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The Power of Writing for all Pre-service Mathematics Teachers

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Jane's decision to write her maths-autobiography came as she witnessed the benefits achieved by other preservice teachers at UNDA undertaking the same task. However, unlike fellow students, Jane did not suffer from Mathematics Anxiety. Jane's autobiographical writing demonstrates the potential uses and benefits for a non-anxious preservice teacher. Her autobiography provides insights for teachers and teacher educators into the everyday experiences of the classroom and students. For teacher educators, it further demonstrates the value of various writing styles as tools for self-growth. Jane's writing contains a number of examples that demonstrate that her childhood experiences and subsequent writing about those times, directly impact on her emerging teaching philosophy and future professional work. Jane's writing also demonstrates the transformative potential of writing a mathematics autobiography for preservice teachers.

Jane's Journey to Writing a Maths-Autobiography

Jane was a high achieving mature-age student. Several of her friends had enrolled in a Directed Individual Study unit, coded ED4810, for the purpose of writing their maths-autobiography. Jane was aware that her peers in that group suffered from varying levels of Mathematics Anxiety, and was interested in the impact the autobiographical writing was having on them. They had informally shared many of the experiences they were writing about, and Jane was interested in the obviously increased confidence levels they were displaying. In one of our conversations, Jane suggested she "join in" and write her maths-autobiography, to tell the story of a transient student. She was aware that she did not suffer from Mathematics Anxiety, and reflected that whilst there were adequate precipitating factors in her own life, there were also numerous protective factors. Jane was interested as she had a strong sense developing that she wanted to teach mathematics very differently to the way she had experienced it for most of her school life. Although her recollections are subjective, from a phenomenological viewpoint what she experiences *is* what she experiences. Jane understood the dangers of solipsism and her writing echoes an awareness of the lack of objectivity that can exist in autobiographical writing.

Stepping into Jane's Story

Jane's autobiography recounts a series of critical events within her school life, including changing schools, moving house, relocating to the country, forming new social sets of friends and interacting with new teachers. It is her relationships with teachers, however, that are at the forefront of her memorable experiences. It is well recognised that teachers play a vital and significant role in student learning. Jane's writing reiterates a recurring theme that student-teacher relationships are central to learning.

My earliest recollection of mathematics was in Year 1. I was six years old and the youngest of eight children. I was very eager to start school just like my big brothers and sisters. I couldn't wait to be in Mrs. H.'s class. Mrs. H. was the Year 1 teacher at M.P. Primary School in a small country town in South Australia. The very first incident I can recall about mathematics was learning to count using an abacus. I loved the colours of all the balls and enjoyed sliding the balls along the wire. The Year

1 classroom had a lot of mathematics equipment on the mathematics shelves. There was a shelf full of abaci in the classroom and every morning we were allowed to play on the mat with them.

On the mathematics shelf were all sorts of amazing things to play with. One of my favourite resources was the till with money in it. Mrs. H. used to set up shopping stalls all around the room, one stall would sell fruit, another would sell groceries and another would sell stationery. I liked it best when I got to be the shopkeeper and had to sell the items on my stall and take the money. I don't recall actually being able to calculate the money, although I was able to imitate what I had experienced when I went to the shop with Mum. I regularly went to the local shop for Mum by myself because the local store was only about 4 doors down from where we lived. In the 1970's most people had a monthly account at the store so I never really got to use money in a real life situation.

I also remember learning to write the numbers up to 10. My favourite number to write was the number two (2), Mrs. H. taught me how to turn the number two into a beautiful swan. She used to use lots of coloured chalk and make all the numbers into pictures, for instance the number eight was a teddy bear. I can't actually recall learning to count or finding it difficult to count. I know I loved school and really liked the mathematics shelf. Mrs. H. really gave me a great start to my school years, especially in mathematics. I can only ever remember doing mostly concrete activities with her and she always made it fun.

The mathematics experience that I can recall is learning to regroup, this was really tricky. We used to have to write the numbers under each other and then draw a line and add them up, my answers were always wrong. I don't remember who my teacher was but I can remember having to write a lot in mathematics. I remember that there was a big emphasis on getting things right, I didn't like it when things were wrong because then I thought I was stupid and couldn't do mathematics. I only stayed at that particular country school until the end of Year 4.

It is instructive to note the differences in Jane's descriptions as she recalls her experiences over time. She provides a detailed description of her feelings and learning activities with Mrs. H., the teacher who made school fun and who really engaged her with mathematics. This contrasts with the sparse description in the final paragraph of the next three years of school. She does not remember the names of her teachers and the relational elements that were detailed in the first grade paragraphs are missing. She does, however, remember several other things that were instilled in her: that you had to get things right, and that when you got things wrong you felt like you were stupid and "couldn't do mathematics". Jane's writing illustrates the human dimension of mathematics learning.

Teachers Make the Difference

Teachers have a major impact on student learning. For example, Turner and Patrick (2004) found that student participation is highly related to teacher practices. Such practices will either be supportive or undermining of the development of student work habits. Jane's autobiography illustrates the relationship between varying learning environments and factors such as resilience, teacher-student relationships, learning programs, and teaching style.

The Impact of Classroom Culture on Learning

The relationship that teachers establish with students is reflective of the culture of the classroom (Dix, 1993). Classroom culture includes the beliefs, attitudes, and values that are then manifest in actions, symbols, icons, and relationships (Good & Brophy, 1994). For example, in a very tidy and well-organised classroom, it could be conjectured that order

and organisation things the teacher considers to be important. A classroom with an attractive reading corner, with cushions, beanbags, and books available, would indicate the importance of reading. The presence of open and effective classroom meetings, with a rotating student-chair, would indicate that democratic principles are valued. Classroom culture does not exist in isolation from the broader aspects of the school culture, family culture and social culture (Jones, 1996). A classroom culture might be attempting overtly to be counter-cultural. For example, a school in a socially disadvantaged area with racial tension might focus on developing a respectful, harmonious community “feel” to the classroom. Classroom culture includes the norms and values that teachers establish within the classroom (Stoll & Mortimer, 1995).

Positive Classroom Culture Reduces Mathematics Anxiety Related Factors

A positive and effective classroom culture results from a broad range of operational factors including appropriate classroom management techniques, a sustained focus on learning, cooperative, and respectful attitudes and harmonious relationships (Cavanagh & Dellar, 1997). A practical example of how mathematics teachers can support a positive classroom culture is by ensuring that students’ “put down” remarks about other students’ mathematical performance, and student behavior that belittles others, is not tolerated. A positive classroom culture encourages “risk taking” and so “at risk” students need to feel safe that they will not be humiliated or criticised for making errors. A classroom culture that fosters tension, anxiety and discord provides fertile ground for breeding anxiety about mathematics.

Good teachers are able to create a learning environment in which students have high and positive expectations about their learning, co-operative behaviour is pronounced, and the culture encourages learning to occur.

Patrick, Turner, Meyer, and Midgley (2003) found that three different types of classroom psychological environments can be established by teachers in the first days of school: supportive, ambiguous, and non-supportive. In supportive environments teachers exhibited behaviours such as expressing enthusiasm for learning, respect for their students, appropriate use of humour and sharing of expectations that all students would and could learn in their classrooms. By contrast, teachers in non-supportive environments tend to use authoritarian control and emphasised extrinsic motivation. Students in supportive classrooms exhibited significantly less work avoidance behaviour and significantly more on-task behaviour than existed in the ambiguous or non-supportive environments (Gallimore & Tharp, 1990). Although these findings were specific to the mathematics learning environment created in the classroom, it is likely that the same applies to other learning areas (Meyer, 1993). Central to the supportive environment is a teacher whose focus is student centred and encourages intrinsic student motivation (Anderman & Midgley, 1998).

The traditional view of “impartially imparting objective knowledge” implies the existence of a passive learner. Jane’s writing illustrates that from a young age, children are active constructors in the learning process.

Jane’s Emerging Beliefs about Mathematics Learning

My family then moved to the city of my father’s work and I started Year 5 in C.C.C.. This is the first time that I can remember using MAB’s. I think in Year 5 the concept of ten finally sunk in, that was

my “aha” moment. I enjoyed seeing how many ways I could make ten using the MAB’s, numbers really started to make sense to me and I loved mathematics. I finally understood the concept of regrouping; using MAB’s made it so much easier. I liked trading the ones for tens and tens for hundreds. Increasingly over the year most of the mathematics that we did was copied from the board, but we were allowed to access the MAB’s if we needed to. Measurement was a major part of our mathematics in this year, we got to use the big measuring tapes from the sports shed and we went onto the school oval and did lots of measuring activities. This is about the time that the real importance of 10 in mathematics started to make sense to me. I learnt that 10 millimetres makes 1 centimetre and that 100 centimetres made 1 metre. I did not like having to do problem solving that was embedded in number stories such as, Sally travelled 10km to school and 10km home from school, how many kilometres did she travel each day? I struggled with problem solving where I had to read a story and solve the problem. Overall, I enjoyed my one year at that particular school.

L. in the city was my next port of call. This school was much closer to my home and a vacancy became available in Year 6 so my parents decided to move me from C. to L. I settled easily into this new school and my teacher Mrs. R. quickly realised that my reading age was only marginally above my chronological age. During this year I worked extensively on my reading and comprehension skills and gained a lot of ground with my reading skills. My comprehension skills were below average and I had difficulty recalling information. I was becoming increasingly frustrated and I was eventually put into a special reading program called the PACE reading program. The PACE program made a big difference to my ability to read and comprehend information from the text.

I liked the positive praise that the students who finished first received from Mrs. R.. I began to rush my work in order to be one of the first finished and receive the praise that the other children were given. Once I had been in the classroom for a few weeks I think Mrs. R. realised what I was doing and she spent a lot of time sending me back to my desk to complete my work to a better standard. I found this very frustrating and on reflection I now understand what a wonderful teacher Mrs. R. was. She always gave a lot of positive praise when you did things correctly and a lot of encouragement when things were not exactly right. Mrs. R. really knew how to get the best work from me and she was my turning point at school. She taught me that mathematics was not about getting it right all the time, it was often about the process that helped you get the answer.

In the opening sentence of the previous paragraph Jane identifies one of the key strategies of an effective teacher as giving frequent encouragement and affirmation to students in the class. This was something that Jane was seeking, as evidenced by her description of her desperate need to finish first so that she too would be praised.

As a preservice teacher Jane has developed a clear understanding of the essence of good quality mathematics teaching when she states that she knows that the process is more important than the right answer. She attributes this insight directly to her teacher. Every time Jane rushed to complete activities, Mrs. R. instructed her to return to her desk to produce a better standard of work. This vignette also provides an insight into how students respond to constructive feedback. It is clear that Jane’s relationship and self-esteem were not being adversely affected by Mrs. R.’s insistence on high quality work. She was able to impart to Jane that it was important and yet at the same time, Jane felt affirmed and valued as a child in that classroom.

Affect Attunement

The term “affect attunement” refers to the emotional connectedness between individuals (Stern, 1995). It can be observed in various life-long relationships, such as between parent and child. It can also be found in relationships between close friends and couples. All children have a basic need for emotional attachment with other people. It is a powerful part of their growing confidence to learn, their willingness to take risks, and their

ability to build relationships with significant people who will assist in their learning processes. Some children display a heightened need for emotional attachment to other adults, influenced by factors such as their age, developmental stage, personality factors, previous experience of adult-child relationships, or their experience of teacher-student relationships within their lives (Fennema, 1989; Garden, 1997). Affect attunement can be significantly impacted upon by a wide range of factors either within or external to the classroom. Factors include teacher personality, subject matter, class size, emotional needs of students, behavioural management needs and demands of the class, emotional and psychological problems of a student or students, and the dynamics of the whole school community and its processes (Grootenboer, 2001).

Poulsen and Fouts (2001) found that attuned teaching, in which teachers and students share close relationships, has a considerable positive impact on academic performance in comparison with “traditional” non-attuned teaching relationships. The same research (p. 189) found that improvement occurred within the context of a single lesson and that the effect of attunement was both “immediate and powerful”.

Jane writes:

The classroom was split into three groups for mathematics; I started in the lowest group. Mrs. R. persevered with each of us giving us lots of encouragement and she allowed us to feel comfortable in taking risks in order to learn. I think she allowed us to learn by mistakes, but because of the wonderful way she encouraged us, it never felt like you were wrong. She made the process of mathematics feel like you do when you are doing a jigsaw puzzle; sometimes the pieces don't fit together the first time, but if you try a different piece eventually, through perseverance, you begin to put the puzzle together. At the end of June I took my report card home to my parents with a huge amount of pride because it read “Jane has fast moved up to the middle group which would indicate that she has grasped the basic concepts and is now ready for some extension.”

My reading and mathematics continued to improve and at the end of Year 6 the mathematics learning area on my report card read “Definitely Jane's best area. She has come along in ‘leaps and bounds’ since coming up to the middle group.” I contributed this improvement in my mathematics to the fact that my reading and comprehension had improved so much. I found it much easier to complete number sentences or problem solving tasks where mathematics was required.

Exploring the Jigsaw Metaphor

At the end of her autobiographical writing, I asked Jane if the metaphor of the jigsaw was important for her mathematics teaching. She explained that it was very important to her. It described her concept of small parts joining to form a larger picture but, unless you knew what the large picture was and what you were working towards, you could never make the small pieces come together. This was a powerful metaphor that she was able to articulate. She elaborated on the impact this had on her own teaching and the processes that she intended to engage in when she worked with students in her own care. This discussion was transformative for Jane, based on both her later feedback, and my immediate impression of her responses as she spoke. In real terms, she was developing her personal metaphor to describe “connected” teaching and learning.

Jane attributes her successes again to Mrs. R., who identified her reading problems and provided additional literacy support. Jane sees strong, directive teaching as being something that generates significant life-long change. In her experience it has impacted positively upon other learning areas and fostered life long learning.

I remember liking the fact that mathematics was so easy, considering I found English a real struggle; it was nice to feel like one of the kids who “got it”. However, if it was not for Mrs. R. identifying my reading problems and her encouragement and support, I think I would have stayed in the bottom group in mathematics and I would have slowly hated school on the whole. I continued into Year 7 feeling very confident in mathematics and was really disappointed when I had to again go into a remedial reading class. I think that I felt that I had to prove myself in the area of mathematics and began to rush to try and finish first. Very quickly I started to make mistakes in calculating sums and my work was showing more and more errors. As the work got increasingly more difficult I was beginning to find some new concepts difficult to understand but I still generally enjoyed mathematics. My final report card for year 7 read “Works well. Errors in mechanics due to impatience. Highly satisfactory grasp of work covered.”

Humiliation as Destructive to Learning

In some classrooms when students make mistakes, teachers use humour as a way of dealing with the issue at hand. In some circumstances they may be reinforcing the notion of “put down” albeit in a situation that is funny for students at the time. To be a participant in the humour may be a funny and warm moment. To be the victim of the humour may be a very negative personal experience that can have far reaching and long term impacts on student learning, and on the learning of other students who are vicariously involved in the situation.

The profoundness of this memory is a significant part of Jane’s autobiography. The trauma of the teacher ridiculing her about her spelling has stayed with her into adulthood. It is apparent that one person can quickly erode confidence that has previously been built by another. Positively affective and effective teachers do not ridicule or make fun of students. They create learning environments in which students feel positive about themselves, and where they know that they are protected from ridicule and humiliation. Humiliation is known to be a significant risk factor for Mathematics Anxiety (Burns, 1998). Jane demonstrates the vulnerability of students to be damaged by a teacher reaction or comment, long after the event.

My teacher in Year 7 was not like Mrs. R. She did not give me much praise and often would belittle us if we did something wrong. I remember when I gave her some written work and I had misspelled a word and she said in a very condescending tone “and I suppose you would put two t’s in writing”.

This has always stuck in my mind because at the time I don’t think I knew if writing had two t’s or one. The sad thing is that those words have stuck with me for 24 years. She took away all my confidence in those few seconds that Mrs. R. had spent a whole year building up. I could feel my stress levels increasing and I can never remember feeling relaxed with this particular teacher. I was always hesitant to hand work into her in case I had made an obvious mistake and she would make fun of me in front of the whole class. The work that was displayed in the classroom was only ever the very best work and therefore mine never quite reached the display board. I always felt as though that particular teacher had no confidence in me, or perhaps she just didn’t like my chatty personality.

My Year 7 teacher took away all my confidence in the area of mathematics, I felt scared to try anything new and often struggled with fear and nerves when it came to test time. Because she made me feel nervous I did not like to take risks in case I got the answer wrong. When she explained a new concept I did not like to ask questions for fear of being ridiculed by her in front of the class. It was not until I reread my reports from Year 7 that I realised that the teacher did think I was quite a good student.

The final report for Year 7 showed that I had achieved above average in all subject areas for effort and ranged from average to above average for achievement.

The Transformative Potential of Autobiographical Writing

This part of Jane’s autobiography demonstrates that the writing process was a cathartic process for her. Interestingly, Jane’s writing might not be transformative for the reader; the transformative potential of an autobiography does not need to extend to readership, explaining why many autobiographies and journals are never published. The authors of such do not desire publication; it is the need to tell the story, more than the need to have others read, that can be a significant motivator for the writer. When she started to write about this time she went back to her old reports and re-read them. She was struck by the fact that her perception (of how the teacher felt about her) was not accurate. Her perception was challenged, and this had a positive impact on Jane.

One particular area that I always felt I struggled with was my times tables. The times tables were a major part of the class learning and therefore this was an ongoing problem for me. We were tested regularly and had to get 100% in our test before we could move onto the next lot of tables. This, on reflection, was only taught through rote learning, and at no stage did anyone explain to me that 5×7 was the same as 7×5 . The whole class kept moving at the teacher’s pace, and if you did not have an understanding of the topic being taught that week it did not matter, the teacher moved on anyway.

Again my parents moved to the country. This time they had purchased a hotel. L. was a boarding school but there were no vacancies for me in the boarding section so it was back to the country and B. Community School was my new school. I started Year 8 feeling very confident and felt as though I had a good handle on the level of academic achievement expected. This school was very different to my previous school; this was an open plan school and very stark and had boys in it. My previous two schools had been all girl schools. I do not remember seeing any resources or concrete materials for mathematics and I quickly became bored. Everything was presented on a white board and I can remember having great problems understanding “area”. I just really struggled with the concepts that were being presented to me, possibly because of how they were presented to me. The teacher style was very much chalk and talk style. I do not remember seeing any sort of teaching aids other than perhaps an overhead occasionally and lots of worksheets. We did have a mathematics book that we worked through from front to back with very little variation from that particular book. I do know that the answers were in the back of the book, so often we would copy the answers into the book and the teacher would mark it and we would move onto the next page.

There was never any group work or group discussion; it was very much students sitting in rows working independently. If you were game enough you might put up your hand and ask for help occasionally but usually only if you were very desperate to get some help. The teacher did not encourage discussion between students and if you did discuss a particular mathematics problem with another student it was considered as cheating and you were normally punished.

Jane’s reflection on her Year 8 experiences is sadly an all-too-common picture of lower secondary mathematics for many students. Learning that is teacher-centred and utilizes didactic pedagogy is likely to alienate students and reduce their interest in a learning area (Kohn, 2000).

Jane observes that whenever students worked together it was perceived as cheating and they were punished rather than encouraged to engage in co-operative or collaborative work activities. In discussion, Jane affirmed that a fundamental belief she holds about effective mathematics teaching is to have students to work together, to talk, to interact, and to learn from each other. The constructivist philosophy that has been embedded into her tertiary mathematics learning area lectures, combined with her experiences, is becoming evident in her own beliefs about how she will teach mathematics in the future.

Classroom Teaching-Learning Styles

In the social constructivist classroom the learning environment and teaching practices are student-centred. Mrs. R. adopted a student-centred approach that was reflected in her ability to identify and cater for the various needs of the individual students in the class. The positive impact this has had upon Jane’s learning is evident in her writing.

Jane is able to differentiate between the social constructivist environment that she chooses to create as a pre-service teacher, and the non-social “traditional” classroom model where interaction and talk are actively discouraged rather than being seen as a powerful technique for learning and understanding. Jane has also described the positive impact motivation has upon learning and the adverse impact the incorrect use of negativity has as a de-motivator for learning.

The Effects of Teacher Expectation and Affirmation

The *Pygmalion in the Classroom Project* (Rosenthal & Jacobsen, 1968) found that “teacher expectation of student performance” was the most significant variable to impact on student learning. Teachers were given grouped ability students with the groups incorrectly labelled. High ability students were described as low ability students and vice versa. The study revealed that students performed as the teachers had expected them to, despite the lack of correlation between the expectations and their actual abilities. Other research has demonstrated that teachers expect better performance from students about whom they have higher expectations of ability, and lower performance from students whose academic ability they doubt. These expectations are matched by student performance. Students who experience low expectations make fewer efforts to seek teacher attention and gradually withdraw psychologically from the learning environment. In effect, what teachers believe about the educational potential of their students has a pronounced effect on their performance and achievement. Mrs. R. communicated her expectation to Jane that she was able to produce good quality work. Her Year 7 teacher communicated her low expectations of Jane with her comment, “and I suppose you would put two t’s in writing”.

Writing Leading to Reflection

Jane commented that after writing her mathematics autobiography she began to think about her teaching philosophy. She stated that it was another “aha” moment when she determined that she really wants students in her classes in the future to have a strong sense of developing understanding and grasping the “big picture” rather than being overly focused on “minor tasks being correct”. She was able to articulate the importance of process orientated, conceptually based learning as opposed to superficial, topic focused learning.

Jane commented that writing her autobiography had been an interesting and demanding process. She felt that she had learned a lot about herself as a learner, as a person, and as a teacher. Teachers with whom she had positive learning experiences and attuned relationships were the ones she wanted to model herself upon. She intended to reject the practices of those teachers with whom she had non-attuned relationships and negative learning experiences. Having completed three core units of mathematics education, Jane said that she felt confident in tackling mathematics in the classroom and making it a subject which would be a positive learning experience for the students in her future care.

Jane’s mathematics autobiography recalls her educational pathway as a passive learner. Yet her attitudes, values and intentions as a preservice teacher are to encourage her students of the future to be active learners. In our post-writing discussions, Jane expressed her thoughts and feelings that it was a composite range of factors that had led to this transformation. For her, these factors included the autobiographical writing process, her own life-long disappointing memories of mathematics learning, the mathematics education courses she had undertaken, her relationships with the lecturers and tutors in those units, and, importantly, her practicum experiences. In her practicum work she was able to see highly effective teachers of mathematics, and felt energized by the students appearing really to enjoy mathematics work, noting the difference from her own feelings about mathematics at school.

Jane did not develop Mathematics Anxiety. There are several potential factors that appear to insulate her from this condition:

- There were a number of positive teacher relationships which developed her confidence as a learner.
- She was aware of making academic progress, of growing in knowledge, thus feeling she could manage new material.
- Transient movement can build resilience – the need to be self-sufficient, manage change, form new social groups – experiences that potentially provide protection from anxiety.
- Jane’s transient life-style was “positive” – each move related to changed employment for her parents, not homelessness, family breakdown, financial difficulties or being “forced” to move – which can be more common in transient students.

Conclusion

Although the use of reflective writing in mathematics is most often used as a therapeutic tool, Jane’s biography has the potential to be used as a discussion starter with both preservice and practicing teachers. It could be used to explore the deep impact of teacher “throw away” remarks, transient families, resilience to prevent anxiety, informal or unplanned career guidance, the power of writing and transformative readership understandings. A piece of maths-autobiography, or journalling, once de-identified, has numerous potential usages as a tool for readers and practitioners. The use of reflective writing for all students in mathematics education units, as demonstrated by this example, would indicate that it could be a powerful tool for self-awareness which may have considerable impact on future teaching performance.

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