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Threshold concepts and attitudes in mathematics education: Listening to students' past, present and projected stories

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Proposal:

The process of becoming a skilled and confident mathematics teacher can be strongly influenced by the teacher's attitudes to both mathematics and mathematics teaching (Johnson, Smith, & Carinci, 2010; Kargar, Tarmizia, & Bayat, 2010). Investigations into the attitudes of preservice teachers have shown that teachers' attitudes directly influence their teaching practices and, subsequently, their students' learning experiences (Prescott & Cavanagh, 2006; White, Way, Perry, & Southwell, 2005/2006). Teachers' understanding of mathematical content and concepts also impact on the quality of teaching. Hence, the identification of threshold concepts and attitudes associated with teaching mathematics can be beneficial to preservice teachers and their students.

By understanding the concepts associated with teaching mathematics to young children, preservice teachers come to transcend their lack of confidence about mathematics and grow to realise the value of purposefully applying mathematics to everyday life. Their perceived lack of competence in their own mathematical abilities can be transformed into an appreciation of how mathematics can be taught in an enjoyable and meaningful manner.

In the study reported in this paper, the researcher examined the threshold concepts and attitudes about mathematics and mathematics teaching held by two groups of preservice teachers who were enrolled in a first year mathematics education course as part of an undergraduate teaching degree. The course in which they were enrolled aimed to enable the preservice teachers to develop an understanding of the mathematical learning, understanding and attitudes normally experienced by young children aged from four to eight years of age. During the course, the preservice teachers were also expected to develop and demonstrate knowledge of the mathematical concepts relevant to teaching children of this age group.

Data were gathered about the preservice teachers' threshold concepts and attitudes. During 2012 and 2013, preservice teachers recorded narrative accounts of how they experienced mathematics and mathematics teaching in the past, how they were currently experiencing mathematics and mathematics teaching and how they expected to experience mathematics and mathematics teaching in the future. They also completed the *Attitudes to Mathematics and Mathematics Teaching Survey* (White et al., 2005/2006) to indicate their attitudes at the beginning and end of a semester period. Throughout the semester, the preservice students participated in a range of course-based activities in which the hands-on nature of teaching mathematics was demonstrated and experienced. The preservice teachers were guided through the process of designing learning activities for young children that were enjoyable, purposeful and engaging. Findings from this study indicate that the preservice teachers' fear and anxiety about mathematics decreased and their confidence about teaching mathematics increased by the end of the study. A range of threshold concepts and threshold attitudes were identified during the study. Furthermore, the findings were used to further develop the design and implementation of mathematics courses within three teaching degree programs.

As well as influencing the teaching context in which this study was conducted, the findings of this study contribute to our understanding of both threshold concepts (Meyer & Land, 2003) and threshold attitudes in teacher education contexts.

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