

# Primary teachers' conceptions of mathematics.

Jean Carroll

RMIT

## Abstract:

*This paper reviews research on teachers' conceptions of mathematics and presents the results of a study which trials the use of a methodology termed "lived experience anecdotes" (Van Manen, 1995) in providing information about teachers' conception of mathematics.*

There is a widely held belief that primary teachers hold narrow conceptions of the nature of mathematics (Balacheff 1990, Freudenthal, 1991, p. 8, Ellerton, 1985, Discipline Review, 1989) which are often linked with negative attitudes towards mathematics (Bobis, 1995). Clements (1995) stressed that teachers of mathematics need to view mathematics relationally and holistically. Teachers' conceptions of mathematics are important as they have an effect on classroom practice in mathematics education (Thompson, 1992, Romberg, 1992).

This paper reviews background research on primary teachers' conceptions of mathematics. A pilot study which trials the use of "lived experience anecdotes" (van Manen, 1995) is reported. The implications of this methodology for further research are examined.

## Teachers' Conceptions of Mathematics

Teachers' conceptions of mathematics may be viewed as consisting of "conscious or subconscious beliefs, concepts, meanings, rules, mental images, and preferences concerning the discipline of mathematics" (Thompson, 1992, p. 132). The notion that there are unconscious aspects of conceptions has ramifications for the type of research needed to investigate them. Empirical studies have documented three

conceptions of mathematics in teachers (Ernest in Thompson, 1992).

The first is a problem solving view of mathematics as a field of human creation and invention which is dynamic, continually expanding and open to review. Mathematics is a process of enquiry not a finished product. A second view, the Platonist view, is that mathematics is a static, unified body of knowledge which is discovered rather than created consisting of interconnecting structures connected by logic. The third view of mathematics, held by teachers, the instrumental view, is that mathematics is a set of accumulated facts, rules and skills to be used by trained artisans.

Romberg (1992) described differing views of mathematics as being located on a continuum. He found that most people see mathematics as a fixed body of knowledge, set in final form, involving manipulation of numbers and geometric deduction. Mathematics is thought of as a cold and austere discipline, without scope for creativity. Contrasted with this is the view that mathematics is not a stable discipline. New technologies, such as calculators and computers are providing the scope for the development of new mathematics and making other aspects of mathematics obsolete. The teachers' conceptions described by Thompson (1992) could be located on this continuum. The problem solving view would lie at one end, with the Platonic and instrumental views towards the opposite end.

### **Effects of teachers' conceptions**

Recent research has focussed on investigating and developing teachers' conceptions of mathematics (Romberg, 1992). This research has been based on the assumption that teachers who have a traditional view of mathematics will represent mathematics differently to students than those who believe that mathematics is creative, constructed and can be used to better understand the universe.

Balacheff (1990) found that many "teachers tend to conceive of teaching mathematics as showing or telling students the "proper techniques" and helping them to reach the "correct" (often meaning the teacher's) way to think about mathematics." As a result of this, students conceive of learning mathematics as appealing to an external authority for definitions and striving to satisfy external authorities with the form of the answers.

The relationship between teachers' conceptions and instructional practice exhibits varying degrees of consistency (Thompson, 1992). It is a complex relationship, however many of the differences in teachers' instructional practices can be explained by their varying conceptions of mathematics (Thompson in Thompson, 1992). Current research has identified inconsistencies between professed beliefs and instructional practice (McGalliard in Thompson, 1992). Further research into teachers' conceptions requires a variety of methods which investigate the context of the instructional settings as well as teachers' espoused beliefs. In addition to detecting any inconsistencies between professed beliefs and instructional practice, this has potential in identifying the influence of "unconscious" components of conceptions.

### **The Study**

The aim of this study was to trial the use of "lived experience anecdotes" described

by van Manen (1995) in investigating the experiences of teachers. The method involves the analysis of data collected when participants focus upon an experience and write about their recollections. The function of this methodology is to bring to awareness perceptions, sensations, actions, encounters and situations which provide information about instructional contexts, social, affective and cognitive factors.

This approach is similar to Chapman's (1993) use of teacher narratives to identify underlying assumptions and unconscious dispositions (frames) which influenced teachers' actions in the classroom. Chapman found that the use of interviews alone was not enough to identify underlying "frames" since the teacher is not aware of them. Taylor (1995) described a related methodology which she termed "mathematical life histories" in which teachers wrote about their reflections on their mathematical backgrounds. Taylor's approach involved discussing the analysis with the participant to ensure that her interpretation was accurate.

### **Method**

Twenty teachers, whose classroom experience varied from first year out to ten years of teaching, were requested to focus upon a time when they were learning or doing mathematics. The teachers were asked to try to relax, close their eyes and think of a time when they were learning or doing mathematics. They were to consider when it was, where they were, who was there, what were the surroundings like, how they were feeling, what they were doing and what was going on around them. They were asked to write about their memories of the incident.

### **Results**

Without exception the teachers selected occasions when they were learning mathematics at school, even though they

had all subsequently learnt and done mathematics in their teacher training. All the teachers reflected upon incidents in which they recalled negative feelings about learning or doing mathematics and which exemplified narrow views of the nature of mathematics. A selection from the recollections is presented and discussed below.

#### Case 1 Anita

*"I was always very competent and confident in mathematics. Once I entered Year 12 maths my self esteem reached an absolute low. I remember the teacher did a few examples from the prescribed text on the board and the students had to copy them down. The teacher went so fast we weren't given a chance to clarify the complicated maths problems. I was so frustrated and annoyed I dropped out of year twelve maths. I really felt jealous of those who were quicker to pick up and solve problems while I struggled, because I always felt good at maths."*

Anita's recollections demonstrate a view that mathematics is about copying examples from the board. Mathematics involved complicated problems which were difficult to understand. Although Anita had experienced success in mathematics for most of her schooling and felt competent and confident, it appears that these feelings were quickly reversed as a result of the experiences described above. The feelings associated with her change in attitude; "frustrated", "annoyed" and "jealous", can be described as strong.

#### Case 2 Suzy

*"When I was in year 7 doing maths, we had a problem solving story. I reached a point where I solved it in my own way, because it was a totally different way than his. He [the teacher] stood up and shouted, is that how you solve the problem and reach the answer, and said it is*

*totally unacceptable and you are really hopeless in maths. I felt horrified and miserable."*

The view of mathematics which can be construed from Suzy's story is that there is only one way to solve a mathematical problem, and that is the teacher's way. It is unacceptable to think of your own alternative approach. Strong negative feelings, "horrified" and "miserable", were also recalled in this incident.

#### Case 3 Roberta

*"I felt inadequate with regards to maths knowledge. Though I always tried, maths concepts seemed difficult to grasp. I had learned all the formulas for working out the sizes of the angles, I was pleased with myself because I could recall them all. However when I looked at the test with all these diagrams, I was devastated, because despite knowing all the formulas, I had no idea where to apply them. Consequently I failed the test."*

Roberta has a conception that mathematics is difficult. Mathematics was presented as the ability to learn and apply formulas appropriately in a test situation. Roberta described her feelings of inadequacy regarding her mathematical knowledge, which are reinforced through failing the test. Her feeling at this time, "devastated", is strong and negative.

#### Case 4 Rosa

*"At the time, and even looking back on the situation I get angry with the lack of support and guidance this male teacher gave to the few females. I guess his actions led me to believe that I am not competent in mathematics, especially at such an advanced level of understanding."*

Rosa recalled that the females in her class experienced a lack of support and guidance. She described beliefs that she is not competent in learning mathematics

and remembered feeling angry about the situation.

## **Discussion**

While the teachers were not asked specifically to describe their conceptions of mathematics, it is possible to identify aspects of mathematical conceptions in the anecdotes. The teachers were asked to describe a time when they were learning or doing mathematics. Examination of the excerpts reveals that learning or doing mathematics, for these teachers, involved copying examples from the board, learning formulas and applying them in tests and solving problems in the teacher's way. Mathematics was viewed as being difficult and generated negative feelings. These views of mathematics correspond to the instrumental view referred to by Thompson (1992) in which mathematics is a set of accumulated facts, rules and skills to be used by trained artisans, however these teachers were having difficulty mastering and applying the facts, rules and skills.

Mathematics is remembered by these teachers as a very limited type of experience, associated with strong negative feelings. In a cultural context in which a high proportion of the population claim to dislike and "not be good at" mathematics, it is important to know how these type of experiences effect the instructional practice of teachers.

## **Implications for Research**

The use of "lived experience anecdotes" in researching teacher's views seems to be effective in allowing a sharp focus on a particular incident. The result in this study was to provide rich, detailed information about social, cognitive and affective aspects of the experience. In contrast to an interview, the participant has more freedom to choose the aspects of the incident which are reported. The method can be used to collect data on teachers' views on their own school experiences, teacher training and

reflections upon classroom practices and the factors which influence changes in practice.

Such research methodologies have been criticised on the basis of their subjectivity. Subjectivity is evident in at least two aspects of the approach. It is impossible to interpret the anecdotes without the researcher's assumptions having some effect the analysis. Taylor (1995) tried to account for this by discussing her analysis with the participants to check that she has reflected their viewpoints accurately. A second aspect of subjectivity is that the participants' recollections will be influenced by their subsequent experiences. Plank and Plank (in Taylor, 1995) felt that this subjectivity could be considered a strength of this approach. They viewed such methods as offering "memories filtered through the individual's consciousness and tinged by his conception of himself" (in Taylor, 1995, p. 695). Van Manen (1995) also acknowledged that later experiences will effect perception when he described the approach as bringing to explicit awareness the structure of some lived experience as they were lived through, and as they present themselves to the participant.

Further research into teachers' conceptions of mathematics, how these conceptions are changed over time and their effects on classroom practice is needed. Methodologies such as "lived experience anecdotes" provide a valuable supplement to data collected by other means such as interviews, questionnaires, observations and journal keeping.

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