

A strong start to numeracy

Dr. Paul Swan explores the key aspects of number education...

Research has shown that the first few years of school are vital in the development of children's numeracy skills. There are five vital aspects of early number education that teachers and practitioners must be aware of; coupled with the 'language of mathematics', these will ensure that children get off to a good start...

Beginning number concepts

According to Ann Montague-Smith there are two schools of thought about how to introduce number. In *Mathematics in Nursery Education* (2nd Ed., 2002), she wrote:

"There are two distinct views about how children develop the ability to understand and use number. The first of these, the Piagetian view, has affected thinking about how children are taught about number for the last thirty years. The second, the 'counting view', is based on research from the 1970s and is gaining acceptance as the way forward."

THE PIAGETIAN VIEW

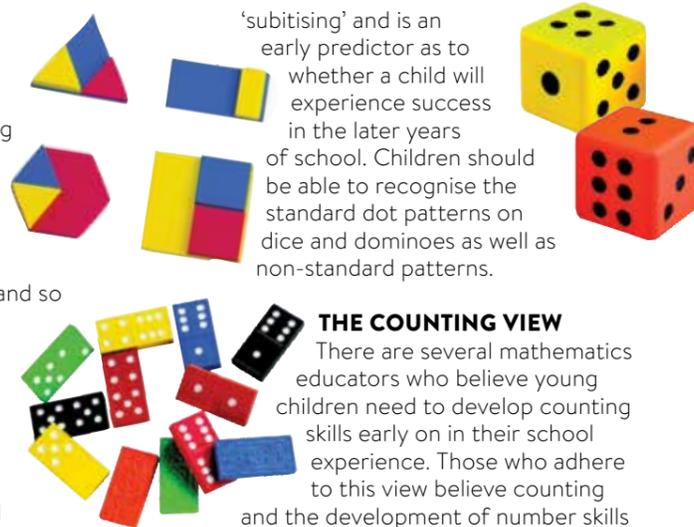
According to Piaget, children need to be able to...

- think logically
- seriate objects
- sort and classify
- match
- conserve number

...before they are ready to begin more formal number work. This explains why most early childhood classrooms have a range of sorting materials, from themed counters right through to sophisticated sorting with Attribute



Blocks. As children sort and classify with these counters they will be learning the principles of counting and developing associated language such as colour shape, size and so on. Materials such as dominoes are based on the idea of matching what is on each end of the domino. While working with dominoes and dice, children should be encouraged to 'see' the dots as a pattern and instantly recognise the number of dots, without counting them. This ability is known as



'subitising' and is an early predictor as to whether a child will experience success in the later years of school. Children should be able to recognise the standard dot patterns on dice and dominoes as well as non-standard patterns.

THE COUNTING VIEW

There are several mathematics educators who believe young children need to develop counting skills early on in their school experience. Those who adhere to this view believe counting and the development of number skills are entwined. While the counting view seems to have gained prominence, we need to be careful not to throw the baby out with the bathwater. There is no doubt that the ability to sort, organise and classify are important processes in their own right and should be regarded as more than simply pre-number activities. In *Teaching primary mathematics* (3rd, Ed., 2004), George Booker et al state:

"The main value of the traditional pre-number skills is as a logical operation underpinning more complex skills involved in problem solving. They still have a place in mathematics in the early years alongside the development of matching and counting, but they are more meaningfully described as early-mathematical thinking."

The five counting principles

In *The child's Understanding of Number* (1986), Gelman and Gallistel list five principles children need to acquire in order to become proficient at counting. Here are the first three:

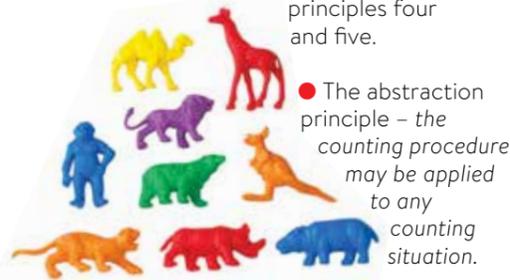
- The one-one principle – the matching of counting words to the items being counted.
- The stable order principle – counting words are always said in the same order. The words need to be said in a stable order, 1, 2, 3...
- The cardinal principle – the final number in the count represents how many in the set.

A beadstring or Rekenrek can be used to assist children to develop these principles. Most curricula encourage young children to count to and from 20 starting at any point.

Counting principles four and five require that the materials to be counted are varied and in a scattered



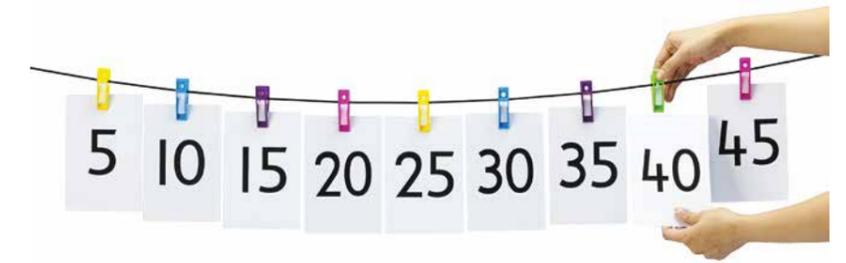
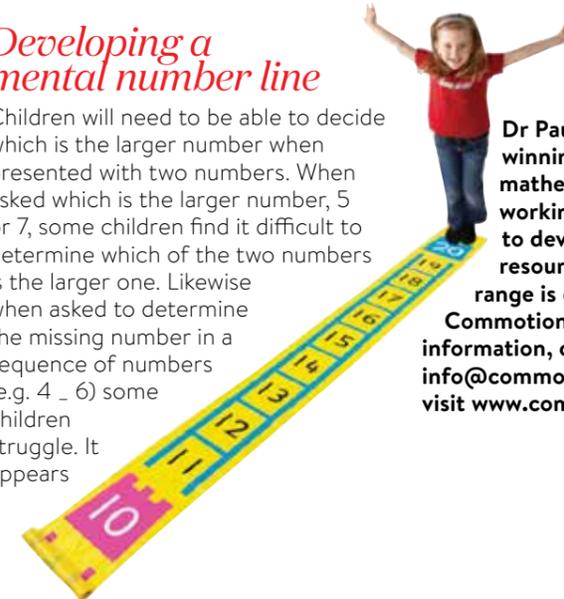
arrangement, rather than in a linear arrangement. A set of themed counters can be scattered on a table and the children asked to count them. While watching the children count, a teacher can 'see' if they understand principles four and five.



- The abstraction principle – the counting procedure may be applied to any counting situation.
- The order-irrelevance principle – the order in which items are counted does not affect the count.

Developing a mental number line

Children will need to be able to decide which is the larger number when presented with two numbers. When asked which is the larger number, 5 or 7, some children find it difficult to determine which of the two numbers is the larger one. Likewise when asked to determine the missing number in a sequence of numbers (e.g. 4 _ 6) some children struggle. It appears



that some children have not developed what is known as a 'mental number line'. When playing a standard track game, children will develop an understanding that one number is larger than another, by 'clues', such as 'when you roll a six, you travel further along the track than if you roll a three'. Also it takes more time to progress along the track. A number track is the precursor to a number line. Both tools will help children develop a better understanding of number.

Walking along a track and pegging numbers along a line will all contribute to a better understanding of the number track and number line. A missing number slider also may help children to improve in the understanding of the number sequence for larger as well as smaller numbers.

Working memory

There is no doubt that working memory plays a role in children's acquisition of the basic number facts, that is single-digit addition and related subtraction facts and single-digit multiplication facts, and the related division facts. There are some measures that can be put in place to improve working memory, but space does not permit to expand on these here. I suggest readers look up Dr Susan Gathercole on the subject of working memory.

Dr Paul Swan is an award-winning author and mathematics educator, and is working with Edx Education to develop high-quality maths resources. The Edx Education range is distributed in the UK by Commotion Distribution – for more information, call 01732 225 821, email info@commotiondistribution.com or visit www.commotiondistribution.com

PREDICTORS OF SUCCESS

In this article I have alluded to four predictors of later success in mathematics:

- The understanding of a mental number line
- Magnitude comparison
- Missing number
- Subitising
- Working memory.

A final early predictor is the learning of arithmetic facts or addition facts $0 + 0$ to $9 + 9$. Typically a child of age eight should be able to know these facts and eventually recall them. I would add that students should really know a family of facts and thereby link addition and subtraction facts. The learning of basic number facts will be the subject of another article.

