SENSITISING PRIMARY STUDENT TEACHERS TO YOUNG CHILDREN'S MATHEMATICAL IDEAS

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Research has shown that young children possess a considerable store of mathematical ideas (particularly about number) when they start formal schooling. This paper describes an attempt that was made to use these ideas as the starting point for a course in mathematics education for first year students at university. Students were given an interview schedule and were asked to interview one or two five year olds over two sessions. Between interviews the students met back at university to discuss and reflect upon the children's responses, and to prepare for the second interview. In a questionnaire administered one week after the second interview, the university students were asked to comment on what surprised them about the five year olds' responses. These were, in order of frequency, that the children knew so much "maths", that they were so open and co-operative, and that their ideas and strategies were se different from those of the interviewer. The implications of these are discussed in the paper.

INTRODUCTION

Young children possess both a store of ideas about number and the ability to use these ideas. This has been consistently shown by a number of studies (Carey, 1991; Carpenter and Moser, 1984; Hughes, 1986; Young-Loveridge, 1991) and is now generally accepted by mathematics educators. How might a group of university students embarking on their first mathematics education course perceive the mathematical ability of young children?

We decided to begin a new mathematics education course with first year university student teachers by taking them into schools to interact with five year olds. There they would interview one or two children. The reasons for this approach were that we wanted the university students to become sensitive to children's ideas in mathematics early on in the course, and we felt it might be a suitable introduction for those students who were themselves maths anxious - a problem with many teachers in training (Nisbet, 1991). As well, we wanted to have the course members gain a wider view of mathematics education than the one they might have developed from their own classroom experiences.

These were the major questions for the author:

1. were the students at all surprised by the mathematical knowledge of the five year olds, and

2. what was surprising about what the children did/said (from the student teacher's perspective)?

INTERVIEWING THE CHILDREN

An interview schedule was devised by a member of the teaching team (Biddulph, 1992). The schedule contained not only questions that might be asked, but also described suggestions for interacting with the children. In particular, guidelines were given for how the students might ask questions, put the interviewee at ease, ask gentle, probing questions, and avoid telling.

The interviewing took place on consecutive weeks in March, so many interviews were held in an appropriate outdoor setting. Most were audiotaped and each lasted about 40 minutes.

METHOD

102 first year university students were administered an open-ended questionnaire. The subjects, 75% of whom were female, ranged in age from 18 to 45 years of age, with a mean of 20. The questionnaires were completed in class time at university under the supervision of the course lecturer. The answers to one of the questions is the topic for this paper.

The question asked was, "What things surprised you about the way the child(ren) responded?"

This question was part of a wider questionnaire that tapped into a number of issues to do with the interviews. These included whether they expected to begin a course by interviewing children, what the most difficult aspects of working with a child were, and what influence the experience might had had on their ideas about the learning and teaching of mathematics.

As well, the students' course log books were used to get information about what aspects of the interviews surprised them.

RESULTS

The student teachers were surprised by 18 different aspects of the child(ren)'s responses. They were as follows (in order of frequency):

1. Thirty-four students wrote that the children had a greater-than expected knowledge of mathematics. Typical statements from the questionnaires that reflected this were:

> I did not expect my child to be so knowledgeable in the area of mathematics. She was well informed on numbers and she could count in twos, fives, tens and so on. She knew many types of shapes including hexagons, pentagons.
>
> Children have a great deal more mathematical knowledge and skill (at a junior age) than I previously thought.
>
> Emma had only been at school 5-6 months and was far more advanced and beyond my mere mortal range of questions. Unlike most kids

> Emma not only gave me answers but a lot of the time she explained to me why this was so without any prompting from me.
>
> My child seemed to know an awful lot. One time I was really surprised when she did something which I still don't understand how she did it.

Fifteen students who replied in this way were asked to elaborate on their statements. Their replies indicated three main areas of "number strength" that surprised them. These were the child's ability to count in a rote and/or meaningful fashion, their knowledge of the operations, and their competence at solving simple word problems. Responses from the interviewers were:

> The thing that surprised me was that a five year old could count so high and could establish where a number would be placed - before or after.
>
> My child could rote count for ages. I stopped him at 100 but he could have gone on.
>
> Meaningful counting - it was interesting that she didn't get confused when things meant something to her.
>
> I was surprised at how well the child I was given, when asked the question, "If mum washes 2 pairs of socks in the family for everyone, how many socks will be hanging on the washing line?", could answer. He did struggle to start with, but basically knew what I meant and could make a start.

2. The second most-mentioned aspect referred to the interaction between the adult and child- seventeen university students were surprised at the openness, candour and co-operation of the children.

> Very talkative and wanted to show me everything that she could do.
>
> The child I was working with was very open and co-operative and did not hold back in the least.
>
> They were keen to work with me.
>
> Their (the children's) answers were often explained without asking - no inhibitions.
>
> He always tried. Even if he didn't know how or what to do, he'd look away and say, "Let me see ..." He always came up with some way of doing it.

3. Twelve students commented on the "unusual" nature of the childrens' ideas and explanations. Some of them realised this was because they were comparing the child's responses with their own.

> How they use logical, simple methods to solve problems without using the ways I had been taught. My boy didn't know about using a ruler to measure the difference between our strides, but he marked where our strides ended with leaves and stood back and saw the difference and then could accurately conclude whose stride was the longest (sic).
>
> For one of the activities he turned it into a game which I wasn't expecting, and would sometimes do things just a little bit differently than I thought I'd explained them.
>
> Some answers to questions were explained to me in a logical way that I'd never explained to myself. But they were very clear to the child.
>
> Their logic seemed totally up the creek at times, and ridiculously straight forward at others.

4. Eleven of the 102 students were surprised by the children apparently "knowing" something one week, only to find on their return a week later that the child had forgotten. As well comments were made about "knowing then not-knowing" within the interviews.

> Sometimes he knew what a rectangle or circle was called in one session, then 10 minutes later referred to it as an oblong or a round.
>
> She also surprised me in the change in her ability through the amount she knew - one week she counted higher than the week before.

The different answers that some children gave to the same question were a concern for some. One student commented, "If I asked the same question again later in the lesson, the answer given was nearly always different from the original. This made me worry about the **true** understanding of any mathematical concepts" This is a perceptive comment that gets to the core of many of our concerns about assessment.

5. The next most often mentioned aspect was how **little** mathematics these young children knew. It might be interesting to know of the background of the students with this view. Were they school-leavers? Or more "mature" students who had had experience in interacting with children?.

> It surprised me how little my child knew about maths.
>
> I was surprised with what they didn't know. I guess I expected New Entrants to have the knowledge of a more advanced child.

The remaining 13 categories of surprises came from smaller numbers - ranging from six to a single respondent. They included:

- how confident the children were
- their ability to use a calculator
- the strong influence of home
- how easily the child became bored and restless

DISCUSSION AND CONCLUSION

The data show that a group of 102 student teachers gave very diverse views on what surprised them about the mathematical knowledge and understandings of five year old children. However, the four most common responses accounted for over three quarters of the total. By far the most common "surprise" for the group was the extent of the knowledge and ability that the young children possessed, particularly in the general area of number. Looking towards the future, this may help these student teachers become more sensitive to the learning needs of children. It may also help them decide on appropriate programs for five and six year olds, and look critically at proposals that de-emphasise extensive work with number (in a variety of contexts) on the basis of "readiness" arguments.

The data suggest that the student teachers were forced to think about the characteristics of children's thinking and mathematical ideas. Earlier quotations from the questionnaire in this paper support this view. This outcome was perhaps assisted by the group discussions and reflections that were held in the school immediately after each interview, and five days later back at university.

Comments reported here also suggest that the student teachers were having to think about how they might work with children. One wrote, "The children knew some jargon without seeming to really know what it meant (eg "square"), but somehow seemed to understand a concept without the technical words. This surprised me in that what the children knew or understood was quite different to surface appearances of what their knowledge was." This student teacher may now be more wary of a "telling" style of teaching where the learner's existing ideas are often ignored, and where they may be few attempts to probe below the surface. As well, s/he may become more sensitive to the role of language in mathematics (cf Hughes, 1985).

From the data reported here, and a course evaluation that was administered to the 102 university students at the conclusion of the course, we now believe that the students have grown in their ability to:

1. listen carefully to children and not be satisfied with initial responses;

2. appreciate that children have their own views of the world;

3. recognise the advantages of working with children in the school setting;

4. work with children in a relaxed and supportive manner;

5. use the technique of interviewing in order to better understand children's mathematical ideas.

The course, of which the interviews were a significant component, continues to be evaluated by the teaching team.

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