

**"This Is *Your* Life":
Initial Study Of Mathematical Autobiographies**

**Beth Southwell, Alan Brady, Ian Harrison and Bryant Lavaring
University of Western Sydney, Nepean**

Despite being involved in a mathematics education subject emphasising student centred methods of teaching, some trainee teachers revert to 'chalk and talk' and rote learning methods. To partially overcome this practice, second year students in a primary teacher education course were asked to write their mathematical autobiographies over a period of eleven weeks. The analysis of these revealed increased awareness of mathematics as a life skill, changes in opinions and greater understanding of the influences shaping mathematical development.

Mathematics teacher educators develop courses of study for teacher trainees in order to help them put into practice the exciting and stimulating ideas they learn in their course. It is a matter of some consternation and dismay to discover that these same trainees, when faced with the demands of the classroom situation on a permanent basis, sometimes revert to the teacher centred, 'chalk and talk' method of presentation of mathematics which they themselves experienced when they were in school. It is hard to give a definitive reason for this phenomenon. It is certain, however, that even those who were not very successful with the 'chalk and talk' method seem to find some solace in imitating their teachers. This could be because of fear they might not be able to handle the mathematics the students discover if more student centred methods are used, dread of poor test results, lack of resources and time for preparation of resources, or simply because the executive in the school have told them to teach that way.

Whatever the reason for the reversion, it is apparent that something fairly radical has to be attempted in order to develop in teacher trainees the will and motivation to implement the methods which they find so fascinating in their undergraduate work. Besides providing the environment at university in which they can explore new methods, some fundamental change is needed in their understanding of the process of learning mathematics and the relationship of their feelings and attitudes to that process. Reflection is one process that could bring about this desired change.

More than half a century ago Dewey (1944) wrote about 'reflective thought'. Skemp (1971) developed the idea of intuitive and reflective intelligence. Polya (1957) and many others working in problem solving emphasised reflection in the problem solving process. Schon (1983) put forward the idea of the teacher as the 'reflective practitioner'. Boud, Keogh and Walker (1985) developed further ideas about reflection in a number of different personal and academic contexts.

Another development which dovetails into this process of reflection is the use of biographical details as the source and object of reflection. Several studies (Cameron and Wilson, 1992) have explored the use of reflective journals in the development of teaching skills. Taylor (1992) extended this idea of reflecting on present experiences to the reflection on one's personal history. Nimmo and Smith (1994) describe a longitudinal ethnographic study of the progress of four secondary school teachers. The study used biographical data and showed the influence of such data on later ability to develop as teachers.

The developmental theory of Vygotsky has, to a certain extent, superseded the theory of Piaget in that he emphasised the social origins of mental functioning. While Piaget maintained that children *learn through* social interaction, Vygotsky believed that children *need* a social environment to learn and that they learn from a more expert partner. His idea of the Zone of Proximal Development stresses the close relationship between instruction and the child's level of development. Another critical aspect of Vygotsky's theory was that language is central to learning.

The Vygotskian Zone of Proximal Development has implications for the teacher in the classroom, in that s/he needs to provide learning experiences for the child within that

zone. It is also important for teachers in their interaction with their own philosophy and practice of teaching as well as their preparation for student activity. The teacher becomes a very powerful role model and support for the learner. This in turn has implications for the development of attitudes and aptitudes in mathematics.

If attitude is defined as a way of thinking, feeling and acting, the development of attitudes will be the result of an interrelationship of a number of different aspects of one's life. The formation of attitudes involves the family, socialising processes, schooling experiences and relationships among all three as well as with role models and mentors. Biographies can often be the catalyst which brings these elements together to form or reform attitudes to learning mathematics. They can also assist the construction of knowledge, thus connecting the process to social constructivism. An emphasis on a Vygotskian form of social constructivism stresses the interrelationship of the people in the classroom, the classroom environment and both the nature and methods of presentation of mathematics.

The basis of a life history is the language and culture of the person concerned. An examination of a person's life history or biography can reveal some of the factors impinging on that person's present attitudes, beliefs and knowledge.

A variation of the life history is the autobiography. Autobiographies have both strengths and weaknesses. Their strength is their subjectivity. Their weakness is the possibility of inadequate memories leading to false assumptions. They do, however, provide memories which have been filtered through the person's subsequent experiences and concepts.

This current study seeks to bring together the need to provide teacher trainees with experiences which will release them from previously held inhibitions and negative attitudes, the reflective process, Vygotskian theory and the results of autobiographical reflection.

Subjects and Method

The subjects were primary teacher trainees in their second year. They were requested to write their mathematical life history using a double entry page mode. For a period of four weeks, the students were asked to write about three entries each week and record incidents that occurred earlier in their lives, in chronological order, if possible, and to also record, in the second column, the implications, as they saw them, of the recorded incident for their education, particularly in mathematics. For a further six weeks, the students were asked to complete their history, if they had not already done so, and then to keep a journal of their current mathematical experiences. It was suggested to them that they include their reflections on the lectures and workshops in which they participated, any reading they did and any out-of-university experience that involved mathematics. It was also suggested to them that they look for the connections between these aspects and what they had recorded in the histories.

Each of these two stages was monitored by tutors who read the submissions. For the first phase, the tutors wrote constructive comments and pointed out ways in which the students could make better use of their work. Part of the analysis of the second phase had to do with ascertaining to what extent the students were able to perceive and implement the advice of the tutors.

Two hundred and sixty seven subjects completed the task with varying degrees of personal satisfaction. From these, several have been selected to illustrate the use of this procedure as a means of creating the reflective environment necessary for developing teachers.

Whilst students wrote entries in their histories, they were actively participating in a university mathematics education subject. They were required to attend two lectures each week and two workshops in which they manipulated materials and reflected on their activity as a way of developing an understanding of the implications of the lectures for their teaching.

Analysis

The analysis took several forms. Comment on the first phase was limited to suggestions to make the process more useful to the students. The second phase was analysed to see if suggestions had been carried out. In addition, more attention was paid to the depth of the students' comments and to the extent to which the subjects had been able to make connections between the various aspects of their history. The ability of the students to recognise the relationships involved and to predict how their learning could be used constructively in the classroom was viewed very favourably. A superficial description of an event did not appear to be as useful as an in-depth reflection on the meaning of the event and its implication for the classroom. Students who did well on this first submission were given suggestions for further possibilities for reflection.

Marks were awarded for the histories in the second phase. This was done, partly because the task was part of the assessment for their normal mathematics education subject and partly because it gave the students an indication of the relative weighting of various aspects of the task. The main analysis was through comparison of the apparent attitudes and depth of reflection between the first submission and the second and the identification of particular incidents recorded that had a significant effect on the life of the student.

Results

Many students found it difficult to remember anything before they went to school and then only the upper primary school. When encouraged, they were able to remember further back and were surprised that they were able to do so.

They were also surprised to find that incidents from their past had influenced their present thinking and attitude. The reflective process appeared to free them from preconceived ideas, fears and misconceptions concerning their motives and attributions. Many expressed their delight and appreciation of the process they had experienced as it gave them new insights and aspirations.

No student reported any awareness or evidence of mathematics anxiety prior to entering school. The students also reported that the mathematics at this stage in their life was relevant to their play and social interactions, they had greater control over and autonomy in their learning, the pace of their learning and the content of their learning. They also had the "right" to withdraw from the learning environment and this right was supported by their parents.

With very few exceptions, the students expressed varying degrees of surprise and pleasure to find that mathematics permeates so much of their everyday existence. One student wrote:

This just goes to show how math concepts totally surround us in everyday life experiences. As teachers, it is very important that we make math a fun subject in order to keep the students interested in it. If students do not take it seriously and don't try to understand the concepts, they will be affected in several ways. We must be creative and imaginative; use a variety of methods; draw on past experiences; and demonstrate how it applies to real life situations."

This quotation also illustrates the understanding which this student has reached as a result of her multiple experiences in workshops and through the autobiographical reflections. Further results will be given as comments on selected entries from a number of life histories.

Example 1. Subject Dee

27/7/95 Birth - School

I remember my very first experiences with maths were all very positive. I would be told that I was "a very smart girl" by my Dad when I built walls with Lego and played with blocks.

I also used to go shopping with my Mother and sister on a regular basis. My sister and I, although we didn't fully understand the concept of money, knew only too well that 20c. would buy us a drink from the machine outside of Franklins. When we received our pocket money Dad would help us by making us think about what we would like to do with the money.

28/7/95 Primary School

In Year 2 we were introduced to the times tables at school and had to learn them by rote. We were also asked to get our parents involved by reciting them to them.

31/7/95 ... I got really curious as to how aeroplanes could stay up in the air when one happened to fly by. I had come across this in class in about Year 2/3 but I had never fully grasped why? Dad said that when we got home we would look up the encyclopaedia and see how planes stayed in the air. Once we had figured out this we were amazed at how heavy they were. When I went to school the next day, I spoke to my teacher (Year 4) Mr E... about it and we went about comparing the weights of different things like planes, cars, people, etc. This led on to a comparison of all of the students in the class's weights and heights. We then made up a chart from this data.

Reflection

I think that my attitude towards things mathematical was originally well-nurtured at home with my family. Mum and Dad would positively reinforce me when I did something like hold fingers up to show how old I was. But along with this they also assisted me to understand my mistakes and would help me to remedy them. This type of 'attention' soon came to be a pre-requisite with me with mathematical problems. Reinforcement became a crucial element of my development. My initial introduction to money was probably like other people's - pocket money. Mum gave my sister and I \$1 per week to spend or save as we pleased. I guess that we were taught a sort of mini-budget system by my Dad. ...

...I believe that the continual repetition was advantageous to my mathematical learning. Not only did it generate interest - as many of the games that were played in the classroom were also intermingled with the tables - but it gave us something to focus our attention on. ... Mum and Dad also reiterated the importance of the times tables to me and my little sister by buying a wall chart and (this may sound silly - but it worked!) putting it behind the toilet door!!

...

I can remember this vividly because it made my sense of being able to compare things from my environment be realised in my own mind. Because I had asked the questions people were becoming interested and using enquiry as a springboard for different things; like my teacher making an entire lesson sequence out of a single incident. This experience was as a whole positive. I was never really certain when it came to the concept however of the mass of an object or thing. I don't know whether I was sick that week or what but it seems that I have never really grasped the idea not have I felt it necessary to have to have it. However, nor that I will be dealing with it with teaching I feel it would be wise to look into gaining knowledge where I know the knowledge is severely lacking. ... The sense of ownership with

3/8/95 Early Secondary School

When I initially went into Year 7, I found the work quite a lot harder, particularly in maths than I had experienced before. My first report card that I brought home to Mum and Dad had me listed as being in the bottom 10% of the class. I was extremely embarrassed at this result because I had been giving the work a real go. The event that finally broke the straw over the camel's back so to speak, was when in Year 8 first semester we were told that we would be sitting an exam that would be a lead up to a maths competition that we were all expected to enter. I became so frustrated and upset that I burst into tears and ran out of the room. The frustration stemmed from the lack of preparation we had been given.

4/8/95 Late Secondary School

By Year 9 (late) to early Year 10 we began to realise that I was falling further and further behind with my maths. By this time Mum had made the decision to get me a maths tutor. The event that finally clinched the tutor was when I brought home my intermediate - (how I had been graded, like streaming) Maths paper and it was obvious that the errors that I was making were mostly due to carelessness - not altogether a total disregard or misunderstanding of formulae or problem solving strategies.

this activity meant that the learning became more meaningful.

.... In the case of this event that I have described, I personally felt there was not enough consolidation and practising of fundamental skills and routines that would be encountered in 'spot tests' such as these. I also felt that discussion between teacher, pupils and each other is integral to clarifying ideas and concepts that are met. Often cross-ability grouping is a strategy that can be employed for students to gain ideas into how to attack problems in different ways, this sort of informal discussion makes it less intimidating for children to put forward ideas that they may have felt uncomfortable saying in front of the entire class. Teachers must consider all of these feelings of students and should attempt to recognise where problems may occur.

Once again when looking back in hindsight it is clear that students need to practise and re-practise concepts that they themselves feel weak on. I know this was the case with me, for when I began being tutored and was able to air my mathematical misunderstandings with someone who could listen I began to gain confidence and feel much more relaxed about tackling mathematical problems than I had previously been (see entry dated 31/7/95). Even though I had expressed to my Maths teachers that I was having difficulties it became a problem to catch them to assist me whenever I needed help. The one to one coaching I got with my tutor benefited me far more than any of the teachers I had at school did.

Another problem in the latter years of my High School was the teacher turnover rate. I think I had about 7 different Maths teachers in two years. ... it seemed we were continually being presented with casuals who appeared to have an interest in teaching only those who could keep up. I believe this also contributed to my poor attitude towards Mathematics as a whole. I realised that I am not a risk taker, I prefer to be shown something concretely not in an abstract manner. This emphasised to

me the multitude of differing learning styles that can exist in one classroom and has made me stand back and think about the role of a mathematics teacher in the learner's understanding and the impact that a teacher who is willing to listen can make on students.

Comment: Comments will be made in terms of the student's perceptions concerning mathematics, apparent beliefs concerning learning and teaching mathematics and evidence of the student's growth and development.

This student has had experiences (such as shopping with her parents) which are fairly common to a number of other students. She was fortunate in that her parents took the trouble to introduce mathematical concepts into many of the everyday activities round the home and on outings. This interest on the part of the parents obviously had a great influence on her and helped to develop an initial very positive attitude to mathematics. This positive attitude was further promoted by the teacher who was alert and secure enough to use her query in a very creative way, thus involving the whole class in the learning process and also affirming her as an integral and important part of the decision making of the classroom.

Despite these positive early experiences shared with her parents, Dee developed a view of mathematics which saw the subject as becoming increasingly harder. She also perceived it as a subject in which practice is necessary. This implies a belief that mathematics consists of routines and facts to be memorised.

For Dee, mathematics needs to be expressed in a concrete form for her to learn it and practice plays a significant part in her view of mathematics learning. Ownership of the knowledge is important, as is the possibility of negotiating decisions that relate to her learning. This possibility of negotiating was no doubt strengthened by her experiences with her parents who provided good role models for inquiry, re-inforcement and decision making.

Because of her own experience, Dee recognises the necessity for the teacher to take note of students' learning styles, to listen to students and to provide practice and concrete materials or examples. Her own experience has highlighted for her the pre-eminence of affective issues in learning/teaching situations.

Example 2. Subject Bea

1.8.95 Reflections on Week 1 Reading

Theorists pose a huge dilemma for me. From memory I believe my past teachers must have had receptive-accrual views of learning.

Primary School - Maths lessons particularly in primary school, involved primarily drill and practice. Although it sometimes became a little monotonous, I feel that this method was quite successful. But now the research suggests alternatives. These cognitive-mediational views do seem to promote much more stimulating and meaningful learning experiences but it is all so foreign to me.

University - My only experience with such teaching was in Maths I last years. I just hope this course and the next will provide me with practical instructional advice. I want to be able to facilitate my students in constructing their own understandings if that is the most meaningful way of learning, as the constructivist theories argue. My concern is that once I leave university, I may feel overwhelmed by everything and revert back to what I know.

Comment: Subject Bea found mathematics lessons involving drill and practice sometimes monotonous yet felt they were successful. Mathematics seems somewhat of a mystery to Bea.

It is interesting that she is challenged by her reading to consider alternative methods of presenting mathematics and seems to have espoused the constructivist theory. Her participation in workshops would no doubt reinforce theory and this is indicated by her final entry in which she writes:

"This journal has really exposed 2 main points that I hope to incorporate in my lessons in the future. Firstly, learning experiences should be motivating and enjoyable. Secondly, and most significantly, activities should make obvious the relevance of the concepts and skills to the individual's life."

Bea has been through a transformation in thinking about the methods she will use in teaching mathematics. The anxiety expressed in her entry on August 1, however, is a timely reminder that there is the danger of reversion to old experiences and habits if she is not encouraged and supported in her endeavours to put into practice her new-found ideas.

Example 3. Subject Kay
1/9/95

Primary School Event Recalled: When I was at school I always had trouble remembering my multiplication tables. I have mentioned before how I sat down with my mother and went over and over my tables. Well, as I got older, in about grade 4 and 5, I would use the multiplication table graph located on the back of text books. I had this teacher in Grade 5 who made me go and stand against a brick wall for using the back of my book in an exam. I was really embarrassed and ashamed of myself.

Reflections on the mathematical significance. I would be naive to think I am the only person who had troubles remembering my tables. I am sure to come across many students who are struggling to remember them. So what will I do? I believe, rather than take away from the students their "security blankets" we should try to build on them. I am aware that students have to learn their tables. However, we are all individual learners, whom some of us will simply have difficulty putting the facts into our heads.

A way of approaching the problem posed above, from my own history, would be to analyse the multiplication table chart. Students can find different patterns on the chart, so they are re-inforcing problem solving and getting familiar with identifying patterns, whilst generating useful cues for the memorisation of these necessary basic facts. This would also help students to feel more confident and able.

This same student was able to also write about her later achievements and attribute her success to her tutor.

25/9/95 Yr 11 and Yr 12

Whilst I was completing 2 unit mathematics for the HSC I received tutoring. I used to travel to the University of Technology, Sydney, for a 2 hour class. There was a group of about 15 people. There were three tutors available, of these one of the tutors would teach us the topic for the day.

Franca, the woman who used to teach the class. was a truly inspiring person. I believe it was not only the energy that she transmitted when she was teaching, but it was the way that she took a personal interest in every individual there. She would want to know how I was going at school, my results. She showed genuine keenness.

I went from a rather average grade student in mathematics to finishing first place in my school for the 2 unit mathematics course. It surprised my teachers, my

parents, my brother and even me when I began getting remarkable grades, but Franca never seemed surprised, just pleased for my hard work paying off.

The point that I am trying to illustrate here is that I was always considered average at maths by teachers, my parents and myself. Franca never put a limit on my ability and I achieved more than just average. She helped me to build confidence in myself and what I could do.

Comment: Kay exhibits a broader view of mathematics than the other two students. Despite her inability to learn tables, she sees patterns as being very important in mathematics and uses them to overcome her own particular deficiency. She also incorporates problem solving as an important aspect of mathematics.

Like Dee, Kay recognises the individuality of learners and the need for re-reinforcement when teaching or being taught. The good mathematics teacher, to Kay, is one who is energetic, inspiring and takes a genuine interest in students, thus underlining the importance of affective issues in the mathematics classroom. The other characteristics of the tutor who inspired Kay was that she believed in Kay - believed that she could do the mathematics. She did not set a limit on what she could do but encouraged and supported her. As a consequence, Kay was able to make great progress in mathematics.

The confidence Kay gained through having a tutor who listened to her and believed in her overcame her previous perception that she could not succeed in mathematics. Her growth in her own mathematical understanding can be inferred from her overt commitment to more meaningful ways of teaching mathematics and from her desire to help students feel confident and able to do mathematics.

Conclusion

The use of mathematical life histories can have several benefits for all and especially for teacher trainees as they seek to overcome inadequate knowledge of and attitudes towards mathematics. As in the case of the above students, reflection through mathematical life histories can provide insights into students' beliefs concerning mathematics, a greater understanding of the levels of confidence students experience and an awareness of changes and influences for change in the understanding of the mathematics teaching/learning process. The process of reflection helps to clarify ideas, transform beliefs and strengthen resolve. This, it seems, needs to be supported and encouraged within the context of good role models and a sound understanding of the teaching-learning process.

References

- Boud, D., Keogh, R. and Walker, D. (Eds.).(1985). *Reflection: Turning experience into learning*. London: Kogan Page.
- Cameron, R. and Wilson, S. (1992). Developing reflective student teachers: a professional development program for cooperating teachers. A paper presented at the 22nd National Conference of ATEA, Ballina, June 28-July 1.
- Dewey, J. (1944). *Democracy and education*. New York: Free Press (Macmillan).
- Ebbeck, M. (1995). Application of Vygotsky's theory. Paper presented to UWS Nepean EdD Conference, Blackheath, September.
- Nimmo, G. and Smith, D. (1994). The rehearsal and the performance: Interaction of biographical and situational factors in beginning teacher enculturation. Paper presented at AARE Conference, Newcastle, November.
- Polya, G.(1957):. *How to solve it*. Princeton: Princeton University Press.
- Schon, D. (1983). *The Reflective Practitioner: How professionals think in action*. New York: Basic Books.
- Skemp, R. R. (1993). *The psychology of learning mathematics* (2nd Ed.). Hammondsworth, UK: Penguin.
- Taylor, L. (1992). Mathematical attitude development from a Vygotskian perspective. *Mathematics Education Research Journal*, 4, 3, 8-23.