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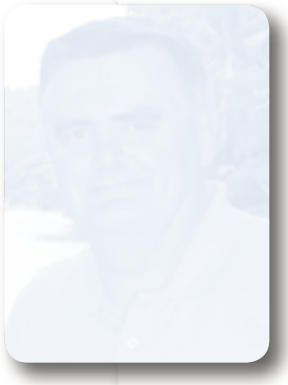
MATHEMATICS IN INDIGENOUS CONTEXTS



BOB PERRY and **PETER HOWARD**

discuss the development of teaching and learning strategies designed to enhance Aboriginal students' mathematics learning outcomes.

The Mathematics in Indigenous Contexts Project

From 1999–2005, the Mathematics in Indigenous Contexts (MIC) project was implemented by the Board of Studies, New South Wales, in conjunction with the NSW Department of Education and Training, and academics from two universities. MIC project members worked with schools and communities at two sites: a primary school in an urban community in western Sydney and both a primary and secondary school in a rural site in western NSW. These two sites were selected because of the significant enrolment of Aboriginal students in the schools. MIC focussed on establishing learning teams comprising teachers, Aboriginal educators and local Aboriginal community people to develop contextual, multistage mathematics units that suited the learning needs of the local Aboriginal students. This article reports on the implementation of MIC at the rural site.

The aim of MIC was to have school(s) and community work together to develop mathematics curricula that enhanced the knowledge and the capacity of the Aboriginal students, community and school(s). MIC was based upon the principle that the mutually beneficial engagement of people and cultures is essential in building a community's capacity for educating Aboriginal students. Within MIC, priority was given to the voices of

Aboriginal participants as an essential means of enhancing the cultural appropriateness and educational potential of mathematics learning for Aboriginal students.

Site description

The schools are in a western New South Wales rural community of about 3000 people, approximately one-third of whom are Aboriginal. Both the primary school and secondary school were involved in MIC. Almost half of the primary school students and one in five of the high school students are Aboriginal. Most of the people in the community are long-term residents.

Key mathematical foci of the MIC project in this site were building Aboriginal students' specific mathematical skills in measuring, mapping, enlarging, estimating, using compasses, and understanding volume and fractions. Both senior primary and junior secondary students completed in-class mathematics activities, mapped changes in land use near the school with the help of a local community member, and described directions using compasses: (An example of one of the activities is provided in Figure 1.)

TYRES

Investigation and Discovery

1. Use a piece of string (or something similar) and measure the circumference of a bike or car wheel.
   Estimate the distance around the tyre _____ cm
   _____ mm
   _____ m
2. Measure the string to determine the distance travelled in one revolution (one turn).
   Record the measurement in mm _____
   cm _____
   m _____
3. Calculate the distance travelled in
   5 revolutions_____
   1000 revolutions _____

Challenge: Determine for the wheel you have measured how many times it will go around on a trip from Gilgandra to Dubbo.

Figure 1. Sample learning activity.

Following these activities, the students visited an area where the Aboriginal community lived from the 1950s to the mid-1970s. The area was well known to the Aboriginal educators at the school and community members. The non-Aboriginal staff, most of the non-Aboriginal students and many of the Aboriginal students knew little of the history of this land. Before the visit, a concept map was generated by the mathematics teachers and Aboriginal community members to identify the types of mathematical knowledge and understanding students could gain from activities utilising the site (Figure 2).

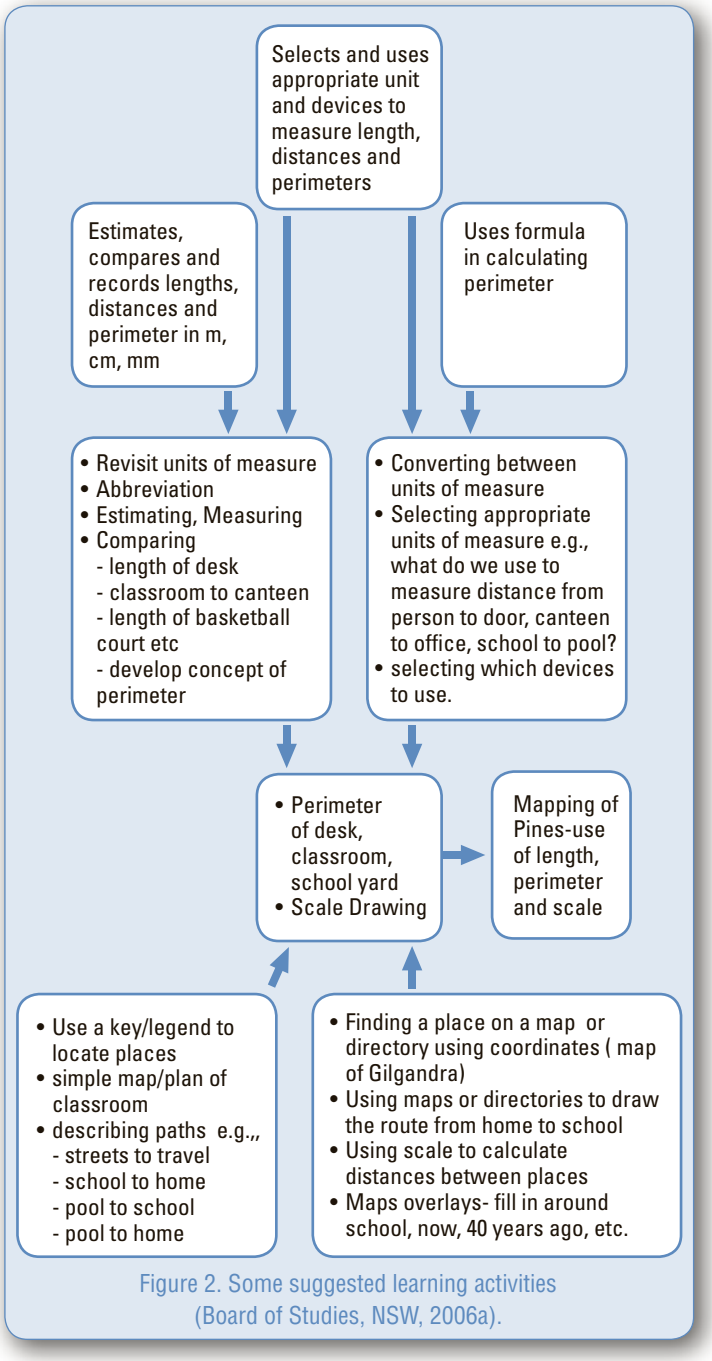


Figure 2. Some suggested learning activities (Board of Studies, NSW, 2006a).

The trees covering the site became a key resource in the development of mathematical activities such as measuring their heights and circumferences and estimating their age. The teachers developed a mathematics unit of work about the central theme of the environment of the area. Non-routine problems involving orienteering, and highlighting position, angle and direction were developed. Other activities included drawing, naming and categorising various flora. These processes reinforced 2D representation from 3D objects. Plans and maps were drawn from various sections of the site with students generating scales and keys (examples of mathematics activities undertaken during the visit to the area are presented in Figure 3).

Number of trees in the area
1. Count the number of trees in the prepared area.
2. Calculate the area in m^2 of the prepared area.
3. The area of the prepared area is … m^2
4. The approximate area of the entire site is … m^2
5. Use this information to calculate the number of trees in the entire site. Record the process.
6. Is your method accurate? Why or why not?
Determining the circumference of given trees
1. Determine which unit of measure is best to use.
2. Why did you choose this unit?
3. Estimate the circumference of each tree and record in the table.
4. Measure the actual circumference of each tree and record in the table.
5. How appropriate was the unit of measure you used?
6. What are the disadvantages of using this unit?
7. Give three examples where one would need to find the circumference of an object.

Figure 3. Mathematical activities undertaken during the visit (Board of Studies, NSW, 2006b).

Students and staff were asked to reflect on their learning through MIC, and particularly the visit to the highly significant area. A Year 5 student reported:

> Last Friday, Stage 3 and Stage 4 students went to the old Pines area for a special Maths day. When we got there we were split into 6 groups. We then listened to Mr XXX talk to us about what it was like living in Gilgandra when he was little. Our activities included measuring the distance between a marker and a tree, determining the circumference of given trees, estimating the number of trees in a certain area, measuring the height of a tree with a pencil, the difference between tree branches and the proportional drawing of trees. We enjoyed the day a lot! (Board of Studies, NSW, 2006a)

The mathematics learning achieved during the day was emphasised by a Year 7 student:

> Today we went on an excursion. It was heaps mad. We did lots of different group work. I would like to see the area kept as a heritage spot. I did like the unit because I did things in Maths I hadn't done before (Board of Studies, NSW, 2006a).

As well as the mathematics content of the day, the visit included talks from Aboriginal Elders about their lives on the site and how the families lived from day to day. Two comments from staff of the high school indicate how they saw the broader community capacity building aspects of the visit. For Harry (Head Teacher, Mathematics), this culminating day of the project evidenced

> a sense of achievement in that we had got so far from where we had set off. I know it was a maths unit that we were asked to do, but then we decided ourselves that there was far more importance on the fact that we should acknowledge, appreciate and know about the Aboriginal people out in that area. [It was enlightening] going out there and seeing the interaction of the children, and seeing the Aboriginal children take an ownership role of their little groups. All the kids learnt something about the

> identity of the Aboriginal people who lived there. For a lot of the non-Indigenous kids, The Pines was an area that you drove past and thought 'Oh, so what?' but now it means something. We need to do far more to acknowledge that part of our history. (Board of Studies, NSW, 2006a)

For Don (Head Teacher, Human Society and its Environment), the day was an enlightenment:

> Fortunately for me I was asked to attend the field excursion to Pines area of Gilgandra which holds significance to the local Indigenous people. As somebody who has an interest in issues surrounding Indigenous education, I found this event to be valuable from a professional point of view and as an excellent tool to engage students in learning. Importantly for me, the whole organisation and implementation had significant input from the local Indigenous community. To have the community together and be seen working can only help to further the cause of a holistic approach to education. Relevance is a vital key in learning. The people involved in this excursion delivered just that. (Board of Studies, NSW, 2006a)

Impact of the project

A major aim of MIC was to build the community capacity across each site. In order to gauge the impact of MIC on communities, the views of all participants involved in the project were gathered and their comments categorised. All participants agreed that MIC enriched the engagement of Aboriginal and non-Aboriginal students in their mathematics learning, acknowledged the relevance of community-based mathematics teaching strategies, and increased the capacity of the community to engage in effective mathematics curriculum reform. Four constructs were identified as the basis of a framework for successful community capacity building (see Howard, Perry & Butcher, 2006 for further details of the development and use of this framework). These are discussed in turn.

Context

All MIC schools were physically welcoming to their Aboriginal communities through significant displays of art and photographs both inside and outside the school buildings and a general feeling of overall calm. There was a sense of self-respect amongst the students and staff of each school. As well, the schools were seen as important centres within the communities.

> There's an exchange of knowledge there when you're getting Aboriginal people that come into schools. OK, they're not very well educated but they know a lot about how Aboriginal people live. And the teachers can see how they relate to the kids and the kids relate to them and you're learning off each other all the time. (Aboriginal community member)

Key to the success of MIC were the long-term contributions of the Aboriginal Education Officers, the Head Teacher of Mathematics, the high school Principal and the primary school Assistant Principal in building mutually trusting and respectful relationships between the schools and community. This is typified by the following comment from an Aboriginal community member:

> Our principal that we've got now, you'd get a fight from a few parents if they try to get him away from here. I said to my kids, you're so blessed to be here in this school, to have the opportunity to go to the school.

Engagement and Learning

When Aboriginal people and the community are engaged in the school curriculum, with their knowledge and presence valued, they come to feel a greater part of the school. In MIC, such engagement has developed a greater awareness amongst all participants of Aboriginal culture and the importance of education and learning.

> It involved the school and the community

> together coming to know that we are one. We are one community, there's no separation in that community. Got to know our kids, the way they learn too … that all kids don't learn the same and some kids are hands-on. They've got to see things then they've got to do it and that's the way you get more response from them that way. (Aboriginal educator)

The mathematics program leading up to and including the visit to the Pines provided relevant mathematical experiences that recognised the particular learning needs of all involved.

Sustainability

One of the features of the approach taken in MIC was to endeavour to have the changes introduced last well beyond the intervention period. Commitment, explaining and timing were seen to be critical elements in facilitating change. The coming together of the knowledges of all participants has led to an enhanced understanding of each others' roles within the community and a deeper appreciation of the complementariness of these roles. Although the project has used the many mathematical opportunities provided by the interaction of schools and community, the key to sustainability continues to be the willingness to believe in the trajectory begun.

> If you believe in something then if you keep focussed and keep going and it doesn't matter how you might have a blockage here but you just keep plugging at it. It is important that Aboriginal knowledge be accepted and valued in schools for if not we're going to keep having that gap between Aboriginal and non-Aboriginal kids in literacy and numeracy. (Head Teacher, Mathematics)

Activities and processes

The mathematical excursion to the Pines was worthwhile in its own right. For example, with both Year 6 and Year 7 working together, various measurement and data handling tasks were completed. Students were able to make their choices of approach to the challenges set. Teachers were able to monitor progress and offer support. As well, the visit to the significant site helped the adult participants to understand each others' cultural history in ways that would be impossible using traditional classroom-based teaching approaches.

> What we did with these projects was brought it back to relevance, not only for just the Aboriginal kids but for the non-Aboriginal kids too. It would be better for the community if they've got awareness of the history of it, the town they're living in and the people in it. So that must feel better. (Aboriginal community member)

Although the mathematical activities undertaken in MIC are clearly important, the relevance of these activities to the learners — both Aboriginal and non-Aboriginal — seems to have been the critical component in their success.

Implications for educators

To achieve the aims of building community capacity through mathematics education, MIC has highlighted the importance of learning about and from the context, and engaging with many people to ensure meaningful learning among all students, educators and community members. The visit to the significant site and the activities that were undertaken, ensured that the opportunities provided by the relationships built between the schools and the community were relevant, meaningful and engaging for both the student and adult learners. MIC enabled part of the Aboriginal history of the community to be recognised and understood. For Harry, the mathematics project was "a good learning experience for both of them (Aboriginal and non-Aboriginal students). It was an excellent learning experience for the staff. Not only the people involved but the reaction that went through the whole school community".

If educators strive to build mutually trusting and respectful relationships with themselves, their students and their communities, then, just as in the case of MIC, outstanding learning in many areas will occur. MIC has shown that it is possible. It is up to all of us to ensure that it is achieved.

Acknowledgements

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