How do we develop a classroom culture that supports a problem solving approach to Mathematics?

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Abstract

With problem solving being one of the main aims of the mathematics national curriculum, it has certainly been high on the agenda in schools for the last few years. But exactly what problem solving is, and how best to teach it, is not always clear. Sometimes the ability to problem solve might be perceived as the preserve of only the most talented mathematicians – the ones who 'just get it' – but the curriculum makes it clear that this shouldn't be the case:

*"The national curriculum for mathematics aims to ensure that **all** pupils can solve problems by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions"*

Aim

To develop a culture so that **all** children are encouraged to develop as independent mathematicians with strong problem-solving skills and thus increase number of children who achieve ***Greater Depth***.

Questions

- How do we facilitate the learning during problem solving lessons?
- How confident are the children to take a risk, to try out ideas, to make mistakes?
- Are children using the different problem solving strategies we have taught?
- How can we develop children's reasoning and mathematical thinking so that they are not reliant on simple counting strategies to solve problems?

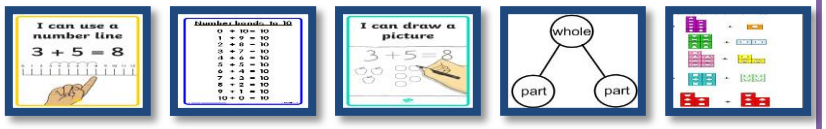
References

CETM (2014a). Developing Mastery in Mathematics. Department for Education (DfE). (2013a). National Curriculum in England: Framework Document. London: Department for Education.

Mathematics Learning Study Committee: National Research Council Visual maths improves performance. Extract from Mathematical mindsets: unleashing Students' Potential through Creative Math, Inspiring messages and innovative Teaching (2016) Jo Boaler Professor of maths at Stanford University Gareth Metcalfe Primary Maths – Blog 2018: Inspiration for visual, deep mathematics

Framework

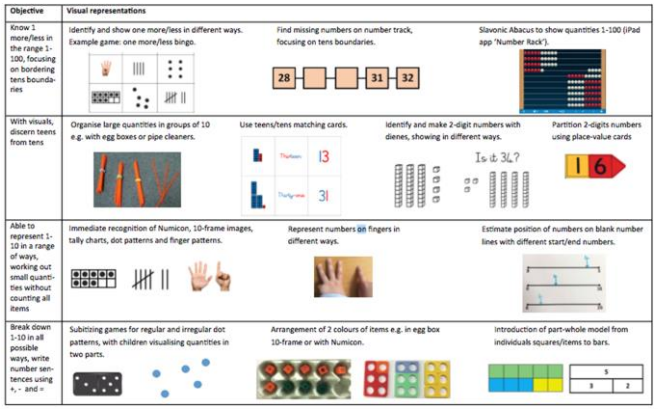
The key is to be clear how you want to use a particular problem to support the development of the children's skills to problem solve. It is tempting to choose a problem that relates to the mathematical content that you have been working on in class. However, whilst children need to be fluent with the mathematical content demands of any problem they tackle, it may be more productive to choose a problem that builds on a specific element of problem solving that you are working on as a class, and uses content that they are very familiar, and more confident, with.



Methods

Becoming confident and competent as a problem solver is a complex process that requires a range of skills and experience. As teachers we tried to support this process in a number of principal ways:

- Through our choice of task and allowing children time to consider, challenge and construct their understanding of key concepts.
- Through structuring the stages of the problem-solving process- guided problem solving sessions.
- Through explicitly and repeatedly providing children with opportunities to develop key problem-solving skills.
- By building understanding by using models and images.
- By fostering mathematical reasoning and thinking by particularly emphasising children's active use of representations to make sense of relationships.



Findings

What have we learnt?

- A problem is something you do not immediately know how to solve. There is a gap between where you are and getting started on a path to a solution. This means that children require thinking and playing-with-the-problem time. They need to test out ideas, to discuss ideas with others and be comfortable to take risks. When children are confident to behave in these ways they are then able to step into problems independently rather than immediately turning to us as teachers to ask what to do!
- As teachers we can support our children to develop the skills they need to tackle problems by the classroom culture we create. It needs to be one where questioning and deep thinking are valued, mistakes are seen as useful, all students contribute and their suggestions are valued, being stuck is seen as honourable and children learn from shared discussion with the teacher, Teaching Assistant and peers.
- Through the use of visual models and pictorial representations children move from reliance on counting strategies to being able to calculate and reason mathematically.
- Conceptual understanding is strengthened when ideas are represented practically and visually.
- Visual prompt help pupils see likely mistakes, notice similarities between questions and develop new strategies for calculating.

What has been the impact?

The % of children working at greater depth in mathematics increased from 26% in 2017 to 32% in 2018

Analysis of SATs data shows an increase in raw scores in the reasoning paper: 2017 11% of children scored 85% and above. In 2018 25% of children scored 85% and above

Teachers are more confident in knowing the models and images that can support children's conceptual understanding

Work scrutiny and SATs paper analysis shows children showing their workings out