Issues in Teaching Mathematics to Aboriginal Students

Peter Howard
Australian Catholic University
p.howard@mary.acu.edu.au

Bob Perry
University of Western Sydney
b.perry@uws.edu.au

This paper reports on the espoused views of a group of primary teachers as they discuss issues related to the teaching of school mathematics to Australian Aboriginal students. They believe that their teaching is significantly affected by trying to program and cater for the wide range of abilities, the amount of mathematics content to be covered and the lack of teaching time. They report a lack of teacher education preparation for teaching mathematics across ability groups and the difficulty of inventing appropriate teaching strategies to meet the learning needs of Aboriginal children.

Australian Aboriginal people continue to be the poorest, most incarcerated, most unemployed and least educated people in Australia (Kemp, 2001). Aboriginal students continue to achieve lower educational levels than those of other Australian students (NSW Aboriginal Education Consultative Group Inc./NSW Department of Education and Training, 2004). Over the last 20 years, "there has been little improvement in the educational outcomes for Aboriginal students" (Cavanagh, 2005, p. 285).

In NSW primary schools, Aboriginal students meet the mathematics derived from the state syllabus (Board of Studies, NSW, 2002) with the assistance of their teachers. Most of these teachers in NSW are non-Aboriginal. While this is not, of itself, a cause for concern, there is the potential for cultural conflicts in terms of the understandings and views of the Aboriginal students (and their families) and those of the teachers (Howard, 2001; Matthews, Howard, & Perry, 2003).

The view that mathematics and mathematics learning is context and value-free in its nature, content and practice has been long challenged (Barton, 1992; Bishop, 1994) with the acknowledgment that the continuing evolution of mathematics takes place in socially and culturally laden contexts (Zevenbergen, 2003). Sfard and Prusak (2005) suggest that learning is a process of sociocultural interaction. School mathematics is constructed in a social context governed by rules. These rules reflect the social and cultural rules of the wider society as interpreted by the individual classroom teacher. School mathematics, though taught within social and cultural practices, may not acknowledge the mathematics of the student's cultural origins. "The 'one mathematics' curricula common in our schools must be seriously questioned because it limits the possibility of mathematics" (Barton, 1992, p. 9). Teachers need to acknowledge the social and cultural contexts in which learning takes place. They have to appreciate the learning environment through the eyes of the learner and thus begin to develop a curriculum that results from negotiation between students, teachers and community. This is particularly so for Aboriginal students placed in classrooms with non-Aboriginal students (Howard, Perry, Lowe, Ziems, & McKnight, 2003; NSW Aboriginal Education Consultative Group Inc./NSW Department of Education and Training, 2004).

Teacher beliefs about mathematics, mathematics learning and mathematics teaching play a critical role in determining how teachers help their students develop their mathematics (Pajares, 1992; Schuck & Grootenboer, 2004). A number of researchers have linked the success, or lack of success, of reform movements in mathematics to the efforts to adequately address teacher beliefs (Battista, 1994; Beswick, 2005; Stipek & Byler, 1997).

Hence, it is appropriate when considering the mathematical learning and teaching of Aboriginal students in primary classrooms to study the beliefs of the teachers in these classrooms. Thus, this paper considers the question, *What do teachers believe to be the important issues in teaching mathematics to Aboriginal students?* In considering this overall question the following sub-questions provide the foci of this paper:

- Is teaching mathematics to Aboriginal students different from teaching mathematics to other students?
- What impact does the context of the lives of the Aboriginal students have on the teaching of mathematics?

Methodology

Data for this paper were collected as part of a 9-month ethnographic study involving Aboriginal students, their parents, Aboriginal educators and non-Aboriginal teachers living in a remote rural community in New South Wales, Australia (Howard, 2001). The levels of cultural sensitivity, awareness and knowledge of the people processes required to maintain effective ethnographic research in this specific context required the author to relate to Aboriginal and non-Aboriginal people, to appreciate the contextual social and cultural factors and to develop mutual trust and respect with the participants over time. The study investigated the espoused beliefs about the nature and learning of mathematics stated by Years 5 and 6 teachers in a primary school in Tremayne, a farming town dependent upon wool, wheat and cotton. The town's population comprised significant numbers of Aboriginal and non-Aboriginal people. Tremayne has a history of recurring conflicts between these two groups. Ellen Road Public School was a two-stream primary school, with a staff of 19 teachers (18 non-Aboriginal; 1 Aboriginal) and an enrolment of 412 students, 32% of whom were Aboriginal. The school had three Aboriginal Education Assistants with specific roles and responsibilities in Aboriginal education. Over a period of 6 years, the lead author had established significant levels of trustworthiness within the school and community through acknowledging and following appropriate negotiation and consultation protocols in undertaking the research.

The author had worked in the school for 5 months both as teacher and researcher and established effective inter-personal relationships with staff, students, Aboriginal parents and community. Conversational interviews were held with all participants ranging from 30 to 70 minutes to enable the teachers to address all issues they wished to raise. The teacher interviews reported in this paper involved the five teachers on Years 5 and 6, all of whom were non-Aboriginal. The interviews were then transcribed by the author. Sixteen categories of responses were determined and analysed using a grounded theory approach (Glaser & Strauss, 1967). For this paper, one of the categories—the teaching of mathematics—is considered from the perspective of the teachers. Pseudonyms have been used for all participants and locations.

The Teachers

Mrs Cotter had been teaching at Ellen Road for the previous 6 years. For the last 3 years she had taught the highest streamed Year 5/6 mathematics group which, at the time of the interviews, consisted of 34 children, one of whom was Aboriginal. Mrs Cotter was born in Tremayne and, after completing her teacher education, returned to teach in Tremayne.

Mrs Allan was the Assistant Principal at Ellen Road Public School. She, too, had been born in Tremayne and left to do her teacher education before returning. Mrs Allan taught the second streamed mathematics class comprising Year 5 and 6 students. There were seven Aboriginal children in the class - five girls and two boys.

Ms Martin had been at Ellen Road Public School for 7 years. Ms Martin taught the Year 6 mathematics class comprising those students deemed to be in the middle ability range. Of these, eight were Aboriginal — four girls and four boys.

Mr Kennedy had been appointed to Ellen Road Public School the previous year as a new graduate. He had grown up in Sydney, and Tremayne was his first experience of living in a rural community. Mr Kennedy taught the Year 5 mathematics class comprising those students deemed to be in the middle ability range, ten of whom were Aboriginal - six girls and four boys.

Ms Jones was a full-time casual teacher teaching the mathematics class comprising the lower ability Year 5 and 6 children of whom 12 out of 25 were Aboriginal - five girls and seven boys.

Results

The category 'teaching of mathematics' identified comments related to the organisation and presentation of teaching and learning activities. The following selection of comments from the teachers is representative of the comments made which were categorised under 'teaching of mathematics'. The comments have been grouped into sub-categories for ease of presentation.

Teaching Aboriginal children mathematics

Mr Kennedy did not believe that Aboriginal children should be taught any differently from other children. All children, no matter their colour, were to be taught in the same way.

> *Mr KENNEDY: I don't have any problems with that. I just teach kids and if they pick it up they pick it up no matter what colour they are. But there are issues that are hanging around that we teach Murris [Aboriginal people from the local area] differently. I'm not a great believer in that.

Ms Martin speculated on the links between Aboriginal children's learning and their relationships with mathematics, although she did not see this as something specific to Aboriginal children.

> *I: You're the first to mention that relationship difficulty with learning maths [for Aboriginal students]. Does that happen with other kids in the class?

> *Ms MARTIN: It would have to, especially the children from average down who are negative in themselves in a lot of ways. They are negative to learning. I think you have to have problems. Those above should have the initiative and outlook to learn. I'm sure there are kids that go into a teacher's class and don't ever improve and next year they can get a different teacher and just go zoom.

Mathematics teaching

Mrs Cotter thought that at the school there had been a push to improve student achievement in mathematics over the last few years. She liked teaching mathematics but expressed her personal difficulty in not understanding why children did not understand.

> *Mrs COTTER: I like teaching maths. I like it because it's logical. I like the English side too but I find maths really logical. Probably where I have the most trouble is that I don't understand why

kids don't understand it. I think that's why they slotted me into the upper strand.

Mr Kennedy was concerned for what his students would have learnt by the end of the week. He was also concerned about his teaching performance as measured by what the children in his class learnt each week.

*Mr KENNEDY: It's a major concern of mine that at the end of this week, are the kids going to know the things that I've been telling them? Have I been successful? I think they'll have an idea but I don't think they'll be able to do it.

*I: Perhaps you're being hard on yourself and what you have to say is, "What do they know?"

*Mr KENNEDY: If I've been trying to teach kids for a week and they have no idea, after a week, I've failed to some degree. I haven't done my job and, as a beginning teacher, I think to myself that I bet someone else could have taught them. It could have been done. How could I have done it?

Mr Kennedy saw his main task as getting the children to listen during mathematics lesson.

*Mr KENNEDY: I liked mathematics at university and teaching last year made me enjoy it cause I could go off on tangents and do extension work. We could do real life situations and it sunk in really quick. They were all bright eyed and they understood and that made me enjoy teaching maths as well. This year I came in with a fairly positive attitude towards it [teaching] and so that's helped me survive a bit. Ten minutes of each lesson would be on "This is how you do it" or "Listen to this person and let them tell you how to do it", or just listening and being shown what to do. The biggest thing for me is to just get people to listen.

At times, Mr Kennedy believed himself to be a failure as a teacher.

*Mr KENNEDY: I'm not always a failure. But there is a point. There are good and bad teachers and the kids in the class learn things and if some of the kids in my class don't learn anything then I have to question myself.

Mr Kennedy believed mathematics was more about thinking and reaching the right answer than having neatly completed work.

*Mr KENNEDY: Because most maths is more thinking about it. Forget how neat it is as long as you have the right answer or as long as you're thinking in the right way. For me a big push in mathematics is not to have it neat, whereas in writing you have to be able to read it so it has to be good.

Ms Martin discussed how much the children had written in mathematics this year.

*Ms MARTIN: I haven't had kids write things down in maths this year though we discussed what we've done to see what they've retained. I tried it one year and I found that the kids who could write and being grouped that year in ability levels the bottom group couldn't do it. The other thing is that you don't always have the time to do it.

For Mr Kennedy time was a constraint on the variety of teaching strategies that he incorporated into his mathematics classroom. He would try group work and he knew the value of the children using materials in their mathematics learning but did not use them because of time pressures to cover the mathematics content. Mr Kennedy gave an overview of the way that he approached his teaching across one week when the topic of 'area' was the focus.

*Mr KENNEDY: Sometimes I do it as a group session and then they're listening and showing and improving their knowledge or proving what they thought. It's maybe more enjoyable and more interesting for them. That's why I do it that way but I don't know. It seems to me from university too much of it was just give it all to the kids and let them decide what to do with it and if they come across it well they would. There was never a question that they would not. They will eventually get to where you want them to get by giving them materials and that. But I don't have any time for that at all I'm afraid.

Mrs Allan reflected on her school days and the place of tables drill stating that, *"I think that if it worked for me it will work for other people. I mean we probably had the threat of death over us."* Mrs Allan presented a perspective of 'generational change' to the discussion. Mrs Allan had been teaching for 24 years and talked about the changes in teaching across that time. She believed that children had lost their innocence through the impact of technology, particularly television and video. These changes had implications for teaching mathematics. She believed that, though she liked teaching, she would not recommend it to anyone as a career because teaching was much harder now than when she first started.

> *Mrs ALLAN: It might be more fun now but we're catering for all the different personalities. When I first started you just taught the class and everyone did the same sort of thing. We have all different levels of ability in our classrooms and we've taught kids to be outspoken and stand up for their rights and they're more aware of everything that goes on. There's hardly any naive kids anymore. They have to be streetwise to be aware of stranger danger. You'd like them to be innocent and be children but then you have to prepare them for all the things that happen now. And they see everything on TV and video.

Teaching a wide range of abilities

Mr Kennedy had some misgivings about what he had experienced in mathematics education through his teacher education program. It had not prepared him for the range of ability that he experienced in his mathematics class. In the previous year he had taught a higher mathematics class but the range of ability levels in this lower mathematics class had presented new problems for this teaching.

> *Mr KENNEDY: That's the difficult part isn't it, covering the range? Yeah I must say that's my biggest shock this year. Last year having the top class where everyone wanted to learn and everybody tries their hardest and didn't take that much to pick up on things. Anyway to this year where you've got the whole range from the bottom up to a bit over half and those top kids who finish faster and pick things up quicker than others, to those who don't listen and are behaviour problems.

Ms Jones, too, had difficulty programming for the range of children's mathematical ability levels in her class.

> *Ms JONES: I get a bit stuck with the ones that finish quickly and get it straight away. I had to move one kid out. What I normally do is put them to use like "I want you to sit next to…" or I send them around marking. It is hard. I tried it once to split them up into ability groups but it was really hard to keep getting round to them all.

Ms Jones' taught the lowest Year 5/6 mathematics' class in which 12 of the 24 children were Aboriginal. She had difficulty finding mathematics problems appropriate to the children's ability level. The wide range of the Year 5 children's mathematical ability also influenced Mr Kennedy's teaching.

> *Mr KENNEDY: I like to think that I can explain it as simply as I can so that some amount of it will sink in. I spend extra time with those who are having trouble during the course of the lesson. There are kids where I could say, "This is how you do it. Go and do it," and leave them for a week doing worksheets and have them know exactly what I want them to know without even coming to see how they went. Then there are those who don't have a clue unless I'm one on one and they're forced to think because they're thinking of what they're going to do when they get home.

Ms Martin thought that her mathematics lessons should include extension work, some fun and review of work covered. These were issues related to meeting the individual mathematics learning needs of the children as a result of the wide range of ability levels within her class. She identified some of the pressures that she felt as a teacher of

mathematics, particularly the belief that there was now more content to teach than before.

> *Ms MARTIN: There's so much to cover. The wide range of kids and I suppose the parent expectations of where they think the children should be at. The only thing that I see is that the children in Year Two this year when they get to Year Six hopefully the range won't be that wide. They would have used a lot more materials because they've only arrived in the last few years. We seem to have more of it and more children can get to it and hopefully you'll be able to get through more.

The reality of teaching mathematics and addressing adequately the individual needs across the range of children's mathematical abilities was something that Mr Kennedy believed he was not doing well. He had had to adopt and invent teaching strategies to cope with the reality of everyday teaching when he did not believe he had the time available to do everything that he was required to complete.

> *Mr KENNEDY: …it just seems to me that having to fit in all the other things as well that I haven't got the time that they are saying that you need for mathematics. I just don't have it so I had to adopt other ways to teach it. I haven't invented them all myself by any means.

Mr Kennedy was unsure if he was supporting the 'bottom kids' in his mathematics class. He did not think that giving children materials, asking them to discover and then to write down what they had found out helped the 'bottom kids'.

> *Mr KENNEDY: I like to think I give the bottom kids more help or explain it to them at the start so they understand it but I don't know if I always succeed in that. I don't think giving them all the materials and saying what do you notice and leave them to it for forty-five minutes and then getting them to write down what they noticed is going to help the bottom kids a great deal.

Discussion

The teachers at Ellen Road Public School have worked in a context where 32% of the 412 students in the school are Aboriginal. The length of time in which they have worked in this context ranges from 1 to 7 years. As well, two of the teachers grew up in Tremayne. It was well known by all teachers at Ellen Road Public School that the researcher was focusing on the mathematics learning of Aboriginal students. He had made presentations to staff meetings and parent groups. He had been present in the school for at least four months interviewing Aboriginal children and their parents before the teacher interviews reported in this paper were conducted. In spite of this, the teachers focussed their attention upon the curriculum issues of teaching mathematics content and the classroom issues of managing the ability range and endeavouring to involve the students in learning mathematics with a focus on explaining and having the children listen.

Despite the obvious presence of a substantial number of Aboriginal children in the school and the teachers' mathematics classes, Aboriginal children are virtually invisible in the comments the teachers have made about teaching mathematics. The same teachers made very few specific comments about Aboriginal children's learning of mathematics (Howard, 2001) but these are not referred to when the discussion moves to the teaching of mathematics. These teachers had a range of teaching experience, they were aware of the Aboriginal population in the school but did not talk about it in the context of teaching mathematics. These data suggest that the poor mathematics learning outcomes reported for Aboriginal students in Australian schools (NSW Aboriginal Education Consultative Group Inc./NSW Department of Education and Training, 2004) could be linked to the lack of teacher appreciation of the presence of Aboriginal children in mathematics classrooms and what this presence means for the provision of relevant and appropriate teaching-learning

activities that support the children's cultural and learning needs.

Even though they were teaching in streamed classes, the Tremayne teachers believed teaching to be harder now than it had been previously because of the children's wide range of mathematical ability. They perceived that they had not received sufficient teacher education preparation for teaching mathematics across such a wide range of ability nor for inventing appropriate teaching strategies for these children in their classes, including Aboriginal children. Teaching mathematics, managing students and accommodating the learning needs of Aboriginal students is difficult and complex. Teachers have to know their mathematics and be quality teachers whilst knowing, appreciating and accommodating the cultural issues within their mathematics classrooms.

Mathematics lessons in which students share in discussions, undertake collaborative work, value each others' ideas, experience relevant community-based mathematics activities and are encouraged to use their cultural and language resources to solve problems provide purposeful mathematics learning for Aboriginal students (Howard, 2001). However, teachers cannot be expected to devise appropriate educational programs for Aboriginal students on their own. Teachers and educational systems need to listen to and take direction from Aboriginal people to appreciate and come to know the contexts in which Aboriginal students are living and learning. Community partnerships need to be reflected in mathematics teaching and change has to be a whole school and community effort (Howard et al., 2003). When it comes to the development of mathematics curriculum, systems need to enact this collaboration by developing documents through community partnership and shared ownership. If collaboration and change are to occur then the voices of parents, teachers and Aboriginal children have to be engaged (Matthews et al., 2003). Meaningful curricula have to be developed "if for no other reason than we need to break the cycle of school being a place of failure for young Indigenous people" (Buckskin, 2001, p. 10).

Conclusion

Teachers need to regularly and systematically critique their mathematics teaching in order to appreciate the particular learning needs of their students, including Aboriginal children. The teacher voices in this study indicate their struggle in dealing with the range of abilities in their class, differing learning needs, management issues and mathematics curriculum demands. There appears to be a lack of awareness of the Aboriginality of the children in their mathematics classes and the impact it can have on their mathematics teaching. It is clear that these teachers require focussed professional development and reflection time to continually address the issue of the presence of Aboriginal students in their classrooms and what implications such presence has on the development of relevant learning activities and the adoption of appropriate pedagogical strategies. There needs to be a greater appreciation of teacher beliefs about mathematics teaching and the impact upon Aboriginal learners to help lessen the cultural conflicts in the classroom and to enhance the mathematical learning outcomes for Aboriginal students. Teachers require continual professional and Aboriginal community support in developing their awareness of the context of the lives of the Aboriginal learners and implementation of appropriate teaching strategies to enhance Aboriginal children's mathematical learning outcomes. It is important to reform school environments where Aboriginal students learn, "… [for without reform] methodology will tend to reproduce social inequalities of achievement and subordinate individual development to social domination" (Teese 2000, p. 8).

References

Barton, B. (1992, August). *A philosophical justification for ethnomathematics and some implications for education*. Paper presented at the 7th International Congress on Mathematics Education, Quebec, Canada.

Battista, M. (1994). Teacher beliefs and the reform movement in mathematics education. *Phi Delta Kappan,* February, 464-470.

Beswick, K. (2005). It depends on the students: Influencing teachers' beliefs about the ends and means of numeracy teaching. In P. Clarkson et al., (Eds.), *Building connections: Theory, research and practice* (137-144). Sydney: Mathematics Education Research Group of Australasia.

Bishop, A. (1994). Cultural conflicts in mathematics education: Developing a research agenda. *For the Learning of Mathematics, 14*(2), 15-18.

Board of Studies, NSW (2002). *Mathematics K-6.* Sydney: Author.

Buckskin, P. (2001). Achievements and challenges in Indigenous education. *Unicorn, 27*(1), 5-10.

Cavanagh, P. (2005). Silences, secrets and little white lies: Reflections on the representation of Aboriginal people in Australian schools. In G. Cant, A. Goodall, & J. Inns (Eds.), *Discourses and silences: Indigenous peoples, risks and resistance* (pp. 269-287). Christchurch, NZ: University of Canterbury.

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory.* Chicago: Aldine.

Howard, P. (2001). *Beliefs about the nature and learning of mathematics in Years 5 and 6: The voices of Aboriginal children, parents, Aboriginal educators and teachers*. Unpublished doctoral dissertation, University of Western Sydney, Sydney.

Howard, P., Perry, B., Ziems, S., Lowe, K., & McKnight, A. (2003). Mathematics in Indigenous contexts: A case study. In L. Bragg, C. Campbell, G. Herbert, & J. Mousley (Eds.), *Mathematics education research: Innovation, networking opportunity* (pp. 436-443). Sydney: Mathematics Education Research Group of Australasia.

Kemp, D. (2001). Educational equality for Indigenous Australians: Unfinished business not special treatment. *Unicorn, 27*(1), 11-15.

Matthews, S., Howard, P., & Perry, B. (2003). Working together to enhance Australian aboriginal students' mathematics learning. In L. Bragg, C. Campbell, G. Herbert, & J. Mousley (Eds.), *Mathematics education research: Innovation, networking opportunity* (pp. 9-28). Sydney: Mathematics Education Research Group of Australasia.

NSW Aboriginal Education Consultative Group Inc & NSW Department of Education and Training. (2004). *The report of the review of Aboriginal education. Yanigurra muya: Ganggurrinmya yaarri guurulaw yirrigin.gurray (Freeing the spirit: Dreaming and equal future).* Sydney: Author.

Pajares, M. F. (1992). Teacher's beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*(3), 307-332.

Schuck, S., & Grootenboer, P. (2004). Affective issues in mathematics education. In B. Perry, G. Anthony, & C. Diezmann (Eds.), *Research in mathematics education in Australasia: 2000 – 2003.* Flaxton, QLD: PostPressed.

Sfard, A., & Prusak, A. (2005). Telling identities: The missing link between culture and learning mathematics. In H. L. Chick & J. L. Vincent (Eds.), *Proceedings of the 29th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 1, pp. 37-52). Melbourne: University of Melbourne.

Stipek, D. J., & Byler, P. (1997). Early childhood education teachers: Do they practice what they preach? *Early Childhood Research Quarterly, 12*, 305-325.

Teese R. (2000). *Academic success and social power*. Carlton, VIC: Melbourne University Press.

Zevenbergen, R. (2003). Explaining success in school mathematics: mythology, equity, and implications for practice. *Reflections, 28*(3), 40-47.