears to have made the array more accessible and powerful for younger children – which was not previously believed to be the case. I hope to research into this further next year with more detailed research in this area.

Whole School Progression of the
Array from EYFS to Year 6



Step 7

Explore the many patterns within each new times table; repeating digits, reversing digits, addition of digits, divisibility and how each table relates to several others.

Examples

$\times 2$ 0,2,4,6,8,0

$\times 8$ 0,8,6,4,2,0

$\times 3$ 0,3,6,9,2,5,8,1,4,7,0

$\times 7$ 0,7,4,1,8,5,2,9,6,3,0



Step 8

This relates to all Steps and runs concurrently, providing participants with opportunities to develop mastery through the use of variation (rather than variety) and through intelligent practice as they plan the content of component 1 and 2.



Data from questionnaires completed by 112 Maths Leads

Pre-intervention Maths Leads were asked about their awareness of the way times tables were taught across their school. Only 10% felt fully aware, with 71% of participants feeling they had limited awareness and a further 19% with no real awareness at all.

Post intervention only 4% were still unsure about how tt were taught in their school and the percentage who now felt **fully** aware had risen from 10% to 68%.

Pre questionnaires demonstrated that 80% of schools had an individual teacher approach to teaching times tables; 12% didn't answer or were not sure; leaving 8% with a whole school approach.

Post questionnaires demonstrated a real shift here, with 79% stating that they had a whole school approach, and the majority of others stating that this would be rolled out in the near future.



Post intervention:

95% stated that there had been changes in the teaching of times tables

100% felt that their subject knowledge had deepened

84% said that subject knowledge of their staff had grown

Maths Leads from Cohort 2 undertook a practice times tables check with their Year 3 children pre and post project (circa 1500 children)

100% of children increased their scores over 5 months, and 76% saw their score increase between 11-30%. A pleasing result, as the project was in the early stages of being rolled out in their schools, 5 months in, and just beginning to embed.



A selection of key impact themes:

- Long term high quality CPD made Maths Leads more confident when working with staff, creating opportunities for deepening subject knowledge and improving pedagogy
- Staff across schools are more receptive when things are well structured, are in small steps and do-able
- Schools involved are now actually teaching times tables with a whole school approach which has improved consistency across the school (or are working towards this)



A few quotes

'This Project has been a perfect balance of rationale, pedagogy, subject knowledge development, examples and ideas to take back to school, the importance of teaching times tables well, and deepening understanding – now it's our turn to implement it and make sure it has lasting impact'

'In the 16 years I have been a teacher, this has been by far the most interesting, practical and useful course I have ever attended. It has clearly suggested and reasoned why this model is good practice and will have a definite impact on my own teaching and my whole school staff. Thank you!'

'The course has been inspiring. It has enabled me to pass on a joy of teaching times tables to my children and colleagues and enabled a deeper understanding of mastering tables and mathematical concepts.'

*'I just wanted to let you know that Holly introduced the teaching of times tables to staff yesterday. The agreed practice is exceptionally clear and usable, her subject knowledge and enthusiasm shone through and I would like to thank you. Your times tables project has been highly impactful at ****'*



Key Limitations

- Time is needed to demonstrate impact. Careful planning necessary, and acceptance that whole school change and impact take time to introduce, deliver and embed.
‘School Staff are willing to take on small changes, one bit at a time’
- Maths Lead and staff time limited - other priorities and staff changes
‘Only limitation is time, haven't done as much as would have liked’
- Staff subject knowledge – several teachers spoke of this issue
‘Exposes limited knowledge in teachers / staff... Children picked up terms and their meanings quickly.’



Whatever we feel about the new MTC ...

(and I am not a fan of the test itself!)

It has opened discussions and created an opportunity to reflect on our curriculum and make positive changes in an area that has probably not had enough focussed attention in the past

We should not return to the dreaded times tables approach I remember as a child...

Drill and practice without understanding

AND

Take it home on a Friday for a test on Monday

If you are interested to know more, the NCETM have featured this project online, including links to 2 articles I have published about it in the MA Primary Mathematics Journal – the second one co-written with two participants.

<https://www.ncetm.org.uk/features/whole-school-approach-to-learning-times-tables/>

THANK YOU FOR LISTENING 😊

