

It's Only Maths: The potential impact of a mentoring project to ameliorate mathematics anxiety in teacher education students

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This paper presents initial data from a study being undertaken into the potential effects of a mentoring program for teacher education students who have self-identified as suffering from mathematics anxiety. The first phase of the study saw 8 primary teacher education students opt into a program matching them in pairs with 4 mentor teachers who had been selected by their principals after meeting 6 criteria that identified them as highly capable mentors in mathematics education. The mentees worked with the mentors in classrooms for 8 weeks. After the program the students were interviewed. Data from these students is explored here with particular emphasis on an artefact presented by one of the students about her journey through the process.

Introduction

With more than 15% of aspiring teachers not doing any mathematics for the Higher School Certificate (HSC) or equivalent (Smith, 2015), and with no specific mathematics pre-requisites for entry into a teaching degree in Australia, there is increasing concern about the mathematics content knowledge and teaching ability of our future teachers. As such, a large number of pre-service teachers (PST) lack sufficient content knowledge (Livy & Vale, 2011) and therefore cannot fully engage in teaching method units within their Education degrees, which are designed to explore strategies to teach mathematics content. This phenomenon can cause PST's to develop anxiety towards mathematics and ultimately dampens their confidence to teach mathematics in the classroom (Wilson, 2009). In a bid to address the low entry requirements into pre-service teacher programmes as well as the low levels of mathematical ability displayed by undergraduate teachers, the Board of Studies Teaching and Educational Standards (BOSTES) NSW have instituted a Numeracy and Literacy Test for Initial Teacher Education (LANTITE) as part of their *Great Teaching, Inspired Learning* initiative. It is BOSTES's intention that through passing this test, which is compulsory for all education students prior to graduation, that all "future teachers graduate with personal literacy and numeracy levels at least equivalent to those of the top 30% of the population" (BOSTES, 2016).

Whilst teacher education students frequently identify the practical experience in their Education degree to be the most valuable part of their education (Smith & Lev-Ari, 2005), they have often reported that participation and completion of their practicum does not always improve their content knowledge, skills, confidence or their ability to conduct effective mathematics lessons.

In agreement with others (Beswick, Ashman, Callingham, & McBain, 2011; Hudson, Skamp, & Brooks, 2005), the authors recently reported on a pilot mentorship program that connects highly skilled and qualified teachers with self-reported mathematically anxious PST's. The pilot study demonstrated anecdotal evidence of improvement in PST's anxiety, self-perceived competency and confidence to teach mathematics in the classroom (Perkins, 2015). In this study, we look specifically at the post-mentoring interviews from 8 of those

students.

The intention of this research is to develop an approach that will foster opportunities for university mathematics educators and school staff leaders to address issues of mathematics anxiety through a replicable mentoring programme intended to improve the confidence of teacher education students and ultimately, the quality of mathematics outcomes for the school students. There is great potential to harness the capacities and skills of expert teachers to mentor those entering the profession in a collegial, supportive and non-threatening environment. The research question being addressed in this aspect of the study is:

In what ways can a mentoring relationship outside of the professional experience block increase the confidence of pre service teachers who identify as suffering from Mathematics Anxiety?

Literature review

Mathematics Anxiety

Although there are many ways to define mathematics anxiety, they all share commonalities. For example, mathematics anxiety is defined by Wilson and Gurney (2011) as “a learned emotional response, characterized by a feeling that mathematics cannot make sense, of helplessness, tension, and lack of control over one’s learning” (p.805). Similarly, it has been defined as a combination of “debilitating test stress, low self-confidence, fear of failure, and negative attitudes towards mathematics learning” (Bandalos, Yates & Thorndike-Christ as cited in Brady & Alan, 2005). This suggests mathematics anxiety is a form of stress that manifests only in specific circumstances.

What these definitions share is a predication on the belief that mathematics anxiety indeed exists and that it is both debilitating for the sufferer in terms of being able to perform mathematical tasks and also that the mathematics anxiety regularly stems from a negative experience in mathematics class or more specifically a negative inter-personal experience with a mathematics teacher. (Perkins, 2015).

Professional Experience (Practicum)

The majority of PST’s consider their professional experience (also known as practicum or prac) as a major influence in their teacher training, and instrumental in shaping their overall teaching craft and perspective (Smith & Lev-Ari, 2005). In addition, there is evidence to support that PST’s who are exposed to longer practicums feel significantly more confident about their knowledge of students and how they learn, classroom management, and overall professional knowledge and practice compared to their peers who undertake a shorter practicum (Reynolds, Howley, Southgate, & Brown, 2015).

However, anecdotal evidence from students suggests that participation and completion of their practicum does not always improve their content knowledge, skills, confidence or their ability to conduct effective mathematics lessons. Indeed, studies have reported high variability in student learning during practicums, which is due to variation in quality and amount of feedback about their teaching, the quality of their personal reflection of the lessons, the cooperation of the supervising teacher and students, and the overall conditions of the practicum (Beck & Kosnik, 2002; Hascher et al., 2004). In addition, the variability in exposure to excellent mathematics teaching can also impact on PST’s perception of a quality mathematics lesson. These factors can propagate the limited capacities of PST’s, leading to poor teaching and impeded learning opportunities for their students.

Furthermore, the complex dynamics of practicums is often cited as a major cause of stress for PST's, which may hinder their learning (MacDonald, 1993).

In addition, as PST's are formally assessed on their ability to teach mathematics during their practicums, they are considered high stakes and thus few PST's are willing to reveal their mathematical weaknesses to their supervising teachers even though practicums are primed for resolving these limitations. Therefore, there is scope for mentorship programs which specifically aim to address PST's mathematical limitations in an environment which shifts the focus away from either assessment or evaluation of their performance and instead focusses on the learning aspect of mathematics teaching rather than on the teaching aspect.

Mentoring

Research has shown that mentors play a significant role in shaping pre-service teachers' practices (Hudson & Hudson, 2010). The desire to "influence the quality of pre-service teacher education" (Hudson & Hudson, 2010, p.1) is often stated as the reason why mentors choose to be involved in mentoring projects. Edwards (1998, p.48), suggests that "the role of mentor has considerable pedagogic potential for the development of pre-service teachers." Lennox, Skinner and Foureur (2008) highlight the need for the mentor "to put the mentees' interest in the foreground of the relationship" (p. 9). The ability of a highly capable mentor to reduce anxiety felt by a mentee, specifically in relation to a reduction in mathematics anxiety is an area worthy of further exploration.

The professional experience block is the main opportunity for teacher education students to be exposed to mentoring practices as a way of inducting them into the profession. Oddly, considering the importance of the professional experience block for the teacher education students, there is currently no mentoring preparation for the supervising teachers. As stated by Hudson and Hudson (2010), most supervising teachers receive no "professional development in mentoring to support pre-service teachers in the school context" (p. 5). This inevitably reduces the likelihood for mentoring of teacher education students into the idiosyncratic world of hit and miss.

On balance, "exposure to best practice in the teaching of mathematics by supervising teachers as well as support and opportunities to lead mathematics lessons in a structured, planned and non-threatening environment, is essential for pre-service teachers" (Perkins, 2015). One of the difficulties facing mathematically anxious pre-service teachers is that they are not always partnered with supervising teachers who have the capacity to diminish their anxiety through exposing them to engaging, challenging, creative and differentiated lessons taught in confident and pedagogically sound ways.

Methodology

A cohort of 309 third year students studying in a Bachelor of Education (Primary) program at a University in Sydney, completed a questionnaire exploring their thoughts and experiences as mathematics students at school and university. The questionnaire incorporated the Maths Anxiety Rating Scale (Richardson and Suinn, 1972) and concluded with a definition of Maths 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" (Wilson & Gurney, 2011) and a question for the respondents asking "Using the above definition, do you consider that you suffer from 'Mathematics Anxiety'?"

The respondents were then offered the opportunity to “opt in” to the study. If they opted in, the students then provided their contact details to be part of the mentoring project. Of the 309 respondents, 38.9% (n=121) responded that they felt they suffered from Mathematics Anxiety and 26 opted in to the study. From this, 14 were selected as being the most anxious, based on their response to the questionnaire and were offered a place in the mentoring project. Eight of these 14 students accepted and were placed in pairs in four schools.

The mentor teachers in the schools were recommended by their Principals based on the extent to which they met six specific criteria. The criteria came from an amalgamation of both Hudson and Skamp’s (2005) and Rogoff’s (1995) models for mentor selection, as previously described in Perkins (2015).

- **Experience** – a minimum of 5 years’ teaching experience
- **Professional Responsibility** – a desire to improve the profession by working with pre-service teachers to improve their ability to teach mathematics. A desire to read and learn from articles about mentoring best practice.
- **Mathematical Confidence** – a very confident disposition towards both doing and teaching mathematics based on a subject matter knowledge
- **Teaching Expertise** – a proven track record of successful maths teaching evidenced through positive dispositions of their own students towards mathematics, creative approaches, positive classroom environments, engaging lessons, differentiated opportunities for students
- **Appropriate personal attributes** – a demeanour appropriate for mentoring pre-service teachers who lack confidence in this subject. Characteristics such as: good listener and communicator, empathy, sense of humour, supportive, encouraging, ability to deliver feedback positively and constructively
- **Time** – A preparedness to plan and review lessons with the PST’s and to respond to their reflections of the experience.

Mentors were from Catholic primary schools in the Sydney archdiocese. They were nominated by their school principals according to how well they satisfied the six criteria listed above. The mentoring process took place in Term 4, 2014 and Term 2, 2015 with 2 PST’s working with 1 mentor teacher in their primary classroom for a 1hr Mathematics session once per week for 8 weeks. Where possible, the team of 3 met for approximately 10 minutes prior to and/or 10 minutes after each session to explore what would be happening in class that day.

The mentees used either a blog or a dedicated Facebook group to reflect on their experience each week. This also provided the opportunity for other mentees to comment on each other’s experience as part of a deliberately designed community of practice (Lave & Wenger, 1991). At the completion of the project, mentors and mentees completed a post survey and a semi-structured interview with the researcher.

Results

Although a number of themes emerged from this study through the student interviews, for the purposes of this paper we focused only on themes that addressed whether the mentoring program had any material impact on the level of mathematics anxiety experienced by the teacher education students and their level of confidence to teach mathematics.

The opportunity to witness an expert teacher actually teaching and to learn from them in a non-threatening environment and the opportunity to take that learning away, reflect on it and apply it to their own teaching seems to be fundamental in improving skills and confidence and thus reducing anxiety. Such a shift in this direction would act as evidence of the success of this trial. The personal characteristics of the mentors, with good communications skills, empathy and time being highly valued by the students, seem to also be fundamental to the students feeling more comfortable and confident to take steps on their journey of reducing their anxiety.

The reduction of stress and pressure and even expectation by not being on a course sanctioned professional experience appears to be one of the key factors as to why the students considered this program to be relatively more beneficial, when it came to the specifics of improving their ability to teach mathematics, than being on professional experience. The high stakes pass or fail nature of professional experience understandably appears to reduce the students' desire to take risks and really learn. They play it safe on professional experience, try not to disclose their lack of capacity and any underlying insecurities in relation to their mathematical abilities and as one student stated, "on prac I try to fly under the radar".

One of the students in the mentoring project, took it upon herself to write a children's picture book charting her own experiences as a student of mathematics from Kindergarten to year 12 and then as a teacher education student over the 4 years of her course. Her writing exemplified feelings and ideas that emanated from other students when they were interviewed after the mentoring program. Her thoughts and comments were shared vicariously via a character named Matilda in the book which she titled '*It's Only Maths*'. Matilda, in a sense was the "everyman" of the group as she represents both the anxieties shared by other students from the group interview of which the author was a part, as well as the growth in confidence discussed by many of the students.

As early as Kindergarten she refers to a "*feeling of heaviness*" when she was exposed to numbers. In Year Four she suggests that "*the words hate and mathematics always seemed to go together*". By Year 6 she refers to a cloud hovering above her in maths that was "*overwhelmingly big and dark*". She refers to the negative impacts of worksheets and textbooks and of the humiliation of being forced to recite times tables and having to stay in during breaks to complete unfinished work.

By Year 9 she refers to "*very intimidating*" teachers who "*threatened students to complete work under strict time limits*" and who would "*reveal student results from lowest to highest in front of the class*". By Year 11 she refers to the ever growing cloud hanging over her in mathematics as being 'black and immobilising'.

Once deciding on a career in teaching, Matilda, the character representing the author in the book finds herself enrolling in a mathematics unit at university and the experience causing "*a particular heaviness that was setting off alarm bells inside her*". Matilda was pleased to have been placed on a Year One class for professional experience as she felt that she could at least manage the mathematics content at this level. However, even this presented an uncomfortable situation, "*Matilda always learnt the Mathematics strategy the night before, ignoring the other strategies that the children offered. Any idea of spontaneity in mathematics brought with it a feeling of intense anxiety*".

The author refers to the anxiety she would feel during mathematics lectures and tutorials at University and how she would "*push it aside by filling her time with Facebook and online shopping*". It is this behavior that she says made her realise "*that she was hiding a deep, dark secret*" as she recognized that she had "*inadequate skills to be a great*

mathematics teacher". Matilda discovers that like her other anxieties, "*Mathematics anxiety*" was what was holding her back.

Matilda is offered the opportunity to join with a classmate and an expert teacher to challenge her feelings of incompetence and lack of confidence. The author states that "[*a*]s Matilda attended the eight sessions the feeling of the heaviness began to lift". Now she was thinking of the future but was still weighed down by a concern about "*whether her negative perception of mathematics would be passed onto her own classes. Matilda knew that she did not want future generations experiencing the same negativity that she had.*"

On her next professional experience in third year she says her "*anxiety was so high that her hands were shaking as she attempted to write strategies on the board*". However, as the professional experience progresses, she thinks more about her mentoring experience and "*she felt something switch inside her*". Indeed "*she started to have fun with mathematics*" with her students. By the time she returned to University for her final year of classes "*Matilda had feelings of excitement to see another Mathematics subject on her enrolment form*". On the final page, and with an illustration of an arrow pointing towards "a good future" Matilda states that "*it is not possible for one to live happily ever after with their Mathematics anxiety. The cloud will always be there but the individual chooses its size and impact.*"

Conclusion and Implications

Recognizing the impact of negative attitudes towards both the doing and the teaching of mathematics in teacher education students is a positive step in the direction of helping them to overcome the anxieties and concerns they feel. These anxieties are playing a significant role in perpetuating a negative cycle of mathematics teaching and learning which is affecting attitudes towards mathematics both within Australia and internationally. The fact that this negativity is not being discussed publicly and that teacher education students are "flying under the radar" so as not to bring negative attention to themselves whilst on their professional experience is of major concern. The initial highly positive results from this study, which the authors have begun to implement is very encouraging. Further phases of the study are continuing in 2016 and will hopefully meet with similarly positive results.

This paper has captured some of the shifts in affective response to confidence in relation to teaching mathematics by teacher education students as represented by the character of Matilda. The initial findings are in keeping with Sullivan's (2011) exploration of the value of teachers watching, critically reflecting and supporting each other - in his case as part of a project evaluating Japanese Lesson Study but also highly applicable here - as a way of developing profoundly valuable mathematics teaching approaches. As he states: "by building trust between teachers and emphasising an orientation to improvement as distinct from evaluation, this approach will result in powerful mathematics teacher learning" (p.59). His "teachers learning from teachers" approach can clearly be adapted to the researcher's teacher education students learning from the teacher's approach. As he goes on to state: "the principles of collaborative planning, with observation and review of the lesson rather than the teacher, can be effectively incorporated into the practicum experiences of prospective teachers" (p.60).

If all students could be matched with confident, expert teachers with a sense of professional responsibility, high emotional intelligence and the time to support teacher education students then perhaps a wedge could be driven into the perpetuation of a vicious cycle of negativity and lack of confidence that is currently present in a disturbingly high

percentage of our teacher education students and indeed classroom teachers in relation to mathematics.

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