Convincing Preservice Teachers about Calculators

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How to convince teachers (other than those who have been involved in calculator projects) of the merits of integrating calculators into primary mathematics programmes is an issue that needs to be addressed. This paper reports effects on the beliefs of a group of preservice teachers who participated in a short but challenging, action-focussed calculator course. The results suggest that preservice teacher beliefs can be changed in a positive direction.

In recent years, several calculator projects (CAN, 1990; Groves and Cheeseman, 1995; Lindale and Biddulph, 1991; Mathematics Education Unit, 1995) have demonstrated the value of calculators in developing children's number ideas. For example, children as young as six and seven years can begin to understand negative and decimal numbers, as well as larger numbers into the hundreds and thousands. Furthermore, teachers involved in such projects have usually come to appreciate the power of calculators to enhance children's learning in mathematics. However, as McChesney (1995, 8) asks,

> Given the overwhelming evidence that appropriate use of calculators can transform the way we teach number in the primary school why are schools and teachers so reluctant to embrace the potential of the calculator?

One likely reason is that the notion that calculators can benefit children's number understanding is counter-intuitive for many teachers and parents. The image of calculator use that springs to mind for these people is that of an electronic number-crunching tool that children are likely to come to rely upon - and thereby become mentally lazy. Visions of dependency, and failing to learn basic number facts, loom large.

Given that recent curriculum documents such as *Mathematics in the New Zealand Curriculum* (Ministry of Education, 1992) assume that calculators will play a central role in primary mathematics education, how can teacher education courses change the understandable mind-set of many practising and preservice teachers? This paper describes one such course and the effects it had on a group of primary student teachers.

Method

The data which inform this paper were collected in 1995 from 24 student primary teachers by means of written reflective statements on a four week calculator component of a 300 level course on Technology in Mathematics Education. They enrolled this course in their third year as an option for their BEd degree.

The Four Week Calculator Component

This comprised two hours per week and consisted of (i) a brief introduction to the research related to calculator use by young children, accompanied by relevant readings, (ii) viewing the Victorian Project video produced by Deakin University entitled *Young Children Using Calculators* (since student teachers in another course the previous year had said that this was an 'eye-opener' for them), (iii) preparing two school mathematics learning sessions incorporating calculators (from calculator resource books provided - see Appendix 1), and (iv) working in schools, for two sessions of approximately an hour each, on two consecutive weeks with a group of approximately three children aged 7-8 years using the prepared calculator learning tasks. Course members had access to sufficient calculators to enable their children to have one each for

the learning tasks. The student teachers were expected to collect data on the children's responses to the calculator integrated learning experiences. The in-school, action-research segment was intended to be a miniature version of the calculator projects indicated above.

The Reflective Statement

This was required as part of an assignment on this component of the course. The assignment itself took the form of a research report, with an appropriate literature review, on the school-based segment. Specifically, the students were asked to, "include a reflective statement about the impact of this course and research on your own views about the place of calculators in primary school mathematics programmes."

The data provide some insight into (i) whether the student teachers changed their views, (ii) what their initial views were, (iii) the origin of some of these views, and (iv) what they considered changed their views.

Results and Discussion

Change of Views

Of the 24 student teachers, all appeared to change their ideas about the place of calculators in junior primary school mathematics programmes and now saw them as essential. However, in the case of one student it is doubtful that she is firmly committed to this view. Although she reported that she now considers calculators an important tool for children to use, and that the children's enthusiasm 'rubbed off' onto her, she also remarked that she still believes that children need to learn, understand and know how to perform basic functions through pencil and paper processes.

Initial Views

In the case of four of the student teachers it is not clear what their prior views were but their reflective statements suggest that there was a change in thinking. For example, one wrote, "The calculator unit in particular has shown me just how children's mathematical thinking can be enhanced by using calculators in the classroom." The remainder of the student teachers revealed in their statements what they had thought previously. These initial views can be classified into seven categories.

Naive view: The naive view encompasses the belief that calulators are suitable only for checking answers or quick calculations. Three student teachers held this view initially. For instance, one student reported, "To be completely honest I began this course with a rather naive view of how calculators might be used in classrooms. My ideas for their usage were restricted to checking answers and working things out quickly."

Neutral view: This view was held by two student teachers and largely stemmed from them not having given the matter much previous thought. One of the two wrote, "This unit has really made me stop and realise the importance of employing calculators in primary school mathematics programes. It has been something I have seen little of on teaching practice and, to be honest, I hadn't given it much thought up until now."

Calculators only appropriate for middle school children: This view was held by just one student teacher who observed, "My own ideas about calculators in maths education have changed from believing that calculators are only incorporated into middle school maths."

Basic facts, operations and understanding are needed first: This initial idea was held by five of the student teachers. As one student teacher wrote, "Before undertaking this course, my thoughts on the use of calculators in primary schools were that children should have already grasped an understanding of basic facts before using the calculator." Another commented,

> Research during this course has definitely changed my perspective on the way calculators can be implemented into a mathematics programme. I once held the view that children

> should learn their basic algorithms via the pen and paper method before having the opportunity to use a calculator.

Calculators have a negative effect: The thinking of student teachers here was that calculators can induce intellectual laziness and dependence. Five initially held this view. In the words of one of them, "I must admit that I was one of those people who believed that calculators would mean that children would not learn their basic facts and tables, that they would become lazy as calculators are the easy way out." Another reflected,

> I am afraid to say that I have been forced to radically change my ideas about the role of calculators in the classroom. Previously I believed that using calculators increased children's dependence on technological aides rather than their mental computation and ideas about number.

Calculators represent 'cheating': Two student teachers reported that this was their intial view. For example, one wrote, "Typically, I have held the view that calculators are a form of cheating." It is also possible that this is what a third course participant meant when reporting, "In my own experiences the use of the calculator was taboo up until 3rd form."

Origin of Initial Views

A small number of course members included in their reflective statements data that give some insight into how they came by their intial views about calculator use in primary school mathematics. These views fell into two categories.

Parental view: One student teacher reported that one of her parents influenced her ideas. She wrote, "I recall being told by my mother to 'work it out for yourself' if I asked to use a calculator. Of course initially this gave me the impression that a calculator was a lazy way of doing maths."

Personal school experiences: Six of the student teachers (25% of the course members) were clear that they had developed their initial ideas from personal learning experiences at school. For instance, one course member recalled, "When I attended primary school in the early 1980s I was always made to think that if you used a calculator then it was cheating."

Factors that Changed Views

The data reveal that four factors influenced course members to change their views about the place of calculators in primary mathematics classes.

Introduction of a new curriculum: One student teacher considered that her recent introduction to *Mathematics in the New Zealand Curriculum* (Ministry of Educaiton, 1992) had helped change her attitude that calculators are a means of cheating. She specifically referred to a statement in the curriculum document about providing opportunities for students to develop accuracy, efficiency, and confidence in calculating - mentally, on paper, and with a calculator (Ministry of Education, 1992, p.31). This factor was somewhat surprising because, although I did briefly mention the view about calculators expressed in the curriculum document, I did not give it special emphasis and did not imagine that it would have such an apparently powerful influence.

Viewing the video: In contrast to my anticipated effect of the curriculum document I thought, based on prior experience, that viewing the video would have had a considerable impact on the student teachers' views. Again I was surprised; only two reported that their ideas had been influenced by the video. One wrote, "My attitude towards calculators has changed a great deal from being part of this course, particularly in watching the video presented to us."

Reading the research literature: I always hope that relevant readings provided will have some effect on the thinking of course members but more often than not at the undergraduate level they seem to regard these as part of the 'academic game' one plays when writing course assignments. I was therefore surprised (for a third time) when nine of the student teachers reported that their review of the research literature actually influenced their views about the place of calculators in primary mathematics. For

instance, one wrote, "Considering the literature... has somewhat challenged my views of the role of calculators in mathematics education, particularly for younger children. To see the benefits that students can gain from their use is quite enlightening." Another student noted, "I have learnt a great deal about the use of calculators in primary school mathematics. This learning has mainly come from the literature read, and not from the action-research that took place." One of the reasons for this latter comment, she reported, was that she had chosen unsuitable tasks to try with her group of school children.

Working with the children: Apparently the two school sessions on calculator-integrated mathematics activities, developed and taken by the student teachers, had a powerful impact on their views; 22 of the 24 course participants mentioned this. The children's enthusiastic responses, their development of understanding of place value, large, decimal and negative numbers, and their successful efforts at problem solving all convinced most of the student teachers of the value of calculators in junior primary mathematics programmes. For instance, one reflected,

> At this stage of my training I have done many school based lessons similar to this, yet I couldn't help but note the enthusiasm and motivation the children showed in these sessions. I can definitely see the benefit of using calculators right from the age of five.

Another reported, "It was not until I was in the classroom myself with a group of children that my ideas were changed. It was necessary for me to see the children working with the calculators before I could see the relevance they had in maths education." A third wrote,

> I had no idea that calculators had such possibilities for extending pupils' knowledge or that they could be used from such an early age. For example, when some of the students were struggling with the concept of place value the calculator was the ideal tool for developing knowledge. The students seemed to really enjoy the calculator. Maybe it was because they were more in control and everything they needed was in front of them.

Conclusion

The data suggest that the eight hour course component effected a major shift in the thinking of almost all the student teachers with respect to the place of calculators in primary school mathematics programmes. The students' initial range of views come as no surprise, and their comments about their changes of perspective seemed to be genuine. However, it is conceivable that a few of the changed views were constructed to please me and/or gain credit for the assignment of which they formed part.

At first glance the two sessions in school working with a group of children had by far the greatest impact on the student teachers' thinking, but it is probably difficult to separate this element from others in the calculator component of the course. For instance, eight of the nine student teachers who reported that the research literature had influenced their views also mentioned that the school sessions had had an impact as well. The same was true of the two student teachers who mentioned the value of the video in developing their understanding of the potential of calculators for extending mathematics learning, and the one for whom the curriculum document had challenged an existing view.

How can the apparent success of the course be explained? Perhaps humanistic learning theory and control theory is relevant. In terms of humanistic theory (Rogers, 1985) the course provided significant experiential learning that promoted personal involvement. It was both meaningful and pervasive in that the student teachers had to confront their prior ideas about the role of calculators in primary mathematics education. Furthermore their individual views were respected during the course. From a control theory (Glasser, 1986) point of view, the student teachers were largely in control of their

own learning as they satisfied their intellectual need to find out how their initial ideas about the value of calculators compared with the research literature and children's actual responses.

Something that this data cannot reveal is whether the student teachers' changed views will translate into classroom practice when the course members become full-time teachers. This is a question which needs to be addressed in further research.

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Appendix 1

Calculator Resources Used for Constructing School Mathematics Activities

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