PROBLEM-SOLVING EXAMPLES FOR DEVELOPING MASTERY IN KS1

1-2

NATURE OF THE ACTIVITIES SUGGESTED HERE

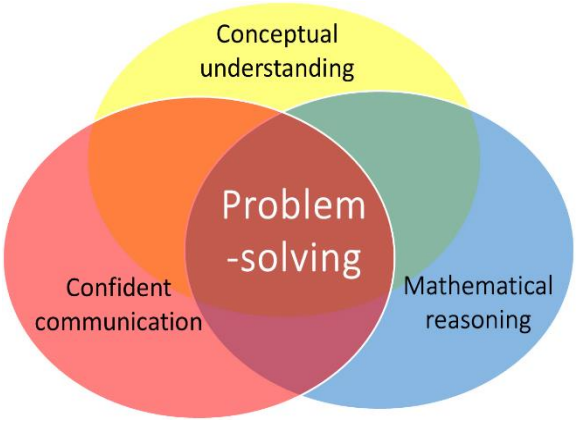
With the surge of interest and sometimes confused interpretations of what is meant by ***Mastery*** in mathematics, a number of different claims have been made about what it means and what is required. The efficacy of different approaches to implementing a Mastery approach to learning mathematics in 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)]

21. Concepts and Principles of Measurement **Developing understanding of length in different dimensions.** **Use the comparative language of long, longer, longest, tall, taller, tallest, short, shorter, and shortest.** Children explore comparative language for length and height, but are also challenged to explore early ideas about ratio and proportion.	**Comparisons** Children working in groups of 4. They will need: • Large roll of paper, of the size used to line a display board, or for covering tables. Emily, Luke, Kasia and Nathan line up in order of their height. They record their names in order from shortest to the tallest. Now they compare the lengths of their feet, the length of their middle fingers, the length of their right arm and the width of their hand spans. How does the order of each of these measures compare to the order of their heights? If you can find a suitably long wall space, make a whole class tableau of the children. The group draws around the outline of each child as they take it in turns to lie on the large paper. They carefully cut around the outline. (If desired, these can be painted or covered with an appropriate collage by each child. The display space needed can be shortened by overlapping the children's images as in a 'crowd scene'. What is interesting here is that provided the top of each head is labelled, at another point much later in the year, the children compare themselves again and see whether there have been changes in the height order between them. If doing this with older children (Y2), they could actually compare heights in metres and centimetres, and make the other comparative measures in cm.	Do children use the vocabulary correctly? Do they confuse 'near' terms – for example ***'big'*** with ***'long'*** and ***'short'*** with ***'small'***? Do they confuse '***tall'*** with ***'high'***, for example, if a child stands on a step? Do the children recognise that proportions are general, and there some surprises in the expectations for who will have longer fingers, feet, hand spans, etc.?