Undoubtedly children learn a great deal at school and we spend a good deal of time assessing and evaluating children’s learning as part of our classroom practice. Invariably this assessment focuses on the knowledge and skills the children have developed, however, they learn much more than just knowledge and skills. In their mathematics classes children develop beliefs, attitudes and feelings about mathematics and themselves as mathematical learners (Grootenboer, 2001; McLeod, 1992). Some have suggested that this affective learning is very powerful and can have a significant impact on the student’s perceptions and abilities in learning and using mathematics effectively (Fennema, 1989; Garden, 1997; Ma, 1997; Walls, 2001).

In *APMC 7* (3) Andrea McDonough (2002) outlined a strategy called PPELEM (Pupil Perceptions of Effective Learning Environments in Mathematics), which was designed to help teachers and researchers understand more fully children’s beliefs about effective learning in mathematics, thus focusing on the affective dimension of their education. This study also focussed on the affective side of some children’s learning in mathematics as they were asked to comment on their beliefs and feelings about mathematics and their learning of mathematics. In short, it was an attempt to ask some kids what they thought about mathematics and themselves as mathematical learners.

**The study**

The study was undertaken in three Year 5 and 6 classrooms in a suburban New Zealand primary school. The school draws from a generally middle-class suburb, and it has
received high praise from many quarters for the high quality, innovative education they provide. Over the last two years the school has been involved in both the Early Numeracy Project and the Advanced Numeracy Project, including the children who participated in the current study. In all, forty-five children aged between nine and twelve participated in the data collection exercise.

To collect the information the children were placed in small groups of four or five and they completed an open-ended questionnaire while discussing their responses with one another. The students’ classroom teacher supervised the group and kept the discussion open and flowing while reassuring the children that we really wanted to know what they felt and thought. The questionnaire had three sections, the first focusing on mathematics, the second on learning mathematics, and the final one on their feelings about mathematics. Overall the student-participants were able to lucidly and concisely discuss and write about their perceptions of mathematics and themselves as mathematical learners.

**The students’ beliefs about mathematics**

The students who participated in the study had studied mathematics for five or six years as part of their primary education so they had a wealth of experience on which to draw when discussing mathematics. What was clear from their responses was the primacy of number and arithmetic. For the majority of the participants mathematics was a subject that was fundamentally about numbers and operations with numbers. Many of the student-participants considered times-tables as the most important aspect of mathematics, and indeed the key to success in learning mathematics was ‘to know your times-tables’.

**Mathematical content**

Initially the children were asked what they thought mathematics was about, and 62% responded with comments about number or arithmetic. For example, Andrew wrote; ‘Maths is about numbers and ÷, ×, +, –’, and Emily stated; ‘I think maths is about doing sums and learning your numbers and how to use numbers. You need to learn your numbers because it is important to be good at them’. The only other content-dimension of mathematics highlighted was measurement, which was only mentioned by two children.

The children were also asked to list the most important things they had learned in mathematics, and again number and arithmetic featured prominently (73% of the participants). They mentioned things like times-tables, division and long division, and more specifically, counting, ‘+,-, ×, ÷’, fractions, ‘doubling and halving’, and long multiplication. A couple of the student-participants listed geometry and one listed statistics but none of them included measurement or algebra.

What is conspicuous here is the omission of some major topics that form an integral part of the students’ mathematics curriculum, in particular, measurement, geometry, statistics and algebra (which, along with number, are the content strands of the New Zealand mathematics curriculum). The students certainly would have studied all these aspects of mathematics each year of their primary schooling, but it seems as if none of them would identify them as an integral part of mathematics! The school has been involved in government-sponsored initiatives to improve numeracy and therefore given some emphasis to number and arithmetic, but the school mathematics curriculum has not ignored the other aspects (measurement, geometry, statistics and algebra).

**The nature of mathematics**

In response to the two questions mentioned above, some of the students involved did not respond with answers or comments related to the content of mathematics, but rather the nature of mathematics and learning mathematics. About 30% suggested that mathematics was about thinking and hard work.

For example, Sharee thought that, ‘Maths is about thinking and learning, using your brain. It is a brainy subject and you have to think hard with your brain’.

Gina suggested that, ‘Maths is difficult and you have to apply yourself and try hard’.

Furthermore, when listing the most important things they had learned in mathematics, five students noted ideas like, ‘keep trying’, and ‘never give-up’,
indicating a need for perseverance when doing and studying mathematics.

A small number (13%) of the students thought mathematics was about strategies for working things out and problem-solving. Interestingly, in each case, their teachers identified the students as being the more able ones in the class. The comments these student-participants made included:

‘It is important to know different ways to solve problems.’ (Brienne)

‘Maths is a way that you can find things out, like how big is a circle.’ (Whetu)

‘It [mathematics] is about problem-solving and finding strategies to work out things.’ (Hannah)

In each of these cases the students seemed to have a perspective of mathematics that incorporated the mathematical processes (an integral part of the New Zealand mathematics curriculum). Unfortunately this did not appear to be the case for many of the other children — perhaps those for whom mathematics is not so easy! Indeed, the students who thought that mathematics was about hard work were more likely to have been those who had struggled in the subject.

**Times-tables**

As already noted, the second question given to the children asked them to list the most important things they had learned in mathematics. Nearly 70% of the student-participants mentioned times-tables, and if they listed more than one item, then invariably times-tables would have been listed first. Some of these respondents listed their reasons for valuing times-tables and they included:

‘Times-tables, because if you can do times-tables you can do just about anything.’ (Jason)

‘I think the most important thing is your times-tables. They help you with long division and other things.’ (Caitlin)

‘The brainy kids are good at [times]-tables.’ (Zhan)

‘Times-tables, because if you know your tables then you will get a good job.’ (Chris)

While it is not the purpose of this article to debate the pros and cons of learning times-tables, it does seem as if they have some sort of privileged status in the perceptions of these primary students. It could be that these students reflected a strong belief in the value of times-tables held by their parents (and the community at large). Nevertheless, one could speculate that a student who had a good memory, and could therefore memorise their times-tables and recall them quickly, would be seen as some sort of mathematical genius! But that is of course, just speculation!

The final question in the first section asked the student-participants to give some advice to students coming into their level in the next year. Their responses highlighted two key things again, namely ‘learn your times-tables’ and ‘always try really hard’. One example is Kirsten who wrote:

‘Maths is not as easy as it looks. You have to work hard and learn your tables and tidy numbers. Maths can be a bit confusing at times but you may as well learn it now or you’ll have trouble later.’

**Learning mathematics**

In the preceding section it was clear that the children’s beliefs about mathematics were closely linked with their experiences of learning mathematics at school. Indeed, their only conceptions of mathematics were limited to the classroom context and so their affective views of mathematics were the same as their affective views of learning mathematics. This point was evident in the students’ responses to the final two sections on learning mathematics and feelings about mathematics, where their comments were inter-connected.

The participants were asked to discuss and describe their favourite and worst mathematics lessons and then the research team identified the defining characteristics of their descriptions. In terms of their best mathematics lessons there was one clear factor - mathematical games. Over 60% of the students described lessons that involved mathematical games as an integral part of the lesson, and often they could list the particular games. Grace said, ‘The best lesson we had was when we were learning about numbers by playing games like four-in-a-row and three-in-a-row. It was fun and exciting.’ In general the responses were clear in their support for games and often they outlined the games in some detail. The students seemed to describe these lessons as ‘fun’, thus indicating that fun and enjoyment were an integral part of a good
kids talking about their learning in mathematics

In outlining their worst mathematics lessons, the key features that emerged were long division, times-tables, bookwork, lack of understanding, public humiliation and learning things they already know. The emergence of long division as an important factor was perhaps reflective of the fact that one of the three classes concerned had just been studying it, but the other factors were noted by at least one student from each of the classes.

It was interesting to note the emergence of times-tables as a characteristic of an unpleasant mathematics lesson for many of the students given the earlier support for times-tables as one of the most important things they learn! Of the 42% of the students who mentioned times-tables here, they noted in particular writing out their tables, repetitively singing their tables and times-table tests.

Perhaps allied to these concerns, the students noted two other factors that were both unpopular for reasons of boredom. The first of these two factors was bookwork where some of the participating students commented on their dull and repetitive perception of bookwork, for example:

‘The worst lessons were when we did lots of writing in our maths book for the whole time. That was a boring way to learn.’ (Casey, spelling and grammar corrected)

‘My worst would be doing it ALL out of books ALL lesson.’ (Karen)

The second sort of lesson that was seen as boring were those that involved ‘learning things we already know’ (Miranda). It seems as if many of these responses were about revision-type lessons, and the students concerned saw them as boring and irrelevant, and they suggested that ‘we didn’t learn much because we already knew it’ (Sam). It was also common for these responses to be linked with bookwork. It should be again noted that this is how some of the children saw these activities, but that does not necessarily mean that revision or bookwork are bad, if fact we believe that revision is an important and integral part of a good mathematics program.

Interestingly, a number of the children listed the opposite position as a factor in their worst mathematics lesson. For these students their worst lesson involved confusion and bewilderment as they seemed to have no idea about what they were learning. Steven (10 years old) wrote:

‘My worst maths lesson was when I was 9 and I had to figure out 6 hard maths equations. I didn't get it and I couldn't do it and no one was allowed to help me because it was problem solving.’

Not surprisingly, the students whose worst lessons involved work that was ‘too easy’ were the more advanced mathematical learners, and those who commented on ‘not understanding’ were those who struggled in their mathematics learning.

Perhaps the saddest comment in this section came from some of these struggling students who felt publicly humiliated or embarrassed in their mathematics lessons. Although these comments only come from four of the student-participants (9%), their comments are piercing, and they speak for themselves (spelling and grammar corrected):

‘My worst lessons are when people laugh at me when I get things wrong.’ (Nadine)

‘When I couldn't do take-aways and the whole class laughed at me. Then I had to stay in all of interval while the others were outside playing and laughing at me.’ (Neal)

‘I was stuck in a group with the good people and they knew all the answers and I didn’t understand and couldn't keep up so I got really behind. I didn't understand the progress or the answers but then I had to report to the class. In front of everyone I cried.’ (Rachel)

Given that most of the participants seemed to link their views of mathematics with their experiences of learning mathematics at school, it is not surprising that many of these children had negative feelings about mathematics. However, these were only four children of the 45 involved, and they were drawing on a number of years of learning mathematics. Perhaps then, we need to celebrate that many of the participants (31%) said that they did not have a worst mathematics lesson, or that they were all good! These students were often positive and excited about mathematics, giving the impression that it was ridiculous to even ask if they would have a bad lesson.
Feelings about mathematics and learning mathematics

As mentioned previously, the children’s feelings about mathematics and learning mathematics were closely related because they only seemed able to consider mathematics in the school context. Nevertheless, these students generally felt positive about their mathematical experiences and they had developed a sense of value about mathematics.

In one question the students were asked to rank all their school subjects from their favourite to their least favourite. Of the nine subjects they listed, mathematics came in fourth (behind the runaway favourite: physical education) and was ranked as high as first and as low as last by individual children. When asked how they felt about mathematics about 48% responded overtly positively by saying they felt ‘great’, ‘cool’, ‘wonderful’, ‘happy’, ‘good’ or ‘love it’. Just under 40% said they felt ‘okay’ or ‘sometimes good and sometimes bad’ and the remaining 12% expressed feelings that were somewhat negative (e.g. ‘uncomfortable’, ‘don’t like it’, ‘boring’ and ‘confused’). It was pretty exciting to see that nearly 90% were not negative, as it seems that many people do have negative feelings towards mathematics and that its value is in its usefulness. It seems as if these children have some thoughts on the age-old question - When am I ever going to use this stuff? What is also obvious is that many of them see mathematics as something they will use in the future for a job or high school. It would have been interesting to see if they saw any use for their mathematics in their current everyday life and in future we will include questions to this end.

For example, some of their comments were:
‘I think it is important to do maths because otherwise you won’t get anywhere in life because you won’t get a good job so I think everyone should know their maths.’ (Liam)
‘Yes. If you know your maths you can work at a bank or a shop counting the money.’ (Alison)
‘Yes, because you need it in high school.’ (Grace)
‘You need to do maths because you use it all the time.’ (Tim)
‘Maths is important but I don’t know why!’ (Brady)

What is clear from all these comments (apart from Brady’s) is that the students have a clear utilitarian view of mathematics and that its value is in its usefulness. It seems as if these children have some thoughts on the age-old question - When am I ever going to use this stuff? What is also obvious is that many of them see mathematics as something they will use in the future for a job or high school. It would have been interesting to see if they saw any use for their mathematics in their current everyday life and in future we will include questions to this end.

Comments and conclusions

In APMC 7 (3), Andrea McDonough (2002) made a strong case for exploring the beliefs and feelings children have about mathematics and learning mathematics. This study did not employ the PPELEM model (although we will be considering it in future work), but it did seek to find out what the children felt and thought about mathematics. It was clear that even through this small-scale study the children were able to articulate and discuss their affective responses to their mathematical experiences. What is more, their perceptions were interesting, relevant and useful to the teachers concerned as it gave them a better understanding of some of the hidden messages that pervade their mathematics teaching.

One of the key things to emerge was that the students’ views of mathematics were firmly grounded in their school experiences. While this may seem rather obvious, it does then behave teachers to consider the way they present mathematics and the form of mathematics they teach, because the students will make their judgments and feelings based on their school experiences. This is a serious issue when one considers how many people seem to dislike and avoid mathematics. One does not need to ask too many people to ascertain that the general perception of mathematics is not good, and this perception is often rooted in their school mathematics experiences (Grootenboer, 2000).
In terms of curriculum, it was clear that these students associated mathematics primarily with number and arithmetic. In New Zealand the government has placed far greater emphasis on numeracy in primary school education, but the curriculum does also have a significant proportion dedicated to discrete areas such as algebra, statistics, geometry and measurement. The children in the study had done quite a bit of work on these other areas throughout their primary schooling but they generally saw mathematics in a limited way. Particularly now we have significant numeracy projects in Australia and New Zealand we need to ensure that a broader perception of mathematics is maintained with both students and teachers. Allied to this was the ultimate value the students placed on times-tables (a view probably shared by many parents!). While this is not the forum to debate the value or otherwise of learning times-tables, their place at the pinnacle of mathematics learning has to be challenged. Certainly the teachers of these children did not see times-tables as pre-eminent, and yet the children have perceived a somewhat different message — perhaps a message that is deeply embedded in our societal values!

In our mathematics classes children are learning many new skills and developing knowledge as they engage in the experiences of their lessons. It is also clear that they are formulating beliefs, attitudes and values about mathematics, and experiencing emotions and feelings about themselves as learners of mathematics. These affective aspects need to be addressed in the classroom as they can be powerful influences on the students as they learn and use mathematics both now and in the future. We encourage you to take some time to find out how your students feel about mathematics or what they believe the subject is about. Perhaps you could try PPELEM (McDonough, 2002), or just have a discussion with them — we are sure it will enhance your teaching and their learning.

References

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