Thinking numerately: All children are mathematicians

I was talking with my five-year-old niece about numbers. I asked her what number was the smallest and she said 'one'. I asked, 'Do you think there are any numbers smaller than one?' She replied, 'No that's the smallest one there is.' She kept thinking about the question and, later on, she said, 'I think 00 is smaller than one because that's the size babies wear.'

This illustrates both how a child thinks numerately and how they can use their knowledge of the world to solve problems. It also shows how adults can make children's thinking visible and challenge their ideas through probing questions.

The Early Childhood Australia and Australian Association of Mathematics Teachers Position Statement on Early Childhood Mathematics (2006) recommends that early childhood educators:

' ... encourage young children to see themselves as mathematicians by stimulating their interest and ability in problem solving and investigation through relevant, challenging, sustained and supported activities.'

This article explores simple ways adults can make children's thinking visible, challenge their ideas and help young children focus on mathematical ideas.

CHILDREN'S NUMERATE THINKING

Young children engage in numerate thinking as they play and explore their world. They investigate numbers, shapes, measures and patterns as they use sand, water, construction toys and everyday materials from their surrounding environments.

Children see numbers and mathematical symbols on traffic and street signs; on electronic devices, such as mobile phones, clocks, microwaves and remote controls; in supermarkets and in everyday print materials, such as newspapers, catalogues and birthday cards.

Many of the problems children encounter and create themselves involve numeracy questions, such as:

- how many?
- how big?
- what fits?
- how long?
- when?

THE IMPORTANCE OF EVERYDAY NUMERATE LEARNING

We all know the benefits of reading to young children, of building skills and positive attitudes about literacy. Building early numeracy skills and a positive attitude towards mathematics is just as important. Many of the same principles apply: make it fun, link ideas to a child's own experiences and encourage thinking by asking good questions in mathematical language, such as:

- 'I wonder how we can work this out? Let's try to count the teddies by lining them up. Will that help us know if we've counted them all?'
- 'Why do you think that the orange is heavier than the drink bottle?'
- 'How will we know we have enough fruit for everyone?'

David Perkins, of Harvard University, points out that thinking is often invisible and hidden, and that children have few opportunities to share or verbalise their ideas and thinking processes. He emphasises the importance of developing children's thinking and suggests ways adults might act to make the process more apparent, such as by using the 'language of thinking', which involves modelling thinking out-loud and building a culture of thinking in the learning environment.

Perkins argues that when such a culture exists, young learners are:

' ... not closed minded but open minded, not bored but curious, neither gullible nor sweepingly negative but appropriately sceptical, not satisfied with "just the facts" but wanting to understand.' (Perkins, 2003).

ADULT AND CHILD INTERACTION

A culture of mathematical thinking can be developed even with very young children, by encouraging curiosity and providing opportunities to investigate open-ended questions which promote thinking, such as:

- I wonder what will happen if ... ?
- what makes you think that ... ?
- how many ways can we ... ?
- is there another way we can find out?
- I wonder if ... ?
- how do you know you are right?
- can we solve the problem another way?

Resources for learning numeracy at home, in care settings and at school are important, but it is interaction with adults that is vital. Construction toys, play equipment and games will not develop children's mathematical thinking on their own. Good questions from adults and interactions between children—in which they can hear how others think—encourage children to ask more questions, to review their existing ideas and try new ways of solving the problems they meet.

CREATING LEARNING ENVIRONMENTS

I recently overheard some children in the block corner discussing how to make their tower support the toy they wanted to place on top. One voice said, 'We need to put some of these big flat ones on top to hold it up.' When this didn't work and the tower collapsed, another put forward the idea that the tower should be built again, using a much stronger base—and the toy was balanced perfectly. This is an example of children learning from each other and, when one way of thinking isn't working, trying another: the basis of problem solving.

An environment rich in numeracy-learning is one in which everyone, including adults, are engaged in asking questions, such as:

- how do you know 10 is bigger than four?
- what shapes will fit together without gaps between them?
- what comes next in your pattern and why?
- will all the toys fit in the box?
- how many days until Grandma's birthday?
- how many biscuits do we need to make if everyone is to have two?
- which coins will we need to buy the milk?

In such an environment young learners will be seeking solutions, trying different possibilities, and justifying and talking about their answers. Sharing ideas means solutions can be compared and discussed, and different ways of thinking can be highlighted.

Susan solved the problem showing that 10 blocks joined together make a longer stick than four, but Joseph also said he knows 10 is bigger than four because his brother is 10 and is older than someone who is four.

Children learn from each other as they tell the story of their thinking—and adults learn along with children as they listen to their explanations.

CONCLUSION

Being numerate involves a lot more than knowing mathematical facts. It requires the ability to think like a mathematician and to inquire about mathematical ideas. Children engage in mathematical thinking as they actively explore their world and meet new ideas, confront problems and interact with others.

All children can be mathematicians if we create learning environments which encourage them to make their thinking visible, celebrate their ideas and challenge them to inquire beyond their current level of understanding.

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References

Australian Association of Mathematics Teachers (AAMT) and Early Childhood Australia (2006). *Position paper on early childhood mathematics*. Adelaide: AAMT. Retrieved 20 June 2007, www.aamt.edu.au/content/download/721/19509/file/earlymaths_a3.pdf

Perkins, D. (2003). *Making thinking visible*. Retrieved 20 June 2007, www.newhorizons.org/strategies/thinking/perkins.htm