Australian Primary Mathematics Classroom

In this issue

a process for
Understanding
Mathematics

What do we really believe about the process of understanding mathematics?

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keeps us thinking about the notion of multiple ways of representing understanding using think boards.

U nderstanding the process by which people construct mathematical ideas and concepts is of critical importance in the design of any mathematics program. Numeracy is not merely the teaching of measurement or the teaching of number. Becoming a numerate person necessitates the ability to select appropriately from all the skills and understandings one has in order to competently and effectively solve the myriad of mathematical problems encountered daily.

Most children enter school with an impressive range of mathematical language and counting skills. Much of this basic mathematics knowledge is acquired naturally as a result of observation and independent activity on the child's part as (s)he strives to solve everyday problems that require mathematics (Labinowicz, 1985). Research (Early Numeracy Research Project, 2001) shows that more than 80% of children commencing school can already correctly identify one of two groups as 'more', correctly locate items 'beside, behind, in front of', can use one-to-one correspondence effectively, recognise three items without counting them and can correctly read the numerals 0 to 5.

A teacher cannot acquaint each student with specific solutions to every mathematical situation they will encounter in a lifetime. We therefore need to be strategic in our approach to teaching mathematics and equip students with skills that are flexible and provide reliable pathways for solving both familiar and unfamiliar problems. What do students 'do' when learning mathematics? What is the actual intellectual process that they engage in? The answers to these questions will provide a construct for teachers that can enhance and focus their teaching of mathematics.

Students need to be encouraged to use their existing mathematical skills and understandings in creative ways and
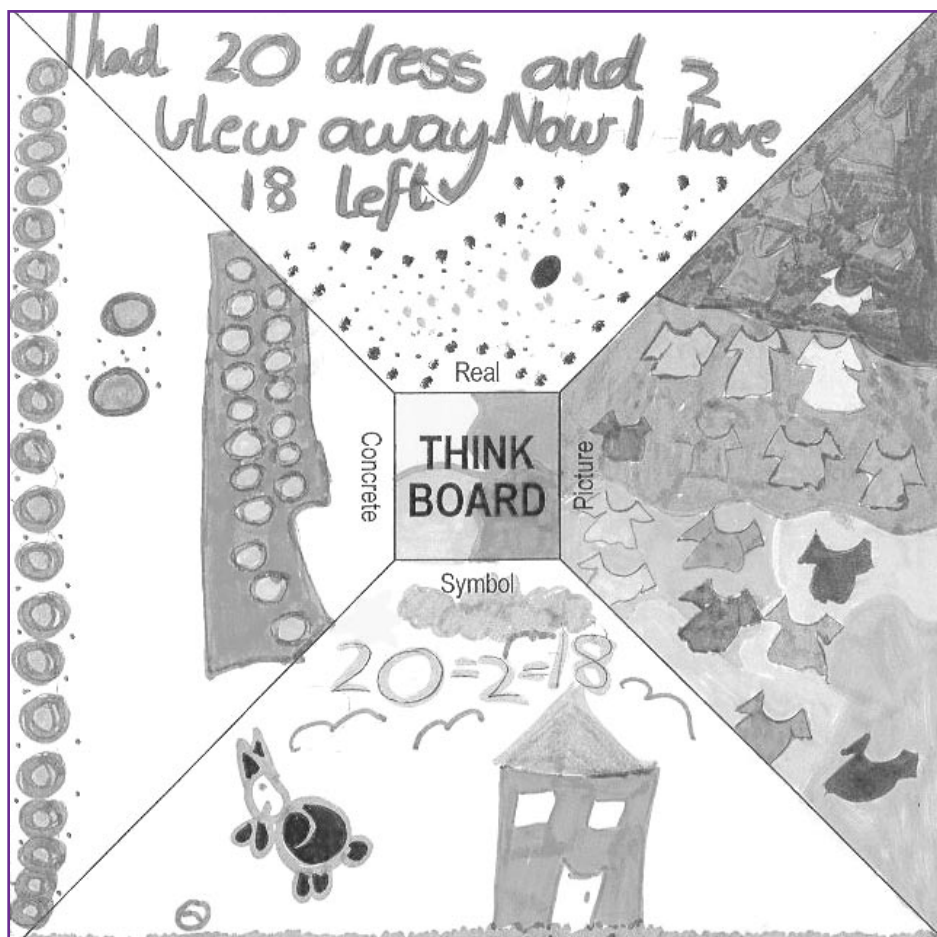
Figure 1. Think board.

Figure 2. Mathematics provides a solution to a real life story.

to find links between that knowledge and newly introduced mathematical ideas. Making these important connections will help students to make sense of mathematics. They will then be in a position to construct generalisations that can be transferred to other experiences, both familiar and new. This cognitive process allows the student to construct a broader, more complex understanding of mathematics (Ginsburg & Baron, 1993).

Consider a child who is learning about the concept of '3'. Over time, the child builds an understanding that the concept can be described by the numeral '3' or the word 'three'. The child also discovers that '3' holds a unique position in the counting series. As well, the number '3' represents the 'many-ness' of a group if it is the last number said when counting a group of three objects. The child develops a deeper understanding of '3' by making connections between these different ideas. The child forms a generalisation of the concept of '3' which proves effective when dealing with familiar and new situations involving different representations and manipulations of '3'.

'Think boards' (see Figure 1) are a deliberate means of helping students make the connections between different mathematical concepts. They provide the opportunity for students to visually represent their understandings in a range of ways. During the lesson, students created 'think boards' to represent their mathematical understanding in four connected ways: as a written story, a pictorial representation, a model using concrete material and using mathematical symbols. The photo (see Figure 2) extends these connections by showing a Year 2 class acting out a real life story where mathematics can provide a solution.

Children learn at different rates but in a relatively orderly sequence. New

mathematics learning builds upon previously learned skills in a loose hierarchical structure. Therefore students who lack understanding early in the curriculum generally continue to experience failure as they move through the school system (Miller & Mercer, 1997).

The simplistic view of mathematics learning following a fairly ordered pathway has been embraced for far too long. Mathematics programs, which include a sequential set of children's texts, workbooks and teacher guides, tend to provide a superficial coverage of many different skills. A major focus of such programs is to ensure completion of the book within a specific time frame (Miller et al., 1997). Such constraints often result in lack of adequate practice and review time. For similar reasons, different strategies for solving problems may be replaced with step-by-step procedural instruction. This teaching approach impacts on the likelihood of students making connections between different mathematics ideas and forming generalisations that will strengthen their mathematical understandings.

It is necessary as a teacher to know not only how much students know but also how well or in what manner they know it (Sophian, 1999). From a contextualist perspective, knowledge is often dependent on specific kinds of social support such as familiar activities or patterns of interaction. Vygotsky (1978) claims that knowledge is therefore inseparable from the context in which it is used.

For a child to learn a new mathematical idea the child must be able to relate it to previously acquired knowledge. This provides the familiar context that makes the new idea meaningful to the child. The teacher then provides scaffolding to the learning process and assists the child to go beyond what they could normally be expected to achieve by themselves.

Children must be able to use their knowledge effectively in a range of situations and be confident enough in that knowledge to transfer it to situations previously not experienced. Encouraging children to talk about what they are doing and justify their use of particular strategies can make their knowledge more readily transferable. Research suggests that the strategies used by students experiencing success in mathematics vary markedly from the types of strategies used by students struggling with mathematics (Gray et al., 1994).

Highly effective teachers are aware that being a confident user of mathematics requires the development of a rich network of connections between various mathematical ideas. The most worthwhile teaching approaches serve to challenge the students, build upon existing knowledge and encourage purposeful explanation and discussion between group members to emphasise alternative methods for solving problems.

Focusing on children's thinking in mathematics is far more challenging than traditional teaching approaches. However such a paradigm shift in the teaching of mathematics stands to benefit students enormously. The assimilation of a network of self-constructed strategies for solving problems and the ability to mathematically communicate solutions will assist children to value mathematics as a reliable means of making sense of the world around them.

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