"MY SELF-ESTEEM HAS RISEN DRAMATICALLY": A CASE-STUDY OF PRE-SERVICE TEACHER ACTION RESEARCH USING BIBLIOTHERAPY TO ADDRESS MATHEMATICS ANXIETY

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We read books to find out who we are. What other people, real or imaginary, do and think and feel is an essential guide to our understanding of what we ourselves are and may become.
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Pre-service primary teachers' mathematics anxiety affects their future teaching of mathematics. This makes them less likely to engage with mathematics, impacting on the attitudes and performance of their future students. Hence, teacher education is a crucial site for further research. Bibliotherapy, incorporated into a fourth-year pre-service teacher's action research during her final practicum, helped identify the impact of previous experiences on her mathematical identity. With each cycle of her action research, supported by the bibliotherapy process, the pre-service teacher was able to develop greater insight, leading to a more positive projection into her future as a teacher of primary mathematics.

Introduction

Recent mathematics curriculum documents, for example, the Australian Curriculum (Australian Curriculum and Assessment Authority [ACARA], 2010), are based on the premise that all students are capable of learning mathematics. This counters the traditional view, in which only a few students were expected to succeed. Mathematics has been perceived as a critical filter (Sells, 1978), associated with elitism and social stratification (Tate, 1995). Beliefs that success in mathematics relates to participants' inherent worth still dominate thinking (Gates & Jorgensen, 2009). Failure in mathematics can have a powerful emotional impact that may extend far beyond the mathematics classroom (Boaler, 1997). The impacts of mathematics instruction produce for many an enduring state of mathematics anxiety. This anxiety has been associated with inappropriate teaching practices, and a prevalent belief that success in mathematics is determined by ability rather than effort (Stigler & Hiebert, 1992).

This paper, part of a larger project investigating the use of bibliotherapy, is written within a framework of action research, as a tool for addressing primary pre-service teachers' mathematics anxiety. This will add to existing frameworks for the study of affect in mathematics education (see, for example, Hannula, Evans, Philippou, & Zan, 2004).

Theoretical framework and literature review

This research is located at the intersection of the literature on the impacts of mathematics anxiety on primary teacher mathematics education, and bibliotherapy.

Mathematics anxiety

Mathematics anxiety is a learned emotional response, characterised by a feeling that mathematics cannot make sense, of helplessness, tension, and lack of control over one's learning. Mathematics anxiety has been associated with inappropriate teaching practices, and a prevalent belief that success in mathematics is determined by ability rather than effort. Ma's (1999) meta-analysis of studies of elementary and secondary students found significant relationship between anxiety towards mathematics and achievement in mathematics.

Theoretical models of mathematics anxiety have multidimensional forms that incorporate attitudinal (dislike), cognitive (worry) and emotional (fear) aspects, (Hart, 1989; Wigfield & Meece, 1988). Baroody and Costlick (1998) suggested that children who develop mathematics anxiety tend to fall into a self-defeating, self- perpetuating cycle, and described a mathematics anxiety model that illustrates how beliefs can lead to anxiety, which reinforces unreasonable beliefs.

The impact of teachers' beliefs about mathematics can be far-reaching in promoting positive outcomes for students, and remains an important focus for educational research (Leder, 2007). Many primary or early childhood pre-service teachers (PSTs) have a fear of mathematics, and see themselves as unable to learn effectively. A great deal of research has been done in this area, but is outside the scope of this paper. Thompson (1992), in an extensive review of research into affective elements of mathematics education, noted that the difficulties in promoting teacher change were intimately connected with both what teachers know and believe. Ambrose (2004) reports that mechanisms that have the potential to change beliefs are those providing emotion-packed, vivid experiences, becoming immersed in a community, and promoting reflection on beliefs.

Bandura's theory of self-efficacy indicates the significance of teachers' beliefs in their own capabilities on student learning and achievement. Bandura (1994) defines self-efficacy as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives . . . Self-efficacy beliefs determine how people feel, think, motivate themselves and behave" (p. 71). People need a strong sense of efficacy before they try to apply what they have learnt or try to learn new things. Teachers' beliefs about their own ability are a significant factor in their approach to teaching mathematics and even militate against their willingness to teach upper primary classes (Wilson, 2009). High teacher efficacy leads to improved student performance learning and achievement (Allinder, 1995; Ashton, 1984; Gibson & Dembo, 1984; Madison, 1997).

Many students come to tertiary teacher education with limited mathematics understandings, and a pattern of avoidance and anxiety. Researchers of primary (elementary) PSTs report high levels of mathematics anxiety, low confidence levels to teach mathematics and low mathematics teacher efficacy. For a more detailed discussion of these issues see Wilson (2009).

Researchers have concluded that high levels of teacher mathematics anxiety can be perpetuated in classrooms (for example, Furner & Berman, 2005). When students are marginalised and do not identify themselves as confident learners of mathematics, they are unlikely to map mathematics into their future identities in a positive way (Boaler, 1997). The way individuals perceive themselves as learners of mathematics is integral to their subsequent identity as teachers. In previous research (Wilson, 2007; Wilson & Thornton, 2008) many PSTs described an interaction during their schooling that led to them identifying themselves as persons who couldn't learn mathematics, and said that this still impacted on their self-images as future teachers of mathematics.

Identity brings together affective qualities and cognitive dimensions. Ricoeur (1994) suggests that people make sense of their own personal identities in a similar way to their understanding of the identity of characters in stories. Identities are mobile, and remain open to revision. Walshaw, (2004, p. 557), argues that "teacher education must engage the identities of pre-service students", and describes the journey of a pre-service secondary teacher, Helen, who, "through a process of formation and transformation, finally at the end of the year, understood who she might become" (p. 563).

In summary, PSTs with mathematics anxiety are less likely to engage with mathematics and have low confidence and low self-efficacy, impacting on their identity as teachers of mathematics. It is for these reasons that teacher education has become a crucial site for further research.

Bibliotherapy

Bibliotherapy is a technique that was developed in psychology and library science. It involves guided reading of written materials used in gaining understanding or solving problems. The procedure is based on reading about the dilemmas of, and identifying with, the protagonist, followed by individual or group discussion in a non-threatening environment. The reader is an active participant in the process and interprets through their own psychological perspective and perceptual lenses, but feels safe because they are not experiencing the crisis.

Advocates for bibliotherapy identify both cognitive behavioural and psychodynamic benefits. Shrodes (1950), a pioneer in bibliotherapy, attempted to explain how literature could aid therapeutic work. Her psychodynamic model focused on the processes of identification (or universalization), catharsis (or abreaction) and insight (and integration) as the key steps for therapeutic benefit to occur. Many writers since then, for example, Morawski (1997), have used similar constructs.

The stages of bibliotherapy used in previous research, (Wilson & Thornton, 2008) are that the reader:

- identifies with and relates to the protagonist (identification)
- is emotionally involved and releases pent-up tension (catharsis)
- learns through the experiences of the character and becomes aware that their problems might also be addressed or solved (insight)
- recognises that we are not alone in having these problems (universalisation)
- can envisage a different future identity (projection).

In bibliotherapy, whether used in groups or individually, it is the additional work that goes on in the group or between the therapist and client that leverages the potential benefits, not just exposure to the literature. Researchers comment on the therapeutic

dynamics of the group, such as getting feedback from others, and hearing other perspectives. Hynes and Hynes-Berry (1986) describe an important feature of interactive bibliotherapy as "the triad of participant-literature-facilitator" (p. 11).

Bibliotherapy has been used in preparing PSTs to teach students with emotional and behavioural disorders, and students with special needs (Morawski, 1997). Previous research used bibliotherapy during mathematics units for PST to examine their attitudes towards themselves as learners and teachers of mathematics (Wilson, 2009; Wilson & Thornton, 2008;). The significance of the changes in response to the bibliotherapy process was that they contributed to the understanding of aspects that drive the development of their mathematical identity. Themes identified through the analysis of previous research strongly suggest the importance of insight as a major factor in bringing about a positive projective identity. The potential of bibliotherapy is that it is a stimulus for this revision, and the planning cycle of action research.

Methods

This paper reports an action research project by a primary PST, which aimed to investigate and develop her professional knowledge and practice. Shannon was in her fourth year of a primary Bachelor of Education degree. She examined how she might address the impact of her mathematics anxiety on her mathematics teaching practices during the final practicum of her course.

Bibliotherapy was used within the framework of action research as a tool for addressing her affective responses to mathematics. Action research has been identified as a powerful process for reconstructing and transforming practice (Somekh, 2005). However, Salzman, Snodgrass, and Mastrobuone (2002, p. 2), state, "in spite of action research's ability to help teachers gain unexpected and valuable insight into the realities of their own classrooms, there appears to be limited innovation at both the pre-service and in-service levels to help teachers develop action research skills." The goal was to understand what had influenced Shannon in the development of her teaching practice, by examining the relationship between her beliefs and her classroom practice, and their impact on her professional identity.

Three instruments were used in the action research cycle:

1. Initially, working with the researcher, Shannon completed a short questionnaire about her self-perceptions as a learner and teacher of mathematics, and past experiences that contributed to these. This was repeated at the end of the project.

2. The second procedure was a cycle of pre- and post- self-assessments of each mathematics lesson. These comprised a survey and short questions completed before and after each lesson, (including feelings, preparedness and teaching success, rated on scale of 1- 10; and notes on level of confidence, what went well, what would be changed in future).

3. The third instrument was a journal of written reflections. Previous papers about mathematics anxiety were provided as part of the process of action research. The readings formed the stimulus for the written reflections, as one of the means of incorporating bibliotherapy into the action research process. The reflections were shared with the researcher and fellow PSTs undertaking action research projects, during and in a presentation and discussion after the practicum.

The reflections were triangulated with the answers to the questions and lesson assessments, and the conclusions were then reviewed in the light of student feedback, and related to the outcomes of previous research using the bibliotherapy framework.

Results and discussion

Shannon identified a critical incident around a packaging problem in a mathematics class "The teacher decided she didn't like mine and held it up to the class (with me standing near her) and started berating my design and my ability and saying this is the sort of thing that she would expect from someone much younger. I felt humiliated … I think that after this time, I really started to withdraw from maths."

Using readings to clarify understanding of learning is central to the bibliotherapy technique. The reflections on readings showed strong identification: "I think this perfectly describes how I feel about maths – especially the tension". Identification is one of the stages of the bibliotherapy process. Shannon also commented that the findings of the readings were interesting and relevant, for example she identified with the reports of mathematics anxiety starting in primary school and related this to her school experiences.

An important part of the initial reflections on the readings revolved around the view of herself as a learner of mathematics that Shannon had developed during her schooling: "I've always been able to 'keep up' but not necessarily understand what I was doing", and "I found that if I understood a formula I was happy about my ability, but if I felt overwhelmed it would be because I wasn't good at maths".

Her preliminary comments gave voice to the concern of researchers to ensure that negative learning experiences will not reinforce negative beliefs and feelings about mathematics in the future students she will teach, and echo the concerns of teacher educators who identify this as an issue. A major concern was that she would "inadvertently pass on my fear and anxiety of maths to my students. I don't want them having the same negative experiences that I have had". During her presentation and discussion with peers, she again emphasised the strength of the concern she felt at the start of her practicum. "I was concerned that I would instill [sic] in students the same feelings about maths as what I have". This echoes previous research findings (Wilson, 2009), where teachers' comments reflect a concern for their students that negative learning experiences will not reinforce negative beliefs and feelings about mathematics.

The reflections on individual lessons indicated that her assessment of her feelings before the lessons stayed in the range from 6 to 8 ½, but that the level after the lessons had a much broader range, from 2 after the first lesson, rising to 8 ½, plummeting to 4 and then rising back to 8. Shannon commented that when she became flustered in lessons, the "lesson focus would change dramatically" and this lowered her assessment of her feelings after the lesson. She related this to her attitude. "If I felt confident before the lesson started, I most often felt good about it afterwards, however if I went into the lesson with a negative attitude, then I most often had negative feelings about that lesson afterwards". Her positive experiences increased her confidence that she would be able to decrease her level of anxiety. "I may even be able to change my negative attitude of this subject over time".

As the practicum progressed, the focus of Shannon's comments moved from reflections about her own inadequacy to the reassurance she felt when students

responded positively to the lessons. With each cycle of her action research, supported by the bibliotherapy process, the PST was able to develop greater insight, eventually leading to a more robust projection into her future as a teacher. "I found that acting confident in maths actually made me feel more confident and I was then able to more clearly convey the concepts".

It might take more time for some students to go through the stages of bibliotherapy, although it is important to realise that everyone is unique and there is no schedule for the process. Shannon reflected, "I know my anxiety about teaching maths has not disappeared". The positive impact of the experience is shown by her motivation to continue with more readings and reflections as she completes her course and begins teaching.

The final answers when the initial questions were repeated provided evidence that the she had shown an emotional response to the readings, had reflected on her own experiences and had engaged in some stages of the bibliotherapy process. Reflection on each lesson during the action research cycles resulted in considerable development of her ability to analyse and critique her own practice, and to improvements in her interactions with students.

Her reflection on her experiences was followed by a consideration of what it could mean for the future and the implications of her insights for her teaching. Her assessment of her increased confidence was authenticated for her by feedback from the class, which corresponded to her feelings about the lessons. In lessons that did not go well, she felt the class "was struggling to understand what I was talking about". However, as the action research cycle progressed and she was able to demonstrate more confidence, "the majority of the class said they felt better about the maths when I felt better about teaching it". Shannon projected herself more confidently into the classroom teaching situation and wrote about the importance of positive attitudes. As Carnellor (2004) writes, "Positive attitudes not only enhance the quality of learning, but also the degree to which learning and understanding become embedded in the real-life experiences of the individual" (p. 5).

The final answers and reflections demonstrate the potential of bibliotherapy to change the way PST feel, as the she summed up her experience by saying: "I believe my self-esteem has risen dramatically".

Conclusion

This research connecting bibliotherapy to cycles of action research is innovative as it brings together analysis of reflections of a pre-service teacher with a study of the beliefs, attitudes and insights that shape her mathematical identities. The juxtaposition of bibliotherapy with action research is potentially a powerful strategy in addressing mathematics anxiety in PSTs. Bibliotherapy, used as part of the process of action research, is able to address Ambrose's (2004) criteria for changing beliefs, as it can provide emotion-packed experiences, encourage PST to become immersed in a reflective community and connect beliefs and emotions, and teacher practice.

Supporting PSTs to develop reflective and metacognitive skills empowers them to take these skills into the classroom, and monitor and critique their practice. The special feature of the bibliotherapy approach of eliciting PST reflections stems from its ability to call forth cognitive responses paralleled by emotional responses.

The power of bibliotherapy, as exemplified in Shannon's action research, lies in the way that her cognitive responses were allied with emotional responses. It changed her understanding of her difficulties and anxieties in the mathematics classroom. Through this research she put her own experiences into perspective, developed enhanced self-images as a learner of mathematics, and changed her assessment of her capacity to learn and teach mathematics. As Wolodko, Willson and Johnson (2003) write "our challenge is to help pre-service teachers confront their past experiences and anxieties about teaching and learning of mathematics. If these are openly dealt with during their university education, fewer teachers may be content to teach just as they have been taught" (p. 224).

Bibliotherapy, allied with action research, provides a new framework that has much to offer. This offers another way that the bibliotherapy process could be incorporated into teacher education courses. It provides teacher educators with a shared language to talk about cognitive and emotional responses in terms of the processes of identification, catharsis, insight, universalisation and projection. Hence, it provides teacher educators and researchers with a framework and language for communicating research outcomes.

Finally, negotiating this issue has the potential to transform learning and teaching beyond that of the PST to the future students. Bibliotherapy allows PSTs to reconstruct their own experiences, and re-evaluate their identities as learners and teachers of mathematics, potentially affecting not only their current study but also their future teaching of mathematics and hence the attitudes of their future students. The potential exists for teachers who have gained insights through this process and, an understanding of the process during their training, to use their experience to help their students address and overcome their own mathematics anxiety.

References

Allinder, R. M. (1995). An examination of the relationship between teacher efficacy and curriculum-based measurement and student achievement. *Remedial and Special Education, 16*(4), 247–254.

Ambrose, R. (2004). Initiating change in prospective elementary school teachers' orientations to mathematics teaching by building on beliefs. *Journal of Mathematics Teacher Education, 7*(2), 91–119.

Ashton, P. (1984). Teacher efficacy: A motivational paradigm for effective teacher education. *Journal of Teacher Education, 35*(5), 28–32.

Australian Curriculum Assessment and Reporting Authority (ACARA) (2010) *Australian Curriculum Information Sheet: Mathematics.* Retrieved December 6, 2010, from http://www.acara.edu.au/verve/_resources/Mathematics.pdf

Bandura, A. (1994). Self efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of human behavior.* Vol. 4. New York, NY: Academic Press.

Baroody, A. J. & Costlick, R. T. (1998). *Fostering children's mathematical power. An investigative approach to K–8 mathematics instruction.* New Jersey: Lawrence Erlbaum Associates.

Boaler, J. (1997). *Experiencing school mathematics: Teaching styles, sex and setting.* Buckingham: Open University Press.

Carnellor, Y. (2004). *Encouraging mathematical success for children with learning difficulties.* Melbourne, Vic: Social Science Press Australia.

Furner, J. & Berman, B. (2005). Confidence in their ability to do mathematics: The need to eradicate math anxiety so our future students can successfully compete in a high-tech globally competitive world. *Dimensions in Mathematics, 18*(1), 28–31.

Gates, P. & Jorgensen (Zevenbergen), R. (2009) Foregrounding social justice in mathematics teacher education. *Journal of Mathematics Teacher Education, 12*(3), 161–170

Gee, J. (2001). Identity as an analytic lens for research in education. *Review of Research in Education*, *25*, 99–125.

Gibson, S. & Dembo, M. (1984). Teacher efficacy: A construct validation. *Journal of Educational Psychology*, 76(4), 569–582.

Hannula, M., Evans, J., Philippou, G. & Zan, R. (2004). Affect in mathematics education – Exploring theoretical frameworks. In M. Hoines & A. Fugelstad (Eds.) *Proceedings of the 28th annual Conference of the International Group for the Psychology of Mathematics Education* (Vol 1, pp. 107–136). Bergen, Norway: PME.

Hart, L. E. (1989). Describing the affective domain: Saying what we mean. In D. B. McLeod & V. M. Adams (Eds.), *Affect and mathematical problem solving: A new perspective* (pp. 37–45). New York: Springer.

Hynes, A. & Hynes-Berry (1986). *Biblio/Poetry therapy: The interactive process - A handbook.* St. Cloud. MN: North Star Press.

Leder, G. (2007). Beliefs: What lies behind the mirror? *Montana Mathematics Enthusiast, Monograph* 3, (pp. 39–50). Helena, MA: The Montana Council of Teachers of Mathematics.

Ma, X. (1999). A meta-analysis of the relationship between anxiety toward mathematics and achievement in mathematics. *Journal for Research in Mathematics Education, 30*(5), 520–540

Madison, S. K. (1997). Preparing efficacious elementary teachers in science and mathematics: The influence of methods courses. *Journal of Science Teacher Education, 8*(2), 107–126.

Morawski, C (1997). A role for bibliotherapy in teacher education. *Reading Horizons, 37*(3), 243–260.

Ricouer, P. (1994). *Oneself as other*. (Trans. K. Blamey). Chicago, IL: University of Chicago Press.

Salzman, J. Snodgrass, D. & Mastrobuone, D. (2002). Collaborative action research: Helping teachers find their own realities in data. *English Leadership Quarterly, 24*(4), 2–7.

Sells, L. (1978). Mathematics: Critical filter. *The Science Teacher* (Feb), 28–29

Shrodes, C. (1950). *Bibliotherapy: A theoretical and clinical- experimental study.* Unpublished doctoral dissertation, University of California at Berkeley.

Somekh, B. (2005). *Action research: A methodology for change and development.* Open University Press: Milton Keynes.

Stigler, J & Hiebert, J. (1992). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom.* New York: Free Press.

Tate, W. (1995). School mathematics and African-American students: Thinking seriously about opportunity-to-learn standards. *Educational Administration Quarterly, 31*(3), 424–448.

Thompson, A. (1992). Teachers' beliefs and conceptions: A synthesis of the research. In D. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 127–146). New York: Macmillan.

Walshaw, M. (2004). Becoming knowledgeable in practice: The constitution of secondary teaching identity. In I. Putt, R. Faragher & M. McLean (Eds), *Mathematics education for the third millennium: Towards 2010* (Proceedings of the 27th annual conference of the Mathematics Education Research Group of Australasia, pp. 557–563). Townsville, Qld: MERGA.

Wampold, B. (2001). *The great psychotherapy debate: models, methods, and findings.* Lawrence Earlbaum: Mahwah NJ

Wigfield, A., & Meece, J. L. (1988). Math anxiety in elementary and secondary school students. *Journal of Educational Psychology, 80,* 210–216.

Wilson, S. (2007). My struggle with maths may not have been a lonely one: Bibliotherapy in a teacher education number theory unit. In J. Watson & K. Beswick (Eds.), *Mathematics: Essential research, essential practice* (Proceedings of the 30th annual conference of the Mathematics Education Research Group of Australasia, pp. 815–823) Hobart, Tas: MERGA.

Wilson, S. (2009). "Better you than me": Mathematics anxiety and bibliotherapy in primary teacher professional learning. In R. Hunter, B. Bicknell, & T. Burgess (Eds.), *Crossing Divides* (Proceedings of the 32nd Annual Conference of the Mathematics Education Research Group of Australasia, pp. 603–610). Palmerston North, NZ: MERGA.

Wilson, S. & Thornton, S. (2008). "The factor that makes us more effective teachers": Two pre-service primary teachers' experience of bibliotherapy. *Mathematics Teacher Education and Development, 9,* 22–35.

Wolodko, B., Willson, K., & Johnson, R. (2003). Preservice teachers' perceptions of mathematics: metaphors as a vehicle for exploring. *Teaching Children Mathematics, 10*(4) 224-230.