

# WHY DO SOME PRIMARY TEACHER TRAINEES HATE MATHS? A CASE STUDY.

Jean Carroll

Royal Melbourne Institute of Technology

*Abstract:: Student teachers' negative attitudes towards mathematics and the inadequacy of their mathematical backgrounds have been a concern of mathematics educators for many years. In an attempt to understand the interaction of cognitive and affective factors in mathematics learning, this paper presents a case study of one preservice early childhood/primary teacher education student's experiences of learning mathematics. The study identifies issues which are of concern to teachers and teacher educators.*

## **Introduction**

Many people seem to be constrained by their negative attitudes, beliefs and feelings about mathematics and mathematics learning. Often associated with these is poor performance on tests of mathematics. Investigations of the interaction of affect and mathematics learning have been conducted by many researchers including McLeod (1992), Hembree (1990), Mandler (1989), Fennema (1989), Buxton (1981) and Bar-tal (1978). The effects of affective factors on mathematics learning are now clearly acknowledged and there is a growing body of research on the topic (an example can be found in Leder (1993)). This study will not attempt to define components of affect. Definitions of affective terms can be found in Hart (1989). This research is a case study of one person's experiences, understandings and feelings about learning mathematics.

## **Method**

The subject of this research was a mature age first year teacher education student (who will be known as Chris) who was training as a preschool and primary school teacher. The study was designed to investigate the affective factors associated with her mathematical understanding, as well as the nature and the structure of that understanding. Because of the difficulty in accessing thinking and feelings a range of approaches have been used to collect the data. A series of interviews, a questionnaire, a diary, a mathematics test and a mathematics curriculum test were used.

Six one hour interviews were conducted over a period of three months in which the subject was encouraged to recall incidents which involved or were related to learning and using mathematics, and to describe them in detail. She was encouraged to think about her experiences in primary school, secondary school, in daily life and at university. A method similar to the narrative inquiry approach used by Chapman (1993) has been used in this study. The interviews also included the presentation and discussion of mathematical tasks. This discussion related to the

subject's reactions on first seeing the task, her memories of similar tasks in the past along with the feelings that these memories evoked and how she would do the task.

A questionnaire was also used. The questionnaire also required her to recall past incidents of mathematics learning and to elaborate upon them. It was felt that the use of a questionnaire would allow her time for deep reflection, rather than having the time pressure of the interview situation.

Some example of the questions are:

Try to remember a time when you were learning mathematics in secondary school. What was happening?

How were you feeling then?

Can you remember a time when you felt really good about learning mathematics?

After each interview session the subject recorded her reflections on the interview and other thoughts and feelings that arose between sessions in a diary. This provided a less structured avenue of investigation as she was free to write about anything, rather than confined to address questions posed in the interviews and questionnaire.

Samples of her work on mathematical tests were collected to provide information about her mathematical understanding. These consisted of her work on a test of primary mathematics which included questions like:

Write 0.53 as a common fraction.

Name the unit which you could use to measure the area of a postcard.

The tasks discussed in the six interviews were also of this type. Her work on a test of preschool and primary mathematics curriculum was also examined. Questions were based on the content of the first semester mathematics education subject on numeration and operations in the primary school, that the subject had completed. The following are examples of the questions:

Describe the place value system.

Preschool children participate in activities and games which have the potential to develop many mathematical ideas. Discuss the strategies that you would use to maximise the mathematical potential of the activities.

Give examples.

## Results

The analysis of the data revealed three broad categories into which much of the data could be classified. Cognitive and affective factors were anticipated, but after sorting a third broad category, social factors, related to the subject's interactions with other people, emerged. Other aspects of the data did not fit neatly into any of these but seemed to span across categories, for example, a section which was classified as 'questions' related to the feelings aroused during question time in the classroom and could be classified with affective factors but there was also a strong social element involved.

### Affective factors

A number of affective factors were identified in the study. Reflections upon her experiences in learning mathematics were closely linked with strong feelings like anger and frustration. On several occasions she refers to feelings of physical pain associated with the stress of doing mathematics. This is a description of how she felt when she was asked to add two decimals:

...having to do this, I found it to be stressful because I guess I just don't know my own ability because these might be perfectly right but I'm just not sure of my own ability. It's like this real pain stricken thing.

Associated with these feelings is an attitude towards the subject which she describes:

I must have had such aversion to maths, such hate of maths...I had some aversion to it that I just turned off. I still kept on doing it. Maybe at high school if they had got to the root of the problem that might have helped me. I still think I developed at a very young age that dislike of maths.

Two aspects of beliefs emerge from the data. The first is a belief about herself. She says 'I always thought it was me, I have got problems but it wasn't necessarily me'. The second aspect, beliefs about mathematics, could easily account for barriers to thinking about mathematics and also may relate to motivation. When asked what mathematics meant to her she replied, 'it is something that I have to do but then probably won't be useful for me later on...it's not going to be useful'. Schoenfeld (1985) pointed out that students' beliefs about mathematics determine how they choose to approach a problem and may weaken their ability to solve non-routine problems.

In all of her work on mathematical tasks Chris's lack of confidence was apparent. Answers which seemed to be well considered were usually accompanied by comments like:

...When I saw the page my mind went blank...

...My mind always tells me my answer to any question presented to me is wrong.

...This might be really completely wrong but it is just my understanding.

...I thought I knew where it was but it's just a silly guess.

Her comments about affective factors reveal that she has strong negative feelings about learning and doing mathematics particularly in relation to her primary and secondary school experiences. A clear lack of confidence in her own ability to do mathematics combined with her belief that mathematics will not be of use to her, could be influencing her ability to learn mathematics. A significant aspect of her beliefs is that she has realised that she was not necessarily the cause of her problems in mathematics. Her lack of confidence in her ability to solve mathematical problems is evident in the interviews and on the tests as she is reluctant to answer a question unless she is certain that she is right.

The data reveal that she has experienced a positive change in the area of affect since commencing her university studies this year. She spoke, in an interview, about enjoying learning mathematics now:

I must admit that for the first time in my life that I really enjoyed maths, having my tutor...I enjoy going back to the basic maths that I remember as a child I really enjoyed learning but then when it got really hard I stopped. I did enjoy the revising and even though a lot of the stuff I knew I suppose I enjoy the 1:to 1-ness with it and the fact that it's private.

She is also confident of her ability to succeed in passing the mathematics subjects at university, this confidence is often linked with her appreciation of teachers and her tutor who will work with her in a one-to-one situation. Her increasing confidence in her ability to succeed is evident in the following comments:

Eventually yeah...but if you had have asked me about maths last semester I would have said no way I will never pass, no way I will never understand it but I feel that as time goes by - yes.

...Well it might take me seven times to repeat in maths to get there but it is confidence, support, like my tutor has really supported me and made me believe that I can do it which I found to be such a help. I just sort of felt by being at university, like the support of you Jean, like Mary you know having a really confident

attitude about me doing maths. It has just been such a help to me, just the support. It has really built my confidence. So that is really important to me, and it has taken a while.

### **Cognitive factors**

I had anticipated being able to chart the extent of her mathematical knowledge and understanding but I found that the nature of her understanding was a more significant discovery. Analysis of the data regarding Chris's thinking and maths learning revealed that her mathematical understanding could best be described as instrumental (Skemp, 1979). The instrumental nature of her understanding was repeatedly demonstrated when working on mathematical tasks. For example she was asked to write 0.72 as a common fraction and did this correctly. When asked to discuss how she knew this she said 'there is two numbers on the top followed by three numbers on the bottom'. She seemed to be aware of the instrumental nature of this response when she said 'I don't think this is a mathematical answer'. This notion was followed up in her diary when she said '...but I understand that I needed to know the process of how it works not just get the answer'. An entry from her diary reflecting upon this episode and my subsequent attempts to relate the question to decimal place value ideas shows that she had some resistance to taking up a relational approach when an instrumental one would do, and also shows the extent of emotional involvement in the situation.

I felt frustrated and emotionally hurt that I was not able to understand or tackle the problems...I walked away from the session wanting to cry...questions that came to mind was why was Jean explaining something in such a long and difficult way when all we were doing was common fractions and I knew how to get the answer anyway.

This excerpt demonstrates her desire to have a quick and easy way to get the answer and her resistance towards connecting the underlying ideas together.

A further example of the absence of evidence of relational understanding was demonstrated when she was asked to place the decimals 0.801, 0.819 and 0.81 in order. Her explanation for ordering them 0.81, 0.801, 0.819 was that the smallest number is 0.81 since 81 is closest to 0, then 0.801 because 801 is smaller than 819. She is restricted to manipulating symbols because of a lack of underlying models or representations.

It is possible to use the data to determine the extent of mathematical knowledge and understanding demonstrated. Examination revealed that she had some understanding of whole numbers and the concepts of the four operations. Some detailed calculations which were done while she was explaining her fortnightly budget revealed that she can add and subtract sums of money, although some facts, like subtraction of zero proved a problem. Mathematical tasks done in the interviews showed that although she knew an algorithm for multiplication, having to derive the basic facts of multiplication made the operation tedious. Evidence of her knowledge of measurement and her ability to apply metric units was limited.

Her result on the test of preschool and primary mathematics curriculum was 8%. The answer to the question 'describe the place- value system' was 'don't know concept' and was typical of

many of the responses on this test. As the mark suggests, very little understanding is demonstrated by the test. The data provides a number of factors which could account for this. The feelings described in the questionnaire about being in this class '...this was very difficult for me as I had not been doing maths for ten years. I felt ashamed, small and intimidated by the classroom structure' do not seem to be conducive to effective learning. Her work on tasks in the interview situation repeatedly reveal a great reluctance to answer questions unless she is sure that the answer is correct. The statement '...I like to be one hundred percent sure when I do something' is typical in her work on mathematical tasks. A distinct lack of confidence in her own ability has been discussed previously in the section on affective factors. It is evident that her lack of previous mathematical knowledge is only one way of accounting for her performance on this test.

Another significant aspect of her use of mathematics was demonstrated when she was asked, in an interview, about the mathematics she used in her daily life. Chris explained in detail how she calculated her fortnightly budget. Her approach to this task was quite different to the 'test-type' tasks that she had been working on and seemed very 'business-like'. The lack of confidence which usually accompanied her work was absent. The task was completed in a detailed way and each calculation was double checked using a different method. Sometimes the check would be mental while others were a subtraction to check an addition. Her feelings about this activity are described in a diary entry, 'I enjoyed showing Jean how I worked out my finances. This type of mathematics is relevant to my life' and can be contrasted with the feelings associated with the decimal example.

It is evident that she has two approaches to mathematics. The functional approach which can be applied with confidence in daily life and the dysfunctional approach typified by lack of confidence, hesitation and a reluctance to put forward an answer used in classes and tests.

### **Social factors**

Social factors emerged as an important theme from the data as Chris described her experiences in learning mathematics. The social influences came from two main sources. The influence of her teachers is discussed below while the role of peers emerges in the section on teachers' questions. Teachers played an important role in Chris's memories of mathematics learning in primary and secondary school, as can be seen in the following comments which have been taken from the interviews:

I can remember one of my teachers saying Chris, if you don't master it now you never will and that is all I remember...I failed maths in form one.[the first year of secondary school]. The teacher knew I had a problem and through that whole year but they never did anything about it...but I still went up but I never repeated. They used to say to my mother Chris is having problems in maths. Well they didn't take me out and put me in the remedial maths class which was something I thought that they should have. I went to form six.

...I just think terrible, appalling, I mean if I'd had a different approach to maths altogether I would probably be fine today but I think I had really terrible teachers who didn't do anything with the problems that I had. Maybe the school situation allowed them to, maybe that was it but I mean I remember my parents came to

student meetings and nothing much was said about my maths. It was said she was having problems with science and she is having a bit of a problem with everything they never really pin-pointed on maths...

...I tried to engage with the material. I always tried to do it but by that stage I just tended to give up easily. I did try but the teachers knew I was having a lot of trouble, they did assist me but that attitude had already been built up - not being good at maths...It just seems so strange that I got up to year nine and failed maths all the way through but nothing was done.

These recollections reveal Chris's feelings of powerlessness to do anything about the situation. She describes years of studying mathematics in classes where teachers have acknowledged that she was having problems but the recurring theme is that nothing was done about it. Inherent in her description is the inevitability that having built up a belief that she was not good at maths, that there was nothing that she could do about it even though she persisted.

The university context is providing changes which are being accompanied by attitude changes. She has teachers she views as supportive and has sought out the one-to-one teaching situation which the data have indicated she prefers. This description of her work with her tutor provides an example:

My tutor has really supported me and made me believe that I can do it which I found to be such a help. 'of course Chris you have really improved so much' and see, that is the other thing about my tutor, something I wrote here yesterday in the questionnaire is that she never made me feel like I had a problem with maths you know she never sort of said look Chris you have got this problem and this problem she just said okay let's do it and we have done it which I have just felt so good about. She never sort of laughed at me and said you have all these problems. I just felt that she had a really good attitude and I adopted that...but to begin with I was really self-conscious and told her to never tell anybody about our meetings.

A significant issue raised here is that 'the problem' was not discussed. This makes Chris feel good and the business of learning some mathematics has been addressed without dwelling on the negative aspects.

### Teachers' Questions

A technique which I used extensively in my classes, prior to this study, is to ask lots of questions. I had no idea that this technique caused so much anguish. Chris describes her reactions to my questions in lectures:

There was no way I was ever going to miss a maths class unless I was sick and I wasn't and I always came to classes but I dreaded you asking me questions and if you did, what I would do whenever you would ask someone to answer a question and I would write down the response and then I would retain in my head the answer to the question that you are going to ask me and then if you didn't I would think 'phew' she didn't ask me but then when you did ask me out of the blue I would answer anyway, I seemed to come up with the answer...

...You would only ask a certain amount of questions. I mean this is a real strategy Jean. It must seem really silly but I would always have nearly the answer to any of the questions or roughly an answer close to it, even half right like just a few points jotted down or just a few notes. To begin with I used to write out these lengthy answers and think Jean didn't ask me that question. So I'd start on the next one and if you didn't ask me that question I would start on the next one. I mean I was just silly. I was so embarrassed that people would pick up on my ability in maths like...

...There were stages when I was in that classroom I felt so frustrated that I just wanted to cry and walk out and go to the toilet...

...I would always make sure they were right because the fear of getting it wrong...I don't think the students in the class would have laughed but there would have just been eyes on me getting it wrong. You know that feeling which relates back to secondary and primary school.

Words like 'dreaded', 'embarrassed', 'frustrated' and 'fear' provide an insight into the agony that this situation created for Chris. These feelings are remembered vividly months after they occurred.

The reference to being laughed at connects to another incident which she recalled from secondary school:

It came to me that I was in year seven and my answer to ... there was a classroom full of students and the teacher asked me a question and I couldn't answer her ... I can't remember what the question was at all but I remember the classroom and the maths book we were using and I just remembered all of the other students laughing you know 'she is a dumbo she doesn't know her maths' kind of thing...In those days everybody laughed out loud if you got anything wrong and they laughed and I just felt really embarrassed.

Once again the vividness and clarity of the memory of the feelings is a feature of this episode. She went on to describe the approach that she developed in secondary school to avoid these situations in the future:

I always went to maths classes. I used to hide at the back of the classroom. I didn't like teachers sort of asking me questions so I would always hide right up the back with a coat on. Because I was too scared in case she asked me and I didn't know the answer and I looked so obvious with this coat and I think a lot of the time they obviously realised that I was hiding. I remember just hiding up the back and just like if she ever asked me the question I couldn't answer it. I think I developed a mentality, I just looked at the teachers and I couldn't even say anything in the end.

Buxton (1981, p101) also found that questioning could lead to tension and embarrassment. One of his subjects echoes Chris's feelings when she said 'I always sat at the back of the class and prayed that I wouldn't be asked a question. There's a dim recollection of some pain associated with being asked a question, but it's too deep to come to mind'.

As Buxton says, the role of questioning needs to be examined. It is a standard and largely unchallenged practice in classrooms. Both of these students have attempted to distance themselves from the teacher in order to avoid the negative affects of being asked to answer a question.

## Conclusions

The study was designed to investigate the affective factors associated with this subject's mathematical understanding, as well as the nature and structure of that understanding. It was found that the subject's understanding of mathematics was mainly instrumental and limited to concepts which are usually taught in lower primary classes. A range of affective factors like confidence, feelings of frustration, anger and embarrassment, influenced her ability to learn mathematics and her performance on tests. Her beliefs about herself not being good at mathematics and mathematics not being useful to her also had an effect. Interactions with other people were identified as a significant aspect in the study. Chris largely attributed the causes of her failure in mathematics to the teachers she had at school, who identified that she had problems in mathematics but did nothing to help her overcome them. Improvement in her confidence in her ability to succeed in mathematics study in the university context seem to be linked to her perception that the teachers are willing to work with her, particularly on an individual basis. The reactions of her peers in classroom situations was identified as an important social factor at all levels of her schooling. Chris was determined not to make classmates aware of her lack of knowledge about mathematics and memories of them laughing at her when she could not answer a question in year 7 were still vivid.

While this paper has presented a case study of one person's experiences in learning mathematics and much has been learnt about Chris, there are many lessons to be learnt by the teacher from the results of this study. Many of the lessons are not directly related to the mathematics which is being taught. Among these lessons are the importance of the relationships between students and teachers, the role of peers in the learning process, the effect of questioning techniques and the debilitating effect of affective factors on some students.

The research process, with the necessity for reflection upon less than pleasant memories, has been demanding on Chris, but not without its rewards. In her final interview she says:

Yes. It is really helping me. It is just like if I am to realise how totally stressed I was, what a nightmare, I'd feel terrible but now I just kind of feel a lot more calmer about it and I feel the reflection is the key.

This is reinforced when she writes in her diary: 'I don't have the I hate maths attitude any more. Now I want to learn maths and understand it'.

### **Bibliography**

- Bar-Tal, D. (1978). Attributional analysis of achievement-related behaviour. *Review of Educational Research*.48,,2, 259-271.
- Buxton, L. (1981). *Do you panic about maths? Coping with maths anxiety*. London: Heinemann Educational Books.
- Chapman, O. (1993) Facilitating in-service mathematics teachers self development. in Hirabayashi, I (Ed.) *Proceedings of the 17th International Conference of Psychology of Mathematics Education*. Japan.
- Fennema, E. (1989). The study of affect and mathematics: A proposed generic model for research. In McLeod, D. B. and Adams, V. M. (Eds.), *Affect and mathematical problem solving* (pp.206-219). New York: Springer-Verlag.
- Hart, L. E. (1989). Describing the affective domain: Saying what we mean. In McLeod, D. B. and Adams, V. M. (Eds.), *Affect and mathematical problem solving* (pp.37-45). New York: Springer-Verlag.
- Hembree, R. (1990). The nature, effects and relief of mathematics anxiety. *Journal for Research in Mathematics Education*, 21 (1), 33-46
- Leder, G. (1993). Reconciling affective and cognitive aspects of mathematics learning: Reality or pious hope?. in Hirabayashi, I (Ed.) *Proceedings of the 17th International Conference of Psychology of Mathematics Education*. Japan.
- McLeod, D. B. (1992). Research on affect in mathematics education: a reconceptualisation. In Grouws, D. A (Ed.), *Handbook of research on mathematics teaching and learning* (pp575-596). New York: Macmillan Publishing Company.
- Schoenfeld, A. (1985). *Mathematical problem solving*. California: Academic Press.
- Skemp, R. (1979) *Intelligence, learning and action*. Chichester: Wiley and Sons.