

Identifying the Dilemmas in Early Mathematics Teaching

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This study gathered teachers' descriptions of dilemmas they faced when teaching young children mathematics. It was considered that asking teachers to describe teaching dilemmas would enable them to identify a problematic aspect of their teaching practice, and lead to reflection, evaluation and refinement of their practice so that their students' mathematical learning would be more powerful. In analysing the dilemmas described by teachers, key elements were identified. These elements have important implications for providing effective professional development.

Introduction

The introduction of the National Numeracy Benchmarks seeks to encourage schools to identify whether each Year 3 and Year 5 student has reached a critical level of numeracy, without which the student may have difficulty making sufficient progress at school. The benchmarking process is part of a strategy to achieve the National Goal, *that every child leaving primary school will be numerate, and be able to read, write and spell at an appropriate level.*

Achieving this goal focuses the attention of school communities on one of their important challenges: effectively supporting the numeracy development of all students. Further, the process of identifying those students who are not making sufficient progress will impel teachers to examine the effectiveness of opportunities they are providing for numeracy learning in the early years of schooling. This may lead to the need for teachers to explore more deeply how young children learn mathematics and to develop new and more effective teaching practices.

In many cases, facilitating teacher change has been based on the assumption that changes in practices follow changes in teachers' beliefs. Professional development programs, therefore, had firstly to change teacher beliefs before any associated change in practice could occur.

Guskey (1985) argues the opposite position. He maintains that changes in beliefs depend on successful changes in teaching practice, and further contends that attempts to foster teacher commitment to new practices prior to their implementation are generally unsuccessful. He believes that teachers become committed to new practices only after they have been using them in their classrooms and observed positive changes in student learning outcomes that resulted from specific changes they had made to their teaching practice. These changes in student learning outcomes include: involvement in lessons, motivation for learning, attitudes towards school, the class and themselves, as well as cognitive and achievements outcomes. Guskey therefore advocates that we need to find better and more efficient methods of providing teachers with feedback on the learning outcomes of their students resulting from the changes they are implementing.

An opposing view is presented by Cobb, Wood and Yackel (1990) who conclude from their research that it is the problems and surprises which teachers encounter in their own practice that give rise to opportunities to re-organise beliefs. Therefore, to enable change, teachers must first perceive their current practice as problematic, and then search for new beliefs and practices to overcome the problems.

Based on this finding, the challenge remains for those providing professional development for mathematics teachers to assist teachers reflect on their practice to identify the problems they have experienced. One way of achieving this is to ask teachers to write about a dilemma they have faced when teaching. Such case writing, as proposed by Judith Shulman,

enables a teacher to describe a critical incident or dilemma encountered in personal practice. Collaborative reflection on the writing enables a teacher, and colleagues who read the case, to understand and interpret the described practice and thus to propose action for change or improvement (Western Melbourne Roundtable Innovative Links Project, 1997, p 29).

It may be argued that it is reflection on the dilemmas that arise in the course of teaching that lead teachers to conclude that their practice may be problematic and in need of change. This often leads to the examination and refinement of beliefs.

Apart from anticipating that the process of writing about a dilemma would act as a prompt for reflection and discussion, and would be an important way of assisting teachers develop their understanding of children's mathematical learning, it was expected that any common characteristics identified through an analysis of the dilemmas would have important implications for the content of a professional development program, *Supporting Children's Early Numeracy Learning*. Furthermore, it would be helpful for those developing and implementing professional development programs to be aware of the dilemmas and difficulties teachers are facing when supporting early mathematics learning.

Gathering Teaching Dilemmas

The teaching dilemmas used in this project were gathered over a nine month period from 76 Years K-2 primary teachers employed in Melbourne schools. These teachers all participated in a professional development course developed by the writer, *Supporting Children's Early Numeracy Learning*. The participants ranged in experience from those in their initial year of teaching, to those with more than 20 years teaching experience. The participants were each asked to respond to the following task:

Describe a dilemma you have faced when teaching young children mathematics. Include what you remember of the context and any other relevant details.

The participants each had one week to reflect on this task and return the response to the writer. Participants were informed that the dilemmas would be used to inform the content of the professional development program, and that they would have the opportunity to discuss their dilemma with other participants during the program.

Analysing and Interpreting the Dilemmas

The dilemmas described by participants were examined in order to draw from the descriptions the key elements of each dilemma. Each description was annotated with the key features identified. The key elements were next analysed in order to determine whether there were any similarities. In some cases, the key elements were re-named to be more inclusive of a group of similar elements. The descriptions were then grouped according to the key elements and a tally made to calculate the number of times each of the key elements was identified in the dilemmas. The key elements were finally analysed and grouped to determine whether any common themes existed.

Teaching Dilemmas

In reading the dilemmas gathered during this project, it became clear that in most cases teachers were not actually describing perplexing situations in which a choice had to be made between alternative courses of action, but were in fact describing problematic situations where a solution was not immediately obvious. The following teaching dilemmas demonstrate the range of dilemmas gathered during the study. The key elements identified for each dilemma are also described.

Dilemma 1: The language demands of mathematics

For the past two years I have taught grade one students in a school with an extremely high percentage of children from an ESL background (95 %). This has immediately brought about many problems associated with the language concepts involved in mathematics. I have found that most of the children have difficulties understanding "more than" and "less than as well as "before" and "after." When I have taught this area of mathematics, I have begun with lots of oral and hands on experiences before moving on to written work. This I find benefits many children, however there are still quite a few who require one to one assistance with both oral and written work and they still struggle to understand these concepts.

The key elements of this dilemma are teaching students who have difficulty coping with the English language demands of learning mathematics concepts, and understanding how children learn mathematical concepts.

Dilemma 2: Children often come to school counting

When you begin exploring 2 digit numbers , some children will reverse the number e.g. 41 for 14. Even though they know the number consists of 1 ten and 4 ones, as place value is taught in conjunction, because of the way they say the number, e.g. Four/teen, they write the 4 first and then the 1 (ten) because teen is like ten. Often they will count...7, 8, 9, 10, 11, 12, 30, 40,.....90, 20. What can we do?

The key elements of this dilemma are teaching students who have difficulty counting and teaching children who have difficulty with numeral recognition and writing numerals.

Dilemma 3: Children who struggle with grouping

At least two to three children in my year one class experience great difficulty in grasping the concept of grouping. This topic grouping usually runs for three weeks, which allows for one solid week of manipulative discovery with groups as the focus. This generally means the children are using concrete materials to make groups irrespective of the number in the group. All I would like at this stage is that they become comfortable and aware of what a group looks like.

In the second week I would hope that the children feel confident enough to make different groups eg. 2 groups of 4 (still using concrete materials). It is only in the final week and again only if the child is ready that we move towards written statements. The multiplication sign (\times) is not introduced in year 1.

The mathematical dilemma is those children who struggle with recognising grouping in the initial stages and only become more confused in future years when they are asked to tackle times tables and equations but still do not fully understand the fundamentals. How do I remedy this situation?

The key elements of this dilemma are teaching the multiplication process, understanding how children learn processes such as multiplication, and taking time to develop children's mathematical understanding.

Dilemma 4: Fear of Failure.

This term we have been focusing on the problem solving process. My P/1 children have participated in many input sessions where I have provided them with many strategies to solve problems e.g. draw pictures, write a number sentence, make a model, use a calculator, look for a pattern, work it out mentally. We have also worked groups and individually to solve problems using all these strategies. My dilemma is that I have a student who has a fear of failure and starts to cry as soon as the words "problem solving" are mentioned. She is a perfectionist and enjoys the comfort of structure otherwise she feels threatened and withdraws from the grade. She becomes so overwhelmed and distressed that not even my assistance is any reassurance for her. She is a fairly bright student who is usually independent and able to cope with most of the classroom activities.

The key element of this dilemmas is teaching students who lack confidence in learning mathematics, particularly in the area of problem solving.

Dilemma 5: Teaching to all need and levels

In a grade 2 class of 32 children, I am finding that my main teaching dilemma for mathematics, lies in the problem of teaching to all needs and levels. I have children at the 'basics' level and those who need to be extended. As well as the mixed maths levels, there is a huge language need for 2/3 of the class. Main language spoken is Vietnamese; of the 32 children, only 3 speak English at home. I would like some strategies on how to extend my more advanced students - so that time can be given to others - and how to set activities which the others can work on independently while I work with the advanced students.

The key elements of this dilemma are catering for the learning needs of all students within a mixed ability setting and teaching students who have difficulty with the English language demands of learning mathematics.

Dilemma 6: Organising group work

A mathematical dilemma which I find challenging nearly every year in the Prep classroom, is trying to organise and manage co-operative, rotational group work. I run an effective program in terms 3-4 as I have a lot of parent support, however, when trying to manage this on my own it always seems to create some difficulty. Listed below are a few concerns, "dilemmas" I seem to face:

- *Keeping independent groups on task for the session.*
- *What grouping is better (multi ability or ability groups?)*
- *The ability to work with a clinical group without disruption.*

The key elements of this dilemma are related to classroom organisation, particularly grouping students effectively for learning and managing groups.

Dilemma 7: Assessing each child

My dilemma is trying to assess each child's ability as assessment needs one to one interaction. With thirty children and numerous tasks to be assessed it becomes almost impossible.

The key element of this dilemmas is effectively assessing students' mathematical learning and managing this assessment process.

Dilemma 8: I'm not confident teaching maths!

My dilemma is that I can teach language with ease. I can quickly think of a task analysis for e.g. teaching a genre, and can execute clear, sequential sessions. I can easily slip in and out of 'English.'" BUT with Maths I am not nearly as confident with the content/big picture/global aims/parts of the whole. When I ask my peers some say, I just use last year's program or I just work through this text book. I don't want to be this kind of teacher. I don't even think I know how to do this successfully so where do I go from here. Is there a great Maths scheme which could guide me. I find using the CSF a little daunting; or am I doing it all without realising it. I think I need help with task analysis for Maths.

The key elements of this dilemma are understanding children's mathematical learning and coping with the curriculum demands of mathematics as described in documents such as the Victorian Curriculum and Standards Framework (CSF).

Dilemma 9: Parents don't see the importance of games

When apparent asks, how can they help their child in maths? my suggestion is always – through board games, card games, dealing and counting money or playing games with them. The parents do not see the importance of these activities. They want worksheets.

The key element of this dilemma is working effectively with parents so that they can support their children's mathematical learning.

Key Elements of the Teaching Dilemmas

Having read through the dilemmas experienced when teaching young children mathematics and drawn from the descriptions the key elements of each dilemma, twelve key elements emerged (see Table 1). These mathematical key elements related to three aspects of mathematics teaching: understanding learning; organising and planning for teaching; and working with parents.

The key elements of the teaching dilemmas identified most often were: teaching children who have difficulty with counting; the need for a deeper understanding of how young children learn mathematics; teaching students who have difficulty with numeral recognition; catering for the mathematical learning needs of all students within mixed ability settings; difficulties with teaching arithmetic process and algorithms; and teaching students experiencing difficulty in coping with the English language demands of mathematics (see Table 1).

Discussion

Analysis of the teaching dilemmas indicated that there were several common characteristics of the dilemmas faced when teaching young children mathematics. It was interesting to note that during discussions about the dilemmas that took place during the professional development program, many teachers prefaced their responses with the comment that they had also experienced this dilemma. It was therefore clear that although teachers described only one dilemma they had faced when teaching mathematics, they had also experienced many of the dilemmas described by other teachers.

Two thirds of the key elements of the dilemmas related to the need for teachers to develop a deeper understanding of how young children learn mathematics. Indeed, the teaching dilemmas often pointed to teachers' lack of understanding of how young children learn mathematics and therefore a difficulty in knowing which teaching strategies most effectively help children learn. It is difficult for teachers effectively to facilitate mathematical learning if they do not understand how young children learn mathematics. This finding suggests important implications for teacher development and mathematics education.

The identified key elements of the teaching dilemmas described in Table 1 suggest that teachers particularly need to explore how young children learn to count and identify numerals, how children learn arithmetic processes and how the language demands of mathematics influence learning. These aspects should be included in professional development programs for teachers. Another important need for professional development suggested by the dilemmas relates to considering strategies for catering for the individual learning needs of students within mixed ability settings.

Table 1

The number of times each of the key elements were identified within the teaching dilemmas described by teachers.

Aspects of Mathematics Teaching	Key Elements of Teaching Dilemmas	No. of Times Key Features Were Identified
Understanding mathematical learning	1. Teaching students who have difficulty with counting;	19
	2. Need for deeper understanding of how young children learn mathematics;	16
	3. Teaching students who have difficulty with numeral recognition and writing numerals;	16
	4. Difficulties with teaching arithmetic process and algorithms;	13
	5. Teaching students who have difficulty coping with the English language demands of learning mathematics, particularly LOTE background students;	11
	6. Developing children's number sense and mathematical understanding;	10
	7. Teaching students who lack confidence in their ability to learn mathematics or who lack a positive attitude to learning mathematics;	3
<i>Organising and planning for teaching</i>	8. Catering for the mathematical learning needs of all students within mixed ability settings (including identifying suitable mathematics activities & teaching strategies);	15
	9. Classroom organisation, particularly grouping students effectively;	5
	10. Effectively assessing students;	5
	11. Covering the mathematics curriculum in one year;	4
<i>Parent Partnerships</i>	12. Working with parents.	6

Conclusion

Teachers constantly face dilemmas when teaching young children mathematics. The process of describing dilemmas provides a stimulus for teachers to reflect on the effectiveness of their teaching. This in turn may lead teachers to decide that their practice may be problematic and in need of change.

The dilemmas described in this project provided a powerful prompt for discussion. Teachers were able to offer comments which helped to clarify the nature of the dilemmas, stimulated teachers to explore the situation giving rise to the dilemmas in more detail, or suggested possible ways to respond to the dilemmas, thus leading to more effective mathematical learning.

An analysis of the teaching dilemmas identified 12 key elements. The majority of these suggested the need for teachers to develop a deeper understanding of how young children learn mathematics. The 12 key elements may be used by those producing

professional development programs to inform the content of courses, so that professional development programs are able to meet the needs of teachers, resulting in lasting teacher change and more powerful mathematical learning in the early years of schooling.

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