

NATURE OF THE ACTIVITIES SUGGESTED HERE

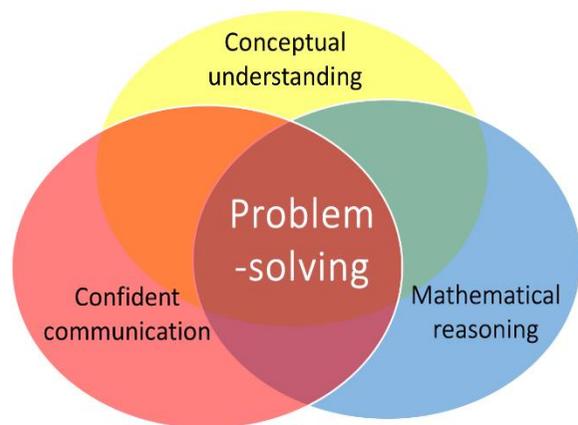
With the surge of interest and sometimes confused interpretations of what is meant by **Mastery** in mathematics, a number of different claims have been made about what it means and what is required. The efficacy of different approaches to implementing a Mastery approach to learning mathematics in the primary school, as demonstrated by higher performing jurisdictions in the Far East, as measured by PISA* and TMSS* have been questioned and challenged.

However, there are some essential points that appear to be in common when examining different approaches.

Research in mathematics education, which curriculum developers and educationalists in the Far East have used, have been known for many years and including Bloom's* theories of *Mastery*, the development of *deeper conceptual understanding* through a progression in *Concrete-Pictorial-Abstract (CPA)* experiences, first discovered by Bruner*, the *realistic mathematics education* of Freudenthal*, and the seminal *Cockcroft Report**, particularly, its emphasis on the importance of *practical experiences* and *problem-solving*. More recently, Lo's* research in the subject of *Variation Theory* has been prominent in exploring how to plan learning for understanding through small steps in conceptual and procedural variation when teaching.

All of these principles have informed the sample of activities presented here. Proponents of Mastery in mathematics (e.g. Drury*) also argue that teaching and learning must focus on enabling children to develop **rich connections** between different facets of their mathematical experience and learning. These aims are also highlighted in the 2014 National Curriculum Aims*. The diagram below shows how these facets are all inter-related, and how teaching to connect these is crucial to **deeper mathematical learning**.

Hence, the activities suggested here are designed to promote the following:



- practical activity manipulating concrete resources where possible;
- working in pairs or groups to encourage the confident use of the language of mathematics through explanation and reasoning with other children;
- ensuring that formal written arithmetic develops from secure experiences with concrete, visual and mental understanding of the manipulation of number and the arithmetic operations;
- solving problems (or by playing games) with the potential for a useful or pleasing result;
- opportunities for finding more than one acceptable result, which children can compare and discuss through collaboration or (guided) peer-assessment.

There is an expectation that discussion and exploration of misconceptions or errors is a healthy and productive feature of the classroom and that children are encouraged to explain their thinking and listen to others.

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In some of the activities, it could be argued that a written sheet of exercises could be given to produce similar results. However, the use of concrete apparatus and visual images provides a medium for discussion and helps to establish a rich conceptual understanding, which is often insufficiently developed through an abstract engagement with written exercises alone. In other cases, children are using equipment to generate the problem to be solved, so can be more engaged in its solution.

Where it is suggested pairs or groups of children work together, the groups may of course be varied to suit the teacher's own judgement. For example, in a game intended for pairs, an odd number of children can be accommodated by a changing combination of 2 vs 1.

To make it more accessible when reading the description of the activities, children's names have been used to identify the sequence of interactions between learners working in pairs or groups.

For every activity, it is paramount that the teacher teaches by modelling the activity with the class, so that children see and imitate what they need to do. Simply providing a written instruction sheet or verbal series of instructions is insufficient for the children to understand and engage with most activities.

Each activity has suggestions for extending or simplification. The expectation is that each can be explored comprehensively within one classroom lesson of 45 minutes or more.

For more information about improving the capacity for teaching and learning mathematics in the primary school, visit www.MathematicsMastered.org

*References

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Programme for International Student Assessment (PISA), [Organisation for Economic Cooperation and Development (OECD)]

Trends in International Mathematics and Science Study (TIMSS), [International Association for the Evaluation of Educational Achievement (IEA)]

<p>11. Mental Strategies for Multiplication and Division</p> <p>Calculate mathematical statements for multiplications and divisions within the multiplication tables.</p> <p>Recall and use multiplication and division facts for the 2, 5 and 10-times multiplication tables.</p> <p>The aim here is to use very obvious concrete examples and visual images to illustrate mental strategies of multiplication and division as repeated additions and subtractions.</p>	<p>Groups of ... For each question children confer in pairs and show their answer on a mini-whiteboard, so that the teacher can assess everyone at the same time.</p> <p>'2 times ...' questions - Multiplication as repeated additions:</p> <ol style="list-style-type: none"> How many feet does one child have? How many feet do 2 children have? How many feet do ... children have? And so on. <p>Division as inverse-of-multiplication/repeated subtractions:</p> <ol style="list-style-type: none"> There are 8 feet. How many children? There are 10 feet altogether: how many children are there? And so on. <p>'10 times ...' questions: Do the same using the number of fingers and thumbs per <i>child</i>.</p> <p>'5 times ...' questions: Do the same using the number of fingers and thumbs per <i>hand</i>.</p> <p>This visual model can be extended to '4 times', using the number of legs on a toy animal or the number of wheels on a car; to '6 times' using legs on an insect, and to '8 times' with legs on a spider.</p>	<p>Inclusion of inverse questions to establish the inverse relationship between multiplication and division.</p> <p>The class has sufficient resources to model and physically check at least the 2-times, 10-times and 5-times questions.</p> <p>Do the children understand the divisor is the group size or number in each group?</p>
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