Place Value as a Building Block for Developing Fluency in the Calculation Process

By Jenni Back

This article follows on from Place Value: The Ten-ness of Ten. It encourages exploration of two fundamental ideas, exchange and 'unitising', which will help children become more fluent when calculating.

Introduction

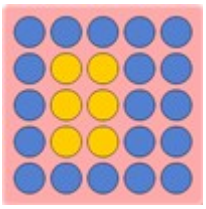
Having a strong 'sense of ten' is a good foundation from which to further children's understanding of place value. In turn, a deep understanding of place value is an essential building block to developing fluency in the calculation process.

The notions of exchange and 'unitising'

So how can we help children explore the ideas that underlie place value? Two of the fundamental notions underpinning place value are exchange and 'unitising'.

Exchange

Exchange is a powerful notion in mathematics that is evident in the early stages of the development of number sense and calculation using all four operations, but which is also used in much more sophisticated contexts such as algebraic substitution and recursive functions. Fortunately we don't have to worry about these more complex notions in early mathematical education but I find it satisfying to think that by helping children to work with the idea at a simple level we will be laying the foundations for their future mathematical work.



Recently Doug Williams wrote an article for 'Mathematics Teaching' (2012) in which he quoted a teacher's account of working with her Grade 2 class in Australia using a resource called Poly Plug. The practical Poly Plug resources can be shipped from Australia as they are unavailable in the UK. (NRICH has created a 5 by 5 grid that you could use with counters either double sided or sets of different colours, if you prefer, as well as several activities first published in September 2011.)

The teacher in the article, Jacki, described how she worked with the children offering them opportunities to represent numbers using the Poly Plug. Initially they created representations of numbers such as 14, 17 and so on. In these cases they assigned each counter a value of one and used them in 1 to 1 correspondence. However once they were asked to represent larger numbers such as 96, 43, 85 and so on, they started to assign values of 2, 5 or 10 to different colours of counters. Jacki repeated opportunities to engage with this task over the next few weeks and the children were given opportunities to record their ideas. Over this time the children's confidence and ingenuity increased and some of them even assigned value to empty spaces on the board – they were beginning to understand the power and value of a place value number system.

They can be a very useful diagnostic tool to assess whether children have an understanding of place value – the notion that one lot of ten (a red counter assigned a value of 10, for instance) can be a fair exchange for 10 blue counters (where they are each assigned a value of 1).

I have also been engaged in discussion with John Mason who is currently focusing on the power of the notion of exchange in mathematics and we have been looking in some depth

at exchanges using counters. We have been considering notions of fairness, equivalence, and series of exchanges that represent different mathematical operations. This consideration has made me much more aware of the complexity of the four arithmetic calculation processes in which we expect young children to engage. No wonder children sometimes struggle to make sense of it all!

Unitising

Part of developing fluency in calculation processes is the ability to engage with 'one lot of ten' as an entity in its own right and operate with it as though it is one object rather than one object comprised of ten other objects. This capacity is referred to by Fosnott and Dolk (2002) as 'unitising' and in their illuminating book they describe a series of classroom activities in which children work with large numbers of objects in ways that encourage them to develop their capacity to unitise.

One such scenario is a task in which the children are given the job of packaging seeds for sale. They need to create packs with say 85 seeds in them and in order to do so they create sets of ten seeds in envelopes. Once again the problem scenario is described but the children are left free to explore how to tackle it, scaffolded by appropriate prompts and questions from their teacher. Children start to collect groups of ten seeds and then mark the envelopes in some way to indicate the contents. In doing so they start to develop the capacity to deal with the envelope of ten seeds as one element and this is essential for the development of the capacity to calculate with numbers larger than ten. They develop different ways of recording their numbers and begin to use units of 5 and 10 and they are able to say how many packs of ten would be needed to have a collection of 84 seeds for instance, so rounding up to the nearest ten in a meaningful context (Fosnott and Dolk, 2002 see p67 – 75).

Conclusions

In this article (and the one preceding it, Place Value: The Ten-ness of Ten), I have tried to show that the notion of place value is one that underlies the structure of all the arithmetic operations and is a complex and sophisticated idea. In order for children to grasp it, they need to be offered meaningful reasons for developing the skills of exchanging and 'unitising' so that they will be equipped to use them later on to partition numbers as well as to calculate.

For more details about what we as teachers can do to support learners' number sense and place value, including a range of classroom activities, see our related article and our Number Sense and Place Value Feature.

References

Fosnott, C.T. & M Dolk (2002) Young Mathematicians at Work: Constructing Addition, Subtraction and Place Value. Portsmouth: Heinemann.
Williams, D. (2012) Mathematics Education is not an Enigma Part 2. Mathematics Teaching. Issue 231 p 6 – 8. Derby: ATM.