Attitudinal Shifts Towards Mathematics of Preservice Teachers

Janette Bobis and Robyn Cusworth

Faculty of Education

University of Sydney

This paper reports on the qualitative data gathered during the initial phases of a longitudinal investigation into the attitudes of preservice primary teachers towards mathematics and toward the teaching of this subject. It provides a more wholistic perspective on the change process by employing multiple data gathering techniques, thus allowing the researchers to focus on the underlying reasons for attitudinal shifts.

Literature on the impact of professional courses on preservice teachers' attitudes toward mathematics highlights the difficulty in overcoming ingrained notions developed during previous school experiences (Sullivan, 1987). Researchers seem to be in agreement, that if we desire to effect change in preservice teachers' attitudes, professional courses must be structured to cause our students to reflect upon and reconsider existing attitudes (Bobis & Cusworth, 1994a; Wilcox et al., 1991). While such studies have reportedly met with some degrees of success, as indicated by traditional quantitative and qualitative data gathering techniques used prior to students' commencement of the course and then again at its conclusion, it is also desirable to monitor the actual change process as it occurs via reflective journals, on-going interviews and observations of their practice teaching. Multiple data gathering techniques provide a more wholistic perspective on the change process, allowing the researchers to focus on the underlying reasons for attitudinal shifts.

This paper provides an update of a longitudinal research project begun in 1993 and reported at previous MERGA gatherings and in research journals (Bobis & Cusworth, 1994a; 1994b). The original aim of the project was to 'investigate the attitudes of two groups of preservice primary school teachers toward mathematics and toward the teaching of mathematics as they begin their teacher education. ...to monitor these attitudes as the students progress through their respective teacher education programs...and to follow these students into their first years of their teaching careers' (Bobis & Cusworth, 1994a, p. 115). Data gathered via the questionnaire for stages one and two have been reported elsewhere (see Bobis and Cusworth, 1994b). Hence, this paper focuses on the qualitative data gathered from initial interviews conducted in 1993 and from reflective journal entries made by preservice teachers during 1994.

Method

Participants

Participants were preservice primary-school teachers enrolled in the Diploma of Education (DipEd) program and the 1993 cohort of the Bachelor of Education (BEd) program at the University of Sydney. While 138 students responded to the questionnaire in the first stage of the study, 22 (8 DipEd and 14 BEd) students were selected for follow-up interviews in subsequent stages.

Materials

Data was collected via multiple techniques: an initial questionnaire, survey and interviews provided baseline profiles of students, while the reflective

journals of BEd students provided evidence of possible changes in attitudes during the first professional course in mathematics education. During future stages of the study it is intended to include observational data from practicum experiences to explore whether attitudinal changes transfers to classroom practice.

Interviews were conducted with students who were shown by the questionnaire to have extreme attitude and self-concept profiles. Students were interviewed from the following categories: high self-concept for mathematics and/or science; low self-concept for mathematics and/or science; high attitude toward the teaching of mathematics and/or science; and low attitude toward the teaching of mathematics and/or science. The interviews included open-ended questions that were intended to probe for deeper understanding of the developmental experiences that are associated with attitudes toward mathematics and science/technology. The general area of investigation included: personal beliefs about the nature of mathematics and science and the use of technology as an aid to teaching these subjects; the formation of mathematics and science self-concepts; and the nature and quality of preservice teacher training and the possible implications for fostering desirable attitudes toward science and mathematics.

Procedure

Stage one of the investigation began in February 1993 when the questionnaire and general background information survey were administered to DipEd and BEd students prior to the commencement of their respective professional teacher education course components. Self-concept and attitude profiles were compiled from the questionnaire data for each participant. Students identified with extremely positive or extremely negative profiles were invited to be interviewed in the last few weeks of semester one. A total of twenty-two interviews were conducted at this stage.

Stage two of the investigation only involved DipEd students as they responded to the questionnaire at the completion of their teacher training.. Results of this stage have been reported elsewhere (Bobis & Cusworth, 1994b) and will not be referred to here.

Stage three began in February 1994 and involved only BEd students as they embarked on the first professional course component in their program. This component consisted of an introductory mathematics education course of 13 weeks duration. Each student was required to compile a journal based on weekly reflections after attending a lecture, tutorial and completing selected readings. This paper focusses on trends in the interview and journal data.

Results and Discussion

A number of themes emerged from our initial analysis of the interview data that were also identified in the reflective journals. Five significant themes have been selected for presentation and discussion here. These themes were labelled generally as (a) perceptions of mathematics, (b) the role of significant others in attitude formation, (c) differences in perceptions of real maths/school maths, (d) confidence vs perceived ability, and (e) attitude toward technology. The following table presents excerpts from the interview transcripts and journals to illustrate each theme. Juxtaposing excerpts from the two columns - interview and reflective journal - often reveals the shifts in attitude that occurred for the majority of students.

Theme	*Interview*	*Reflective journal entry*
(a) perceptions of mathematics	*my attitudes are pretty poor...like I don't enjoy it (Malcolm - DipEd: low)* *...it scares me. 'Cos I've never been very good at it (Helen - BEd: low)* *Numbers...Yeah, just numbers. sums and things like that and questions like problems... (Ronda - BEd : High)*	*In our tutorials we were asked to draw a picture of what we thought of maths, mine shows the standard boring classroom.....I had no confidence in maths. In fact I can honestly say 'I hated it!!!' (Ellie: Week 1)* *If I try to reflect on maths not once did I link concepts or find relationships, rather I learnt rules. (Jacqui: Week 4)* *When I was at school, I saw mathematics as an irrelevant, illogical subject. In primary school, I thought that I enjoyed mathematics, but what I really enjoyed was the fact that I could automatically complete a mathematical operation and attain the correct answer, before many of may classmates. Looking back, I didn't really understand what I was doing, I just knew how to do it. (Stephanie: Week 1)*
(b) the role of significant others in attitude formation	*I always remember when I was doing fractions...I remember the teacher. I can see his face... so impressive - man! He...intimidated me badly and I couldn't grasp this concept.. (Malcolm-DipEd: Low)*	*The greatest influence on my ability to enjoy mathematics...was my grade six teacher. She taught us to work through our math problems and use other means of working out problems other than our fingers and toes. (Ellie: Week 1)*
(c) differences in perceptions of real maths/school maths.	*When it comes to thinking about maths doing finance and how to shop ...I just do that fine. I don't have a problem with that..like take my taxation... I have no fear of that. ...as to structured maths, my attitudes are pretty poor. Like I don't enjoy it and I don't like the way it was taught... I always found it to be a negative experience so my attitude is a negative one* *I enjoy finding out what's cheap on the shelves and from brand to brand...I like it (Malcolm - DipEd: low)*	*Before, (I am ashamed to admit) I read these articles, I would have considered play a waste of time... Now I know that it can be integrated into a lesson to make it more enjoyable for the students - I hope that I can achieve this in my maths lessons. (Ellie: Week 2:)* *My curiosity and interest was also sustained when mathematical problems were associated with real life problems. (Katrina: Week 2)* *So many times I heard myself and my peers wondering out loud when we were ever going to use such things as integration once we had left school. (Katrina: Week 7)*

Theme	*Interview*	*Reflective journal entry*
(d) confidence vs perceived ability	*If you're not confident you can't do it properly (Jenny - BEd: High)* *To young children I'll feel very confident (to teach maths)* *I won't be worried about teaching maths...especially in the primary school (Peter - BEd: High)*	*These articles made me realise that I need lots of activities to help me teach maths - it made me feel really incompetent and inexperienced. (Ellie: Week 7)* *I am going to teach myself the proper way to do fractions, so that I can teach my students. ...I have realised from this reading and primary maths 1 lectures and tutorials that I need to do a lot more work on developing my own fraction skills, to be able to teach it effectively. (Ellie: Week 12)* *I will have to develop my skills to involve all methods of computation equally. I think this will be hard as I am not very experienced, especially in mental and calculator computation. (Jane:Week 2)*
(e) attitude toward technology	*...calculators, I don't think they should be used in primary school. ...losing those skills to process information and think about what you're doing...keep calculators out of primary school. And I can't really say about computers because I have never had any experience with them at all. (Helen - BEd: Low)* *...have it because obviously it's going to be part of life...but to limit it ...With a computer they are relying on the computer's power and they're not thinking for themselves.(Helen - BEd: Low)* *...I think sometimes kids today know about computers. I don't know. I think it's really good that they understand the concepts before they actually get hold of something that does it for them. (Mary - BEd: Low)*	*One aspect which came up in our tutorial which I am not too sure about yet and tend to disagree more than agree with is the use of calculators in elementary maths. (Jane: Week 1)* *My attitude prior to Maths 1 was that, students in primary school should not at all use calculators...but my attitude now is totally in reverse, and I can see the usefulness of calculators from kindergarten. (Jane: Week 9)*

The interview and journal data illustrate the restricted perception many students have of mathematics regardless of their high/low profile. Students identified as having either high or low attitude and self-concept profiles defined maths in terms of numbers, problems and consisting of rules and procedures to be memorised. An overwhelming majority claimed that they took mathematics in their senior years of high school because they considered it important to career prospects and entry into tertiary education - despite the fact that they may have hated it. Even students with positive self-concepts reported that they often did not understand what they were doing in mathematics but because they had learnt the rules they considered themselves, and were considered by

others, to be good at maths. They reported that the reinforcement received from their ability to get the 'right' answers fostered the development of positive attitudes toward the subject.

Journal entries, however, revealed that many students who were good at maths had never realised that mathematics was intended to have meaning in rel-life situations. The realisation that mathematics should be meaningful to young children had a significant impact on the entries students were making in their reflective journals. For instance, students identified as having both positive and negative self-concepts of mathematics reflected on their own understanding of the subject and vowed to teach children so that they might understand mathematics and not to teach the way they were taught. While interpretation of journals read by lecturers must be interpreted carefully, writing in this vein would not have advantaged students in any way.

The data clearly indicates the impact teachers and parents have on the attitudes and self-concepts of students towards mathematics. It was reported often that students could remember distinctly a teacher who had either a positive or negative influence - the more traumatic being remembered and reported more vividly. The frequency with which such traumatic experiences were recalled, seemed to have had a longer-term impact. Students who recalled teachers or parents who had had a positive impact on their attitudes toward mathematics were often praised because they helped them understand what they were doing - possibly giving students some intrinsic reward and 'boost' to their confidence.

The distinction between maths done at school and real-life maths figured prominently in interviews and reflective journals. Students identified as possessing both positive and negative attitudes toward mathematics indicated that they were more interested and understood content better when it was related to real-life problems.

An important implication can be derived from this evidence for teacher education programs. A potential avenue exists for improving attitudes toward the teaching of mathematics during a teacher's preservice education. it is suggested that significant others (university lecturers or cooperating teachers on practicum) can play an important role in helping students confront their own understandings of and attitudes towards mathematics and then think explicitly about alternative ways to teach it.

Of most interest was the fact that, despite students' admissions to not understanding mathematics (whether they were good at it or not), all students interviewed displayed remarkable confidence in their ability to teach mathematics at the primary level. The main reason being that it was all 'pretty basic stuff' at that level. Journal entries revealed, however, that once the importance of teaching for understanding in mathematics was recognised, they were much less confident and expressed commitments to improve their own knowledge before teaching primary school children.

Attitudes to using calculators

The fact that every student interviewed expressed negative attitudes toward the use of calculators in primary schools before they started their professional teacher education is indicative of the general community and reflects the lack of, or limited nature of, their personal experiences with such technology. Many students commented on the way they used calculators at high school and seemed unaware of any benefit it might have to the development of mathematical ability. Without exception, students were concerned that calculators would stop children thinking. Reflective journal entries, however, reveal attitudinal shifts during the course of their initial mathematics education course indicating

the positive impact such instruction can have. Computers were also frequently attributed with stopping children from thinking and interfering with their socialising skills, but unlike calculators, were considered a necessary evil and a fact of life. While students felt confident they could teach children how to use a calculator if necessary, few expressed the same confidence about computers. The greatest fear being their own lack of experience and expertise and the belief that the children would know more than them. While computers were not treated in the first component of the BEd program, they figure prominently in the third year of the mathematics program and again in the science and technology component undertaken in the fourth year. It will be of interest to compare changes in attitude toward technology of the BEd students with those in the DipEd program who only had a few hours of instruction on computers and who still expressed great reluctance to use them in teaching even after their teacher education had come to an end.

Summary and Conclusions

While the BEd students have only completed the first component of their professional education program, reflective journal entries already indicate at least short-term shifts in attitude, with many students stating a commitment not to teach the way they were taught. As the investigation moves into its third and subsequent years, these commitments can be further explored when observational data is gathered during practicum and field experiences.

Finally, a more wholistic perspective on the change process is gained when multiple data gathering techniques are employed. The interview and journal data reported in this paper not only confirm the conclusions drawn from the quantitative methods that have been reported elsewhere they also allow the researchers to focus on the underlying reasons for attitudinal shifts and provide a richer source of data from which teacher educators might derive possible implications for fostering desirable attitudes toward mathematics and technology.

References

Australian Education Council (1991). A national statement on mathematics for Australian schools. Carlton, Victoria: Curriculum Corporation.

Bobis, J. & Cusworth, R. (1994a). Teacher education: a watershed for preservice teachers' attitudes toward mathematics. In G. Bell, B. Wright, N. Leeson, & J. Geake (Eds.). Challenges in Mathematics Education: Constraints on Construction. Vol. 1, (pp. 115-120). MERGA: Lismore.

Bobis, J. & Cusworth, R. (1994b). Changing preservice primary teachers' attitudes toward mathematics and science/technology, Forum of Education, 49, 2, 9-20.

Sullivan, P. (1987). The impact of a pre-service mathematics education on beginning primary teachers. Research in Mathematics Education in Australia, August, 1-9.

Wilcox, S., Schram, P., Lappan, G. & Lanier, P. (1991). The role of a learning community in changing preservice teachers' knowledge and beliefs about mathematics education, For the Learning of Mathematics, 11, 3, 31-39.