Memories of their mathematics teachers: implications for pedagogy

Sally Hobden

Abstract

The future teachers in this study were asked to tell the story of their engagement with mathematics, beginning as far back as they could recall, and ending with the present which was as they were about to begin a module entitled Mathematical Literacy for Educators. The narratives contained accounts of their struggles (many) and successes (few) with learning mathematics. The focus of this paper is on their memories of their mathematics teachers who feature in most of the autobiographies. The purpose of this memory work was twofold: to provide a starting point to overcome mathematics anxiety which had the potential to inhibit their engagement with mathematics, and to inform the selection of pedagogical practices in the module. Selected memory narratives are presented and the themes of teacher memories are discussed. Finally, four pedagogical purposes for memory narratives are identified and discussed.

> *I've learned that people will forget what you said, people will forget what you did, but people will never forget how you made them feel.*
>
> Maya Angelou (Kelly, 2003)

Background and context of the study

Teacher education in South Africa has been governed by a national policy document that sets out the norms and standards for educators (Department of Education, 2000). In order to comply with the requirement of 'being numerically, technologically and media literate' any future teacher at my institution (intending to teach subjects other than mathematics at the secondary level) without having passed Grade 12 school mathematics would be required to pass a foundational module in Mathematical Literacy. Consequently, in 2003 I took charge of a new module, *Mathematical Literacy for Educators* (MLE), introduced with the aim of developing in the students appropriate mathematical literacy skills, and engendering self-confidence in their ability to deal with quantitative situations that might be encountered in daily life, or more specifically, in their future professional lives as teachers.

The two main reasons for future teachers returning to mathematics in this module were (a) their poor performance in mathematics precluded them from studying it in the senior school years or (b) they had attempted and failed the final Grade 12 mathematics examination. Both these reasons were expected to have a left a bitter taste in the mouth and so I considered that my first task as the lecturer of the module was to begin to address possible negative views of mathematics. To this end the introductory week of this module was devoted to surfacing memories of school mathematics and trying to encourage the future teachers to overcome their mathematics anxiety and to reconceptualise themselves as people who could deal with mathematics in everyday situations.

Several activities were planned to encourage the future teachers to talk about their school mathematics experiences. First, the future teachers were given a questionnaire in which they were asked to circle two words, from a list of ten, which best described their experience of school mathematics. These words, which from my previous experience are used by people to describe mathematics, were equally divided into positive words (useful, easy, relevant, fun, rewarding), more negative words (difficult, humiliating, frustrating, irrelevant) and challenging which I considered a neutral word as it can be construed either positively or negatively. In this same question, students were asked to write one or two sentences summing up their school experience of mathematics. The qualitative analysis of the sentences written confirmed the quantitative counts of the words chosen, i.e. the future teachers began the MLE module with a school mathematics history that they described as difficult, frustrating and challenging. The 'positive' words, (useful, relevant, fun, rewarding, and easy) accounted for only 12% of the choices (Hobden, 2007).

The second introductory class activity was based on a Math Anxiety Bill of Rights, created by Sandra Davis and described by Tobias (1993). This is a list of fourteen rights regarding mathematics learning, such as: I have the right to say I don't understand; I have the right to be treated as a competent adult. The purpose of this activity was to engage the preservice teachers with the rights as a first step towards taking charge of their mathematics learning and ceasing to be intimidated "both by their own lack of confidence and by hallowed traditions in the maths classroom that stop them feeling good about themselves" (Tobias, 1993, p.226). The future teachers worked in small groups to select and rank eight of the rights. Over the three years of this study, the top two ranked rights were consistently *I have the right to learn at my own pace and not feel put down or stupid if I'm slower than someone else* and *I*

have the right to feel good about myself regardless of my abilities in maths (Hobden, 2007). I felt that this was indicative of a group of hurt and anxious learners used to lagging behind.

The third activity, writing mathematics autobiographies, required the future teachers to purposefully remember their school mathematics experiences. These memories, and in particular the memories pertaining to their teachers are discussed in detail in this article.

The problem of mathematics anxiety and mathematical avoidance and why it matters

Folk wisdom tells us that it is not so much what people can do, as what they are willing to do that determines their success. Tobias (1993, p.100) claims that "negative attitudes. . .can powerfully inhibit intellect and curiosity and can keep us from learning what is well within our power to understand". The presence of maths anxiety is thought to interfere with the working memory – as noted by Sparks (2011), mathematically anxious people use up the brain power needed to solve mathematics problems on worrying. Willoughby (2000) at the end of a list of fifteen mathematical skills he believes all people should possess, cautions us: "None of the skills above will be of any use if the individual who has learned them has also learned to avoid mathematics whenever possible. . . If the student has learned to hate mathematics and the learning of mathematics, then I believe the schooling has done more harm than good" (p.10).

Ashcraft (2002) found a lack of empirical evidence on the origins and causes of mathematics anxiety but suggests that there are some strong hints. These include exposure to teachers who were impatient with errors and held learners accountable for their lack of understanding and subjected them to public displays of their incompetence. Ashcraft (2002) concluded that "it is entirely plausible. . .that such classroom methods are risk factors for math anxiety" (p.184). This view is supported by Michael Goldenberg who, in response to the online version of Sparks (2011), wrote "math anxiety is not something people are born with: they catch it from others. However, there are carriers who are not themselves suffering from the disease. Contemptuousness from mathematics teachers can readily drive someone into math anxiety, I strongly suspect".

Duffin and Simpson (2000), suggest that it is important to move adult learners for whom mathematics has been a struggle, to see maths as a goal (i.e. a state learners want to be in, and through their actions try to approach) rather than an anti-goal (i.e. a state learners wish to avoid, and through their actions, try to move away from). They warn that: "the fact of that failure is often, of itself, sufficient to have made mathematical situations anti-goals for the learners involved and this brings with it emotional indicators which can prevent an otherwise intelligent adult from attempting any form of mathematical task. The development of the anti-goal nature of mathematics has come from their learning in school and, perhaps from a mismatch between the learner's way of thinking and the teacher's style" (p. 97).

The future teachers in this study had a compulsory module *Mathematical Literacy for Educators* to pass, but the motivation for trying to alleviate some of their mathematics anxiety went beyond the short term goal of module marks. It is evident that mathematics anxiety and mathematics avoidance coupled with poor mathematics ability will impede the development of the mathematical (or quantitative) literacy needed to function as a self-managing person and a productive worker. In the seminal article making the case for quantitative literacy, Steen (2001) described in detail how "professionals in virtually every field are now expected to be well versed in quantitative tools" (p.12) and how almost all fields of education now require some quantitative literacy. Personal management of health and finances is also increasingly dependent on sophisticated understandings of number and statistics. Statisticians have joined in advocating statistical literacy and Schield (2002) noted that "anybody lacking this type of literacy is functionally illiterate as a productive worker, an informed consumer or a responsible citizen" (p.41). The latter role suggests a second motivation for a mathematical literacy programme, i.e. to develop the quantitative literacy required for responsible citizenship in a democracy. Cohen (2003) contends that dating back to the early 19th century the links between democratic government and political arithmetic have been threefold: (a) the political legitimacy of a representative democracy rests on counts and proportional reasoning; (b) a government needs good aggregate data about its citizens to make policy decisions for the greater good; and (c) the citizens in a democracy need good data in order to judge the decisions made by the government and express this judgement through their vote. Citizens who wish to participate fully in a democracy cannot afford to refuse to engage with numbers.

Memory work as a feature of mathematics autobiographies

Memory work has been successfully used in teacher education and teacher development (see for example Pithouse, 2011; Cole, 2011; Mitchell and Weber, 1999) typically in the context of developing teacher identity and influencing future practice. In contrast, my focus in the context of the MLE module was not on teacher development but on personal empowerment through the development of some degree of mathematical literacy. The memory work in this module was an attempt to deal with the legacy of mathematics anxiety – for the future teachers themselves to face their negative memories. It was also an opportunity for me, as the lecturer to adapt my pedagogy to take their remembered experiences into account. At the outset of the module the future teachers were asked to write their personal story of 'Maths and me' – in other words, to wilfully remember the path their mathematics learning had taken and to pen their mathematical autobiographies or life histories.

Mitchell and Weber (1999) regard memory work and the domain of autobiography and life histories as distinct yet related. Memory is a feature of autobiographical writing.

> [Memory texts]. . .are driven by two sets of concerns. The first has to do with the ways memory shapes the stories we tell, in the present and in the past – especially stories about our own lives. The second has to do with what is that makes us remember: the prompts, the pretexts, of memory; the reminders of the past that remain in the present (Kuhn, cited in Mitchell and Weber, 1999, p.220).

The study of mathematics life stories has its roots in the larger research methodology of life history research. "Life historians examine how individuals talk about and story their experiences and perceptions of the social contexts they inhabit" (Goodson and Sikes, 2001, p.1). Mathematical autobiographies (or mathematical life stories) are the personal recollections of a person about their experiences with mathematics as far back as they can recall. The use of mathematical autobiographies is widely, but not exclusively, cited in the context of mathematics anxiety, (see for example Benn, 1997; Tobias, 1993). Adults are encouraged to focus their attention on their "personal mathematics history and the forces and contexts that have patterned the way [they] see and do mathematics" (Benn, 1997, p.107). The hope is that mathematically anxious people will be able to face their demons as it were, and move on.

Goodson and Sikes (2001) draw attention to the transient nature of the stories told by informants in life story research projects since "they are telling their story in a particular way for a particular purpose, guided by their understanding or conceptualisation of the particular situation they are involved in, the self/identity/impression/image they want to present, and their assessment of how hearers will respond" (p. 41).

It could be argued that when adults construct their mathematics autobiographies, current self view clouds the memory and past events are interpreted from an adult perspective. All life stories, by their very nature, are "already removed from life experiences: They are lives interpreted and made textual. They represent a partial, selective commentary on lived experience" (Goodson and Sikes, 2001, p.16). Furthermore, the process of telling about themselves, allows people to construct an identity and to add meanings and explanations to their actions in their retrospective narratives so that events seem more coherent and rational than may have been the case at the time (Convery, cited in Walford, 2001, p.91). Hauk (2005), however, contends that whether the events described are real and accurately described is not the crucial issue as these personal memories "shape the way a person perceives experience, conceives the world, regulates cognitive and emotional responses, and interacts with others" (p.39). What endures, is the student's perception and interpretation of past events, and so this is what is reported.

Gibson and Costello (2000), in the context of student autobiographies that seem to indicate either a decision that mathematics is an unattractive subject, or that they had incompetent teachers, warn that the "stories may be a vehicle for external attribution of lack of success in mathematics rather than as a means of self-disclosure" (p.38). Furthermore, "dwelling on the past is not always useful in and of itself – indeed it can become obsessive or self-destructive. It is possible to take refuge in the past, living in memory in order to forget the present" (Mitchell and Weber, 1999, p.5). Despite these caveats, the negative memories of mathematics and mathematics teachers that people retain can influence their lives in ways that matter, and so they are best articulated and dealt with.

Memories of school mathematics - three narratives

Memories of their school mathematics experience were collected from 245 future teachers in three successive cohorts of students doing the MLE module as part of the introductory module activities. They were given a page to write the story which had to begin as far back as they could recall and end with the phrase "and now I am doing mathematical literacy". This followed some class discussion around the Bill of Rights activity described previously but it was emphasised that these were to be their personal stories. Permission was obtained for the use of the memory writings for academic research purposes. Three of the memories are reproduced in their entirety below in order to provide a sense of the responses. These were selected because they contain clear memories of their mathematics teachers – not all mathematics autobiographies included specific reference to their teachers.

Thandiwe's memory

> *When I was young, I went to primary school where I enjoyed calculating and adding numbers. I was getting along with it and also doing well. My trouble started when I was doing Grade 8 at high school. . . I was very shy in class and that made me not being able to write and calculate sums on the board. To him [the teacher]I looked stupid and not capable of doing sums. But when it comes to homework I could do my homework correctly without any help. So my teacher thought I cheated. I became very angry every time I attend maths and was also humiliated. There for I decided that maths is not my thing, I started hated everything about maths. Now I'm still angry that I have to do maths. Something that I told myself that I will never do in my entire life* (Thandiwe, 2004). Thandiwe went onto complete her Bachelor of Educaton degree and qualify as an English, Technology and Life orientation teacher.

Craig's memory

> *Many many moons ago in the valley unknown, a little boy named Craig would be going to school for the first time. He was so excited and eager to learn but he did not know that this was the beginning of a thirteen year struggle against a mathematic hell. It was a new mathematical system that would give Craig nightmares in the deep dark night. The mathematic system eluded him. He was taught to calculate in a card format and the way of the soldier sum. He never understood the concept of the quantive (sic) value of a number. Then came the crippling blow that would forever be a mental scar for him. He sat at a white claustrophobic cubical where he stared blankly at a mathematical test. It laughed at him, it made him feel like a fool. Thus it resulted in him shedding tear and think this happened to him in the first two years of his school career. The next five years mathematic hide its ugly face as it did it*

damage in his. Mathematics raised its head once again but in two forms. The first was the new mathematics teacher and secondly the class he was in. The new mathematics teacher did not know how to control his students. Thus the class took advantage, therefore mathematics got another upperhand on Craig. The next year Craig would get his own back. As a mathematic wizard known as Mr. B would help him conquer his fear. Unfortunately the wizard had to retire. Craig soon had to leave that school and was moved to a rural school. Here would be the final show down between Craig and his eternal enemy mathematics. Mathematics beat him down and down until Craig fell. His body bent and spent he said pantingly "You win, I quit". But now it is the return of Craig and he will be victorious against his mathematic enemy (Craig, 2004). Craig successfully completed the first year of a Bachelor of Education degree and then abandoned his studies.

Maree's memory

When I was young I started school with an open mind, excited, expecting the unexpected and unjaded view of ever of everything, since I had no frame of reference, it was all new and exciting to me. But as the days went by, my Grade 1 teacher was so mean and impatient, she started to warp my ideas on how maths was looked at. Then year after year, I continued to get a cruel and evil maths teacher slapping of hands, standing in the corner, ripping out pages and of course the ever dreaded public humiliation of "Maree, tell us how it's done"– you name it, I've experienced it all!! Naturally I got a mental block about maths and the two of us, just do not mix. . .nevertheless teaching is what I am passionate about, and this is what I have to do to achieve it. . .just one more hurdle in a long line of hurdles in life. . . To be where I need to be I must do maths and now I'm doing Maths literacy (Maree, 2004). Maree passed the Mathematics Literacy module with high marks and went onto achieve a Bachelor of Education degree with merits in her specialisations of English and Drama.

Memories of their teachers

The memories recounted by the future teachers provided peepholes into the classrooms of South Africa and some indication of how mathematics learning can come to a standstill, often quite abruptly (Hobden and Mitchell, 2011). The focus of this article is on their memories of their school teachers and the effects of these memories.

The future teachers whose stories are presented above had spent at least twelve years at school and their teachers must have said and done so many things. Yet they remember most how they were made to feel – Thandiwe was

angry and humiliated by being thought a cheat, Craig was made to feel a fool, and Maree felt publicly humiliated. While it has to be understood that these products of deliberate remembering do not necessarily reflect the way it really was, as much as the way it appeared at the time or even now appears to the person in hindsight (Mitchell and Weber, 1999), they are the memories affecting the person's life in the present. I was surprised to see many instances in the memories where the students reported the actual words of the teachers. Some of these were oft repeated clichés such as *practice makes perfect*, intended to be positive and encouraging; some were discouragements – words that were meant to dissuade the students from continuing with mathematics; and finally there were dismissals – words that were used to dismiss requests for help from struggling learners. It is the professional duty of teachers to advise learners about their choice of subjects and learners are often unhappy to hear that their marks do not qualify them to continue with mathematics. The examples of discouragement in this context and cited below clearly caused lasting offence to the people involved: *Come end of the year, my Bible education teacher called me into the office and told me that God does not intend for me to be a doctor and that I was not allowed to carry on with maths* (Myra, mathematics autobiography, 2005); *she told us that we had no hope so instead of wasting our time we should quit* (Zami, mathematics autobiography, 2004). Some future teachers retained the memory of disparaging comments made by their mathematics teachers, usually in the context of declining to help them further. Some examples are: *He used to said that he is here to teach not to change a fool to become smart* (Phiwe, mathematics autobiography, 2004): *If you asked her to explain further and said you don't understand. She will answer by saying "If you don't know, it is not my baby to feed, I'll move with those who wants to go with me."* (Vallencia, mathematics autobiography, 2005): *My math teacher could actually tell us that he doesn't care. His usual term was "You snooze you lose". I tried to cope with the situation until I couldn't get more than 20% correct. After that I said to hell with maths* (Gladness, mathematics autobiography, 2004). Sometimes, as in the case of Maree, it was the actions such as slapping or tearing up their work that was remembered. And finally, as postgraduate lecturers we have to feel a little ashamed of the postgraduate student referred to by Zami in her mathematics autobiography: *When my teacher taught Maths I couldn't understand her. . . The most thing that she use to say was that she has her 'honours' and now she was doing her Masters.*

Memory narratives for pedagogical purposes

The narratives produced by the future teachers reflect their memories of their school teachers. I will argue that written memory narratives can influence mathematics pedagogy in at least four ways, namely (a) laying the memories out for adult consideration and evaluation, (b) by providing specific background information on a cohort of students which can inform the selection of pedagogic practices, (c) by broadening the understanding of the work of mathematics teachers to include the development of positive attitudes to mathematics, and (d) by providing a methodology for use in mathematics education research. These are discussed in the four sections that follow.

Using memory narratives as a starting point to new beginnings

I collected all the mathematics autobiographies and read them immediately. I tried to respond to each future teacher's story in an encouraging way, typically with a note that now as adults they might find the mathematics made more sense and that this was an opportunity to succeed in a mathematics module. Although the personal stories of their mathematical experiences were not explicitly discussed, the future teachers soon realised that they were in a class where many of their peers shared similar backgrounds. *So when we were in Maths literacy class for the first time and I saw there were lots of white people, I thought that if they had the same problem then why not me. I came to realise that Maths is actually everyone's problem. Nobody in this class has passed maths in Grade 12* (Gabi, interview, 2003). The three memory narratives reproduced in a previous section illustrate the different attitudes that the future teachers had towards the compulsory MLE module. Thandiwe was angry at the requirement, Craig felt he could possibly conquer mathematics and Maree, although not keen to engage with the module, had the maturity to view it as a step towards her greater goal of becoming a teacher. To emphasise the point that surfacing their memories should be a positive step in their mathematics learning journey I usually engage the future teachers in a follow up activity to the mathematics autobiographies. They are asked to write down, on a small piece of paper, the single best thing they can remember about their school Mathematics experience and the single worst thing they can recall. All the slips of paper containing bad memories are then burnt in a container in front of the class. The ashes are preserved and

displayed on a poster entitled 'bad memories of maths R.I.P'. alongside a poster containing all the good memories. I hope this helps to provide a concrete reminder that negative memories need not inhibit their engagement with mathematics and that they can, as adults, begin to develop the mathematical skills that will enable them to become self managing people, productive workers, and responsible citizens.

Using memory narratives to direct pedagogic practices

Reading the memories of the future teachers, it is clear than many of them were exposed to several of the risk factors for mathematics anxiety identified by Ashcraft (2002) and discussed in a previous section of this article. The memories also alerted me to the sensitivity of the future teachers about their mathematics ability and their low confidence levels. It seemed important to be encouraging and affirming wherever possible. My efforts at motivation towards clear goals seems to have some success as indicated by the strong mean agreement in the final module evaluations with the composite factor statement "*the lecturer motivated and encouraged me*" (Hobden, 2007, p.218).

It was a challenge to select pedagogic practices that would not touch raw nerves. I took notice of the comments made regarding the humiliation of public disclosure of assessment results, for example: *When I got to high school my teachers just discoursed (sic) me. They would make jokes about my marks instead of helping me and what happened on Grade 9 was more humiliating, devastating and shamefully because the teacher puts me under pressure. She always wants to show off what a fool I was in front of the class.*

In addition to refraining from mentioning marks in any public forum, I altered the usual format of test papers which have the marks recorded on the front page of scripts, to have the mark recorded on one of the inside pages. This way when test papers are handed out or left for collection, the individual marks are not visible.

I think as teachers we often fail to understand what students hear when we speak, especially when idiomatic speech is used. For example, the phrase 'You snooze you lose' could have been a jocular encouragement to use an opportunity to learn, but seems to have been interpreted by Gladness in her memory of her teacher as an indication that the teacher did not care. On a

personal note, I have reverted to plain speech in my interactions with students after reading in a particular module evaluation that I was regarded as rude and dismissive because I referred to students as being blind and fools. I couldn't imagine when I would have said such things but on further thought I recalled my interactions with students working in groups. I often ask if they are sure about the answer and receive the reply that the other members in the group agree with them so it must be correct. To which I might have replied "I hope it is not a case of the blind leading the blind", or "Indeed great minds think alike, but it could also be that fools never differ."

Using memory narratives to inform thinking about the work of mathematics teaching

After surveying the field, Maass and Schloglmann (2009) conclude that "affect has come to be seen as having an important influence on mathematics learning" (p.vii). Kilpatrick, Swafford and Findell (2001) reminded us that "motivation for school mathematics learning depends primarily on the interaction of students with teachers and of students with mathematical tasks" (p.339). The memory narratives clearly indicate that the former interaction is long remembered by the students. There has been recent attention given in the international mathematics education literature to the notion of productive disposition as a feature of mathematical proficiency (Kilpatrick, Swafford and Findell, 2001). This has the implication that in addition to developing conceptual understanding, procedural fluency, adaptive reasoning and strategic competence in mathematical content areas, a significant part of the work of mathematics teaching is the development of a belief in the value and coherence of mathematics, and of a sense of self-efficacy in the learners. Following international trends, the South African school curriculum (Department of Education, 2002) highlights the skills, knowledge and values (SKAVs) required in each school subject, and specifically in mathematics. The inclusion of the values is an indication that the teachers need to go beyond providing mathematics knowledge and skills to develop positive values and attitudes towards the subject. The newer Curriculum and Assessment Policy Statement (2011) commits teachers to a curriculum that is "sensitive to issues of diversity such as poverty, inequality, race, gender, language, age, disability and other factors" (p.6). I would argue that one of the 'other factors' would be differences in mathematical aptitude. The teaching work of engendering positive feelings towards mathematics, and of

approaching struggling mathematics learners with sensitivity would be informed by the insights gained from the memory narratives of those who had passed through the schooling system.

Using memory narratives in mathematics education research

The written mathematics autobiographies in this study were written mainly for the first pedagogical purpose – to assist students to overcome their personal mathematics anxiety. It was never intended that these stories be shared with the group, partly because they were personal and partly because time within the module did not permit any peer discussion of the narratives. The only interaction was in my written comments on each person's autobiography. Formalising the process along the lines of the steps for memory work advocated by Onyx and Small (2001), seems a promising way for small groups of particularly mathematically anxious future teachers to explore their feelings in community to and take control of their past. This methodology requires adherence to a series of prescriptive steps such as writing in the third person, using pseudonyms and refraining from interpretations and explanations in the written work (Crawford, Kippax, Onyx, Goult and Benton, 1992). Thereafter the participants meet in a group together with the academic researcher who assumes a peer position within the group to analyse the written work with a view to theorising their memories, and viewing them in the light of the wider academic literature. While I am convinced of the value of the group interaction and collective work in making meaning of the individual memories, I concur with Onyx and Small that "in practice, it is usually one particular researcher who uses the method for the purposes of gaining a qualification, or in order to publish a paper" (2001, p.780), raising ethical issues with this methodology. I suspect it would be difficult to sustain the participants' interest past the general discussions and into the academic arena, but I have not as yet attempted to engage the future teachers in this way.

Conclusions

I have provided some examples of the narratives produced by future teachers after a request to specifically remember their experiences with mathematics. The memories provided pointers to pedagogical approaches that might be

successful with people who had been exposed to negative experiences of mathematics and were very likely to suffer from some degree of mathematical anxiety. I think the process of bringing the memories to the surface was helpful to the students who could sense that their feelings were being acknowledged, and that they were in a safe space to try again to succeed at mathematics. The memory narratives were certainly a reminder to me to tread sensitively in my pedagogy, to be affirming, and above all to avoid public discussion of individual achievements. Perhaps as teachers, we should think a little less about exactly what to say and do in the daily lessons, and a little more about how we are making the learners feel – this could well be how we are remembered.

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Sally Hobden
School of Education
University of KwaZulu-Natal

hobdens1@ukzn.ac.za