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maths. with meaning

If you start with a compelling problem, children will rise to the challenge, says Mike Askew, director of BEAM Education...

When I went to school – heavens, I'm sounding like my father – we didn't have difficulties learning about problem solving. Problems on, say, multiplication came at the end of the chapter on multiplication, so you knew exactly which operation to use. The thing is, we didn't really learn about solving problems at all; the set up of the textbook provided a veneer of success. Faced with a problem outside of that structure, where I had to decide on the maths to use, I was lost. And I was marked out as being 'good' at maths within the class!

Although such an approach is rare these days, I think there is still a popular belief that children need to be taught skills and procedures – how to subtract or multiply for example – in isolation before they can solve problems that might draw on such mathematical ideas. Problems are seen as a way of applying previously learned mathematical skills. Such an approach is clearly appropriate in other situations – few could learn to knit by being given a pair of needles, some wool and being told, go on, knit a pair of socks. But how like knitting is mathematics?

Necessity is the mother of invention

Children may not be born knitters, but they are natural problem solvers. Just look at all the problems they must solve in learning to talk: distinguishing which sounds are significant, separating words, figuring out grammatical structure and so forth. All without formal instruction, but not without help and appropriate correction. The important thing is that the lead comes from the child. Parents don't think "today's objective is to teach Scarlet the simple past tense". They wait until she is trying to talk about a memory and then help her to express it appropriately.

Young children can also solve mathematical problems for which they don't have formal techniques if the problems are presented in a meaningful way. Ask a six-year-old what three divided by four is and, at best, they'll tell you it's impossible. Offer that same six-year-old three bars of chocolate for them and four friends to share, and she won't refuse the chocolate on the basis of the sharing being impossible.

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Start with a meaningful context

I am arguing that by starting with a problem-solving context that is meaningful to children and accepting of their informal, improvised way of working out a problem, solutions can provide a rich setting, out of which the more formal mathematics can be developed. An example will make things clearer.

The example comes from a Y5 lesson. The children were having difficulties with fractions and with the idea of equivalence in particular. So we, the teacher and I, planned a lesson around an everyday situation that we thought the children would understand: sharing pizzas.

We started the lesson by talking about friends, parties, pizzas being good for sharing, favourite toppings, where to get the best locally and so forth. Time spent like this immersing the children in the context is not simply about 'window dressing' the problem. It sets up an atmosphere in the classroom that says 'we', the teachers, are interested in what 'you', the children, are bringing to this. Skimp on this and children are more likely to try and guess what method of solution the teacher has in mind rather than engage with the problem itself. For similar reasons, we didn't start the lesson by saying 'today we are learning about fractions', but we did share and talk about the learning intention at the end.

Finally we posed this problem, verbally: **12 friends went out for a pizza. It was towards the end of the month, so they only had enough money to order eight pizzas. They ordered the eight and shared them equally. How much pizza did each person get?**

The children cooperated in small groups, sharing one large piece of paper and a thick pen. As they worked, we went round encouraging the children to explain their methods. As the work was drawing to a conclusion, we selected two solutions that we thought should be shared with the class and told the children in those groups to be prepared to come up and address their fellow pupils. Note that the sharing was not down to volunteers – the point of the plenary was not to celebrate the ingenuity of solutions but to provide a shared experience of dialogue about equivalence.

The first method was typical of what many groups had done: everyone got half a pizza each and the remaining two pizzas could be sliced into sixths. So the friends got $^1/_2 + ^1/_6$ pizza each.

The other solution was based on sharing four pizzas so that everyone would get $^1/_3$ pizza. The second four pizzas would provide another $^1/_3$ each. So in this group each person would get $^2/_3$ pizza.

The last pizza the puzzle

After both solutions had been presented and discussed, the class was in agreement that each was correct. But what was happening here? Going out with one group would mean getting $^1/_2 + ^1/_6$ of a pizza to eat, going with the other group would give you $^2/_3$ pizza. Were these the same?

CONT...

If you really liked pizza, which group would you want to go out with?

This is the point at which the time spent setting up the context becomes important, because the children had 'bought into' the world of sharing pizzas. Their everyday knowledge meant that, intuitively, they knew that the portions had to be the same size. The challenge was to sort out why, mathematically, these appeared different. This is a crucial difference in starting with a problem – everyday knowledge is used to support emergent mathematical understanding. This stands in contrast with the teach-the-content-first-then-apply-it approach that assumes children can easily access and use abstract mathematics to make sense of everyday situations.

Back in their groups, the children were challenged to come up with some representation that would show whether the two amounts were equal or different. The plenary discussion about what they'd learnt indicted that many of the children were beginning to get a sense of what equivalence was really about.

Solve the world's problems

The Realistic Mathematics Education materials developed in Holland has a whole curriculum based around this idea of 'mathematising' the world. Based on the philosophy that mathematics is a human construction that arose out of problem solving (fractions were invented by mathematicians precisely in order to be able to answer calculations like three divided by four) key mathematical ideas are initially introduced through problems like this pizza puzzlement. If you would like to read more about this approach, I recommend Cathy Fosnot and Marteen Dolk's books which set out the ideas-approach in detail.

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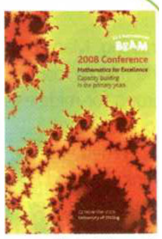
22nd of November – don't miss out!



If you want to teach truly excellent maths lessons, then this is your best opportunity to pick up enough fresh ideas to keep your class engrossed all year. The BEAM primary maths conference is being held on the 22nd of November at the University of Stirling, and will feature such inspirational speakers as Lynda Keith and Mike Askew, professor of mathematics education at King's College, London – not to mention the author of this article! As well as sharing their latest theories on primary education, course experts will be running workshop on subjects such as:

Active learning in mathematics – Engaging and motivating cross-curricular links can make maths relevant, challenging and enjoyable for everyone. Be prepared to dance about and use your imagination!

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