A balanced approach to teaching times tables

Or…

Preparing for the times tables check in Year 4 (and why a good understanding of times tables is much, much more important than that!)

By Mark Avis

Preparing for the times tables check in Year 4 (and why a good understanding of times tables is much, much more important than that!)

Children in Year 4 in 2020 (This year's Year 3) will take the first Tables Check test.

It's important that children have fluent recall of tables facts but there are two key questions to think about:

Why is it important?

Given the high importance placed by our educational system on the results of national tests, it's tempting for school leaders and teachers to focus on teaching the tables so that children can "pass" the Tables Check Test and get a big tick for the school.

It's no coincidence that there is a plethora of new products that you can buy in order to "improve children's tables fluency".

That's not to trivialise the importance for schools of getting a good pass in the test which will be a "straight" on screen test (no divisions, no applying to problems) where they will have just six seconds to answer.

But there are really important **mathematical** reasons that children need to develop automatic recall of tables facts.

When faced with a long question involving multiplication such as 234 x 46 to solve using a written method (where six individual "times tables" products need to be found before the whole problem can be answered) children will take too long to answer the question and be more likely to get it wrong if they have to work those six individual questions out by, for instance, counting.

Similarly, if they are faced with a question involving division or fractions, or a question requiring reasoning, there are obvious benefits to being able to apply a good understanding of the tables and their inverses.

Some theorists explain this in terms of "cognitive load". We have a massive long term memory where things that we have learned (remembered) are stored as "schemas" – mental models of how ideas are connected to each other. We also have a much more limited "working memory". If we can store a deep understanding of the connections and patterns involved in times tables, we can quickly draw them out from our long term memory to our working memory to help us to solve bigger and wider problems. If we can't, then we create too great a cognitive load on the working memory, we need to use too much of our working memory to calculate them.

What do we mean by "fluent recall"?

We can think of fluency as being about speed and, of course, it will help to be able to recall tables facts quickly. We might call this "procedural fluency" or "instrumental understanding" (what the maths writer Richard Skemp describes as rules without reasons).

But we can also think of fluency as being about understanding the connections and patterns which are inherent in the tables. We might call this "conceptual fluency" or "relational understanding". Having this sort of connected and meaningful understanding will help to lock the tables into those schemas in the long term memory.

It was much better in the old days…

Whilst, clearly, music was far better in the 1970s, it is a myth that there was a golden age where all children had fluent recall of all tables facts and could apply them to a range of questions and contexts. It is also a myth, put about by politicians who want to make it seem that they are spearheading a return to good old fashioned values, that the fundamental approaches to teaching tables was abandoned decades ago.

In reality, in the past, as now, some children found it easier than others to recall tables facts and some found it easier than others to apply them to a range of questions other than a narrow tables test.

Also, in reality, regular and often very frequent, tables testing and "drill" type practices are still very common in very many classrooms as the main or only ways of "teaching" tables. Sometimes the "tests" are quite fun such as Harry Potter springing up in an app or on a website and asking a tables question which you have x number of seconds to answer. But that's still a timed test.

Some good research (Beilock, 2011 and Ashcraft, 2014) suggests that timed tests are a strong factor in developing "maths anxiety".

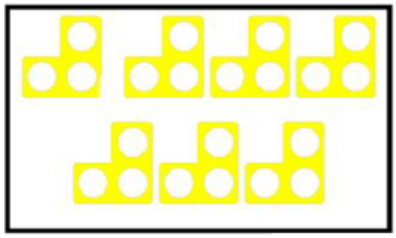
It's all about the balance

My research in 2017 (Business as usual or a better balance), showed that there was a definite advantage to teaching tables using a more conceptual approach and more recent research has suggested that teaching the concepts, connections and patterns and then practising them using a balance of conceptual and procedural activities, is the way to go.

What are the concepts?

Repeated Addition

Multiplication can be seen as repeatedly adding the same number e.g. 7 + 7 + 7 is the same as 3 x 7. This can be taught by sowing the repeated addition in a range of different ways and doing activities that ask children to make the connection between them and the tables fact e.g.



7+7+7

3 groups of 7

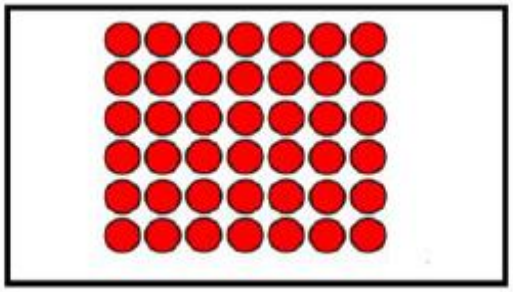
There are games and activities which use this concept in the booklet – Conceptual games for teaching times tables.

In the National Curriculum, children are expected to count in steps of the same size in different year groups e.g. 2,3 and 5 I Year 2 and 4 and 8 in Year 3 etc.

Multiplication is commutative

The fact that 3 x 7 is the same as 7 x 3 means that it is often useful to turn a question around to make it easier, to see the opportunity to use a connection.

This concept can be shown and practised using materials which draw on this connection and in particular which use arrays to show it e.g.



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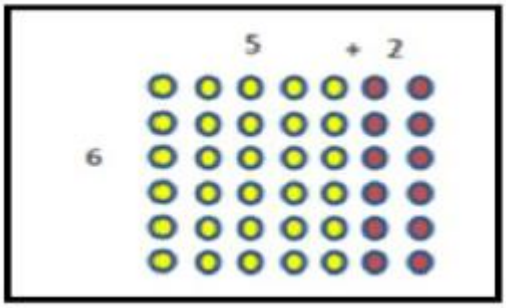
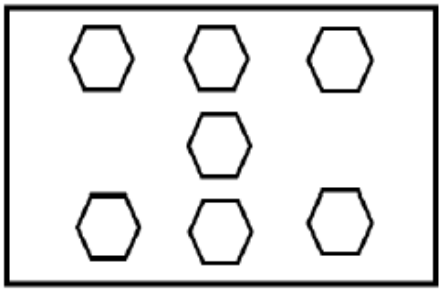


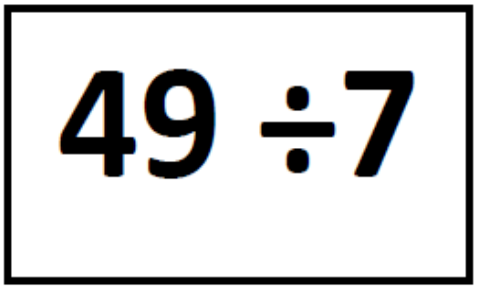
the games

Division and multiplication are inverse

As above, using arrays can underline the fact that 6 x 7 = 42 is the inverse of 42 ÷ 7 = 6.

Matching the different representations in games and other activities can help establish this in the long term memory.





to

Using the connections and patterns

3X – Double it and add another one. 3 x 8 → 2 x 8= 16 and another 8 =24

4X – double it and double again. 4 x 8 → 2 x 8 = 16 2 x 16= 32

5X – Use your fingers

8X – double, double, double

9X – Call it x 10 and take away the number that you are multiplying by 9

2 x 9 = 2 x 10 = 20 – 2 =18

3 x 9 = 3 x 10 = 30 – 3 = 27

4 x 9 = 4 x 10 =40 – 4 = 36

10X – Generally just put a 0 on the end

11X – Double the digits up to 9

And generally getting children to see all of the connections for a particular tables fact e.g.

4 x 7 = 28

7 x 4 = 28

28 ÷ 4 = 7

28 ÷ 7 = 4

Practice makes perfect

When children have worked on the patterns and connection in the tables by activities such as counting in steps and connecting multiple representations to the tables fact (such as the game and activities in the booklet, "Conceptual games for teaching times tables") - they might practice them in different ways. These may include lots of "procedural" activities such as working on apps such as Times Tables Rockstars, websites, singing songs and playing board games such as those in the booklet, "Procedural games for teaching times tables".

What about tables tests?

There is research evidence to suggest that testing can play a positive part in helping children to learn, to commit ideas and facts to long term memory (Roediger et al, 2011) **but regular tests do not have to replicate critical, high stakes, summative tests in order to have a positive effect** (McDermott et al, 2014).

Low stakes tests such as self - quizzing, can help children to see where they are with different tables facts and sets of tables. They are likely to be more beneficial than a weekly speed test.

You might still use these but only infrequently to see where everybody is with their tables learning.

Planning for success

Year 2 (2s,5s and 10s)

Build up - Build up by first using 1, 2, 5 and 10 as the first multipliers e.g. when looking at the 5X table, work on 5 x 1, 5 x 2, 5 x 5 and 5 x 10 first. Then go on to 5 x 3 and 5 x 4 then 6,7 and 8 and then 9,11 and 12.

Concepts - Begin by counting in steps and then showing the concepts through activities such as those in the booklet "Conceptual games for teaching times tables".

Practice - Once they have worked on the concepts and have begun to see the connections and patterns, ensure that they have plenty of varied practice. This might be using apps, websites and board games such as those in the booklet "Procedural games for teaching times tables" as well as regularly revisiting the conceptual activities.

This is very adaptable across a week's teaching – 10 minutes' practice after lunch, after break, 15 minutes in a maths lesson or longer period when you are focusing more on multiplication etc.

It is adaptable across a year by using a wide variety of ways to practice.

Tests – Use regular self -quizzing and other low stakes tests rather than frequent speed tests. You might test the speed of recall from time to time to see where they are.

Year 3

It is common to work on the 3s,4s and 8s in Year 3. But it makes more sense to work on the connections between the 2s,4s and 8s e.g.

4X – double it and double again. 4 x 8 → 2 x 8 = 16 2 x 16= 32

8X – double, double, double

…and then to work on the connections between the 3s, 6s and 9s e.g.

3X – Double it and add another one. 3 x 8 → 2 x 8= 16 and another 8 =24

6X – Double 3x. E.g. 6 x 8 → 3 x 8= 24 6 x 8 = 48

9X – Triple 3x. E.g. 9 x 4 → 3 x 4= 12 12 + 12+ 12 = 36

Build up - Build up by first using 1, 2, 5 and 10 as the first multipliers e.g. when looking at the 8X table, work on 8 x 1, 8 x 2, 8 x 5 and 8 x 10 first. Then go on to 8 x 3 and 8 x 4 then 6,7 and 8 and then 9,11 and 12.

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You might then introduce the 7x table in the same way.

Year 4 (All tables and introduce the 11s and 12s)

Build up - Build up by first using 1, 2, 5 and 10 as the first multipliers e.g. when looking at the 7X table, work on 7 x 1, 7 x 2, 7 x 5 and 7 x 10 first. Then go on to 7 x 3 and 7 x 4 then 6,7 and 8 and then 9,11 and 12.

Key Facts – The test developers' handbook suggests that there are certain tables which may come up more than others in the test. These are the 6,7,8,9 and 12 x tables (No 1x table and a maximum in each test of 7 questions from the 2s,5s and 10s)

It also tells us that the "multipliers" (assuming that for instance, 8 x 3 is an 8X question) will be controlled. That means that these questions and their commutative will be more likely to appear.

6 x 6	**6 x 7**	**6 x 8**	**6 x 9**	**6 x 12**
7 x 8	**7 x 9**	**7 x 12**		
8 x 9	**8 x 12**			
12 x 12				

Just for the record, yes this is jumping through hoops, teaching to the test etc. The Tables Check Test is a waste of time and money that will not improve children's mathematics any more than the Phonics Check has improved reading.

But a systematic development of children's conceptual as well as procedural understanding of tables using a balanced approach rather than teaching by testing is long overdue.

Concepts - Begin by counting in steps and then showing the concepts through activities such as those in the booklet "Conceptual games for teaching times tables".

Make sure that you also work on the structure e.g. as well as the earlier ones,

9X – Call it x 10 and take away the number that you are multiplying by 9

2 x 9 = 2 x 10 = 20 – 2 =18

3 x 9 = 3 x 10 = 30 – 3 = 27

4 x 9 = 4 x 10 =40 – 4 = 36

11X – Double the digits up to 9

Practice - Once they have worked on the concepts and have begun to see the connections and patterns, ensure that they have plenty of varied practice. This might be using apps, websites and board games such as those in the booklet "Procedural games for teaching times tables" as well as regularly revisiting the conceptual activities.

This is very adaptable across a week's teaching – 10 minutes' practice after lunch, after break, 15 minutes in a maths lesson or longer period when you are focusing more on multiplication etc.

It is adaptable across a year by using a wide variety of ways to practice.

Be systematic – A test can help you to find out which children know which tables facts well. Carrying on testing in the hope that they will get better is not a good plan. Once you know who can do what, systematically teach them the facts that they don't know (rather than, for instance, the whole 6 x table).

Tests – Use regular self -quizzing and other low stakes tests rather than frequent speed tests. You might test the speed of recall from time to time to see where they are.

Years 5 and 6

Be systematic – A test can help you to find out which children know which tables facts well. Carrying on testing in the hope that they will get better is not a good plan. Once you know who can do what, systematically teach them the facts that they don't know (rather than, for instance, the whole 6 x table).

Build up - If there are children who are not confident in their use of nearly all of a particular table, build up by first using 1, 2, 5 and 1 as the first multipliers e.g. when looking at the 8X table, work on 8 x 1, 8 x 2, 8 x 5 and 8 x 10 first. Then go on to 8 x 3 and 8 x 4 then 6,7 and 8 and then 9,11 and 12.

Concepts - Begin by counting in steps and then showing the concepts through activities such as those in the booklet "Conceptual games for teaching times tables".

Make sure that you also work on the structure e.g.

3X – Double it and add another one. 3 x 8 → 2 x 8= 16 and another 8 =24

4X – double it and double again. 4 x 8 → 2 x 8 = 16 2 x 16= 32

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11X – Double the digits up to 9

If you want to multiply any two numbers (at least one of them has to be even), halve the one and double the other. Keep doing this until the calculation is easy:-

14 x 16 = Very hard!

28 x 8 = Still too hard!

56 x 4 = Still quite hard!

112 x 2= Piece of cake!

Practice - Once they have worked on the concepts and have begun to see the connections and patterns, ensure that they have plenty of varied practice. This might be using apps, websites and board games such as those in the booklet "Procedural games for teaching times tables" as well as regularly revisiting the conceptual activities.

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