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Enhancing Mathematics Learning through Effective Community Capacity Building

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This paper describes the 2005-2006 *Building Community Capacity* project which sought to identify key aspects of meaningful engagement between schools and communities focusing on the development and implementation of contextualised, relevant and connected mathematics curriculum and teaching and learning strategies to enhance Indigenous students' mathematics outcomes. Using case study methodology within two school sites in New South Wales (NSW), the paper identifies critical elements of community engagement and provides underlying principles which other communities might consider in their own community capacity building. The vehicle for this study is the *Mathematics in Indigenous Contexts* project which demonstrated the potential of shared ownership of mathematics curriculum development among Aboriginal Australian and non-Aboriginal Australian community members as a way of enhancing the understanding and respect of each group for the other as well as developing the mathematical knowledge of primary and secondary students in the community.

Strong relationships established between schools and communities can improve learning outcomes for students. The development of such partnerships requires time, commitment, genuine consultation, mutual respect and active listening through shared discussion between those in the school and the community. This paper reports on one example of what can be achieved through effective engagement and community capacity building and presents a model for possible collaborative research across the region with a focus on school/community engagement for enhanced mathematics teaching and learning.

Key Words: mathematics; learning; community capacity; Aboriginal; Australia.

Introduction

From 1999-2005, the Board of Studies, NSW in conjunction with the NSW Department of Education and Training, Australian Catholic University and University of Western Sydney, has worked with schools and community members at two sites: one urban site in western Sydney and one rural site in western NSW in the *Mathematics in Indigenous Contexts* (MIC) project. These two sites were selected because of the significant enrolment of Aboriginal students in the schools. MIC focused on establishing a learning team comprising teachers, Aboriginal educators and local Aboriginal community people to develop contextual multistage mathematics units that suited the learning needs of Aboriginal students. The mathematics activities reflected each community's knowledge, engaged the students in meaningful learning, created closer school/community links and brought cross-cultural groups together. An underlying principle of the project was having the school seen as central to the community, with both working together to develop curriculum which enhanced the knowledge and the capacity of the Aboriginal students, community and school. Building community capacity was a key element of the MIC project. The MIC participants included: Aboriginal

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educators; Aboriginal parents and community people; primary and secondary teachers; teacher mentors; Aboriginal and non-Aboriginal students; NSW Board of Studies personnel and university mentors.

MIC was based upon the principle that the mutually beneficial engagement of people and cultures is essential in developing a community's capacity for educating Aboriginal students. According to Matthews, Howard, and Perry (2003), "educating Aboriginal students requires Aboriginal and non-Aboriginal teachers to understand the needs and cultures in which each Aboriginal student lives" (p. 18).

Community Capacity: Setting the scene and identifying challenges

The *Building Community Capacity* project seeks to analyse the success of MIC and encourage its generalisation into other communities and contexts by examining the:

- place of community capacity building within current political, social and educational contexts;
- nature of community capacity building; and
- challenges such community capacity building provides for teachers and communities.

Mathematics in Indigenous Contexts was funded by the Board of Studies NSW at a time when there were limited, if any, formal channels for Aboriginal communities to have a representative voice in local curriculum development initiatives. Within MIC, priority was given to the voices of Aboriginal people and students as an essential means to enhancing the cultural appropriateness and educational potential of learning goals and strategies for Aboriginal students.

Nature of community capacity building

Community capacity can be described as the bringing together of the community's knowledge, skills, commitment and resourcefulness to build on community strengths and address community challenges (McGinty, 2002). Community capacity building involves both attending to the foundations of the capacity and taking the capacity beyond where it is at present. Engagement that is respectful of, and sensitive to, the values of these communities and cultures is key to community capacity building.

Challenges of community capacity building

Community capacity building means that school leaders, teachers, students, community leaders and members are involved in a process of mutually beneficial engagement through a discourse of relationships and exploration. Relationships of respect and trust are the gateway to effective engagement. School leaders and teachers are challenged in the first instance to move beyond the educational model of "teacher and taught" to one of mutual respect and engagement with the Aboriginal community as learning partners.

Community capacity building challenges schools and teachers to use learning approaches that are based upon the mutual engagement of the school and the community. One of the criteria for quality teaching and learning (NSW Department of Education and Training, 2003) is that schools must move beyond approaches which assume that they alone have responsibility for ensuring learning is related or applied to students' contemporary world and cultural contexts. A second challenge requires educators to move beyond a model of minority children's school achievement which deals only with factors that educators can potentially influence (Okagaki, 2001). Leadership and power lie within and across the school and Aboriginal communities rather than with the school alone. The integrity of leadership lies in

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the capacity to engage and explore in an alternative and open discourse which will inform approaches to education and learning for Aboriginal students.

A third challenge for schools and teachers lies in their stance with respect to quantifiable measures of student capacities which are used as benchmarks for public reporting and accountability such as student attendance, progression and retention data, and Basic Skills Tests, Secondary Numeracy Assessment Program, English Language and Literacy Assessment, School Certificate and Higher School Certificate data. These 'evidence-based' measures, which report upon student behaviours, performance and competencies inform one's understanding of the learner and learning but do not define or bring closure to a student's capacity. In the case of Aboriginal students' learning, such 'informing' requires educators to consider a further register of indicators and evidence which are both informative and culturally inclusive.

A fourth challenge for schools and teachers is to engage with communities in a shared understanding of how home, community and school can work together in supporting student learning. Alton-Lee (2003) found that for most effective development of student learning outcomes there needs to be an alignment of capacities across student, teachers, and the school community as a whole. This requires teachers to value community contexts and their strengths. Schools and teachers are challenged to engage with the community and the cultural contexts of the students' worlds (Barton, 1994) in ways which impact upon school and teacher approaches that are aligned with these contexts. School leaders and teachers develop the cultural and educational alignment of school and community through enhancing their own capacity to think with the cultural perspectives of the students and their communities (Bernstein, 1996).

A fifth challenge underlying a school and teacher's capacity to enhance the education of Aboriginal students lies in teachers developing their own personal and collective efficacy for community engagement. Educators and researchers are challenged to see teacher efficacy as being multi-dimensional including not only their current pedagogical focus on teaching and classroom management (NSW Aboriginal Education Consultative Group Inc./NSW Department of Education and Training, 2004), but also their efficacy to engage with the community (Labone, 2004).

In summary, community capacity building for enhancing the education of Aboriginal students presents schools and teachers with the *five challenges* of developing:

- mutual respect between the Aboriginal community and the school community;
- mutual engagement with the community in developing learning approaches based upon alternative and creative discourses;
- evidence-based discourses to inform one's understanding of learners and learning;
- home-school-community alignment for enhancing student learning; and
- personal and collective efficacy for community engagement.

These five challenges pose a framework for engaging with the school and Aboriginal communities and exploring their community capacity building to enhance the education of Aboriginal students. Within the MIC project the curriculum focus of Aboriginal students' learning of mathematics was the specific vehicle for enhancing community capacity.

Methodology

The *Building Community Capacity* project focused on three NSW Department of Education and Training schools in the two sites – a primary school in an urban community and both a primary and secondary school in the rural site. These schools were chosen based on the collaboration between the Aboriginal community and school in previous *Mathematics in*

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Indigenous Contexts activities. Each site identified an Aboriginal educator as the key project link between the school and the Aboriginal community.

Qualitative data about building community capacity through meaningful engagement in the *Mathematics in Indigenous Contexts* project were collected by the authors during a number of school visits. Semi-structured interviews with Aboriginal community members, Aboriginal Educational Assistants, Aboriginal students, teachers and school principals were the principal data collection strategies. During 2005, three interview visits were made to each site. There was a fourth visit to each site in 2006.

The *Building Community Capacity* project focused on investigating attitudes of teachers (*primary and secondary, including school executive*) in respect to parent/community (*Aboriginal*) involvement, issues impacting upon community (*Aboriginal*) involvement, and the possible ramifications on student engagement (*Aboriginal and non-Aboriginal*) in school (*primary and secondary*). The three key research questions were:

1. What are the critical interactions between Aboriginal communities, increased community capacity and positive Aboriginal student engagement with education?
2. What are the critical issues that impact on developing sustainable community capacity projects between schools and Aboriginal people?
3. What activities and processes underpin the development of effective school community capacity projects?

All interviews were audio-taped and transcribed. An initial categorization of the qualitative data was established using a grounded theory approach. Coding was conducted by the authors and identified four constructs linked to the research questions. These constructs formed the *Framework for Successful Community Capacity Building*.

- *Context* – data related to the physical, social, economic, cultural and historical factors in each site;
- *Engagement and Learning* - data related to levels of involvement of Aboriginal students and community with the schools;
- *Sustainability* – data related to factors influencing the continuity of initiatives established during the *Mathematics in Indigenous Contexts* project; and
- *Activities and Processes* – data related to the effective interactions that facilitated school/community engagement.

The sites

The urban site is situated in Western Sydney. The primary school was established in the mid-1970s. In 2005, approximately 140 of the 450 students at the school were Aboriginal. Most of the people in the community are long-term residents, and many of the children at the school are second generation students.

In 2002/2003, Year 4 teachers volunteered to be involved in the *Mathematics in Indigenous Contexts* project. In collaboration with the Aboriginal Education Assistant (AEA) and the Aboriginal community, mathematics units were developed around a mural theme, use of the local Aboriginal reserve and group-based activities that focused on building specific mathematical skills such as measuring, numeracy, basic operations and geometry.

The rural site is a harmonious community of about 3000 people, approximately one-third of whom are Aboriginal, in western New South Wales. 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.

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A key focus of the MIC project in the rural site was building Aboriginal students' specific mathematical skills in measuring, mapping, enlarging, estimating, using compasses, and understanding volume and fractions. The 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. Following these activities, the students visited 'The Pines', 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 knew little of the history of this land. A concept map was generated by the mathematics teachers and Aboriginal community members to identify what type of mathematical knowledge and understanding students could gain from activities utilising the site. The site, as suggested, was covered in pine trees. These became a key resource in the development of mathematical activities such as measuring the heights and circumferences of the trees and estimating their age. The teachers developed a mathematics unit of work about the central theme of the environment of the Pines. Non-routine problems involving orienteering through the Pines highlighted position, angle and direction. Other activities included drawing, naming and categorising various flora. These processes reinforced 2D representation from 3D objects. Plans/maps were drawn of various sections of the site with students generating scales and keys. The project day included a talk from Aboriginal Elders about their life on the site and how the families lived from day to day. The integration of mathematics and history engaged the students in the learning and enabled them to become more aware and appreciate a critical element of the history of their town (Handmer, 2005).

Results, Analysis and Discussion

The *Mathematics in Indigenous Contexts* project gave priority to the voices of Aboriginal people as an essential means of enhancing the cultural appropriateness of mathematical teaching and learning for Aboriginal students. It was based upon the rights of Aboriginal people to be engaged as decision makers in local policies regarding the nature and form of mathematics education.

The Aboriginal community members interviewed expressed the view that the *Mathematics in Indigenous Contexts* project 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.

Context

All three school sites involved in the project were physically welcoming to the Aboriginal community, through significant displays of art and photographs both inside and outside the school buildings and a general feeling of overall calm. There was an obvious sense of pride in the presentation of the schools and this was respected by their communities, staff and students. 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, rural site)

Staff, students and community at all of the schools commented that there was really no overt racism. When isolated instances of conflict occurred, those involved were clearly told by school or community that it was just not acceptable in these locations. People from all groups took the responsibility for ensuring harmony.

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In all the sites, there are key members of the communities and the school leadership teams who have shown long-term commitment to their roles in developing the strengths of the schools and their engagement with their communities. Of particular note are the roles played by some school executive members and the Aboriginal Education Assistants. The data identify people at both sites who provide role models for other sites in terms of their skills and knowledges and the ways in which they act and interact to build community capacity. Of particular importance in the sites studied were the following people.

<i>Urban site</i>	Aboriginal Education Assistant; Principal; Assistant Principal.
<i>Rural site.</i>	Aboriginal Education Assistants (primary and secondary schools); Principal (secondary school); Head Teacher, Mathematics; Assistant Principal (primary school).

The participants in both sites expressed their beliefs that they wanted to go beyond an involvement of the community with the schools through traditional parent/teacher meetings, school barbecues and sports days. They wanted to move towards a purposeful engagement of community in providing appropriate learning opportunities for Aboriginal students. This willingness was evident in a long-term commitment to build relationships between schools and communities and mutual trust and respect among all involved.

Engagement and Learning

By coming together and engaging in community capacity building, all participants are engaged in learning. The teachers were mentored by the Aboriginal educators and community people in developing a different appreciation of the learning ways of their Aboriginal students.

There is a lot of ignorance of Aboriginal culture. We have to educate them to what we are made of, what we are and where we have come from. We have to open their eyes to see that their way, while it's a good way, it's not the only way to do things. (Aboriginal community member, rural site)

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.

Change is coming. It has been gradual but I think now there's a bigger focus on it whereas before it was ignored. I think getting people into the school to raise the teacher's awareness is helpful. It makes the students feel more a part of the school. It's that awareness that's changed in non-Aboriginal people and leads to other changes. I reckon it's making the kids more aware of their education and the need for education. (Aboriginal community member, rural site)

Sustainability

The effects of many educational initiatives are short-term and unsustainable. One of the features of the approach taken in MIC was to endeavour to have the changes last well beyond the intervention period. There was a commitment to an engaged presence of the Aboriginal community within the schools and a clear purpose in the tasks undertaken. Commitment, explaining and timing were seen to be critical elements in facilitating change.

The people involved in it from the beginning got to be committed and they've got to go out and first be here with their Elders and with the community and not give up on them. So you go back there now and you find another way of doing it, it may work. But you've got to keep at it ...it's just explaining yourself more. If

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they don't understand what they're getting into, well, they're not going to have a go. You've got to catch them at the right time. Things are going on in their lives where it's impossible for them to do things. So if you get them at that right time, you're right. Sometimes you just can't so you just have to keep going back. And you don't try to push it on them, you explain it to them and if they don't understand it, if you haven't explained it properly then you will go back and you'll think about it and go back again...you got to have compassion.
(Aboriginal community member, rural site)

The indications from these participants are that they now feel in a position to continue similar initiatives generated from within their own schools and communities.

The coming together of the knowledges of all participants has led to an enhanced understanding of each others' roles within community and a deeper appreciation of the complementarity of these roles. Key features of the sites that have made this possible are:

- an environment of openness and trust;
- mutual respect;
- sincerity in establishing and maintaining relationships;
- a shared commitment to the tasks involved;
- effective leadership from both the school and community,
- willingness to do more than might be seen as one's duty;
- knowledgeable and confident Aboriginal Education Assistants;
- confidence, resilience, efficacy and initiative of Aboriginal community people;
- expressed recognition and celebration of the value of Indigenous knowledge;
- the presence of key Aboriginal and non-Aboriginal community members with a history of harmonious engagement;
- an appreciation of the risks that need to be taken to engage purposefully and a willingness to take these risks;
- active listening;
- a sharing with other schools and community of what had been achieved;
- managing the subtle prejudicial behaviours that might emerge; and
- tangible products and outcomes from the work undertaken.

When these features are achieved in a project, then there would seem to be an excellent chance for sustainability in building community capacity.

If our kids are going to thrive, we need our community members, and the only way to get them is to let them know what is going on and let the school know what and who is available out there. I'm like a contact person, liaison person and also make sure that the Aboriginal people that are in the school are comfortable. We want them to come back and do what they are good at doing.
(Aboriginal Education Assistant, urban site)

Activities and Processes

What mathematics is done in a project such as MIC is less important than how it is done, providing it does offer opportunities for all participants to engage in meaningful, relevant and interesting tasks. However, there is much evidence that the mathematical excursions to The Pines in rural site and to the Reserve in the urban site were very worthwhile activities in their own rights. They enhanced student mathematical outcomes in special and particularly relevant ways. As well, they helped the adult participants understand each others' cultural history in ways that would be impossible using traditional classroom-based teaching approaches.

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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, rural site)

From the perspective of community capacity building, the actual mathematics learned was a pathway along which people travelled to reach a greater understanding of each other and their communities.

Conclusion

Through these two case studies and the reporting of the project's impact upon the communities, key features have been identified that other communities could use in enhancing their own community capacity building efforts. The frameworks provide a structure whereby communities can evaluate to what degree they are achieving the key components of a successful capacity building program. Each framework considers the community activities from a slightly different perspective but all have relevance to the development of communities. In the past, too much has been left to chance as well-meaning groups of people strived to improve the lot of Aboriginal people without Aboriginal people having a direct engagement in the process. The *Mathematics in Indigenous Contexts* project has provided models for a shift in approach which does ensure that Aboriginal communities play a leading role in the development of their capacity.

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Comparing Effective Mathematics Instruction with Less Effective Mathematics Instruction. References. The Effective Mathematics Classroom. What does the research say about teaching and learning mathematics? Structure teaching of mathematical concepts and skills around problems to be solved (Checkly, 1997; Wood & Sellars, 1996; Wood & Sellars, 1997). Encourage students to work cooperatively with others (Johnson & Johnson, 1975; Davidson, 1990). Communication can occur through paired work, small group work, or class presentations. Using multiple representations to communicate mathematical ideas. Learning focuses not only on the knowledge but also on enhancing awareness and skills. This makes the learning complete, critical and useful; learning is derived from the experiences of the participants. If learning and experience phase and practical phase are those that form knowledge, skills and attitude for learners physically, realization phase and curiosity phase are respectively emotional ones. In these phases the learners can realize themselves better and discover their implicit capacity. Learning-by-doing, which directly involves managers through group work. Fig.3. Deming "Plan-Do-Check-Act" (PDCA) cycle: a - general scheme; b - PDCA cycle in the OSH management system. at the organization [2]. There is now no doubting that learning is improved when learners explicitly engage in thinking about what they are learning. Mike Askew, formerly Professor of Mathematics Education at King's College London, is now Professor of Primary Education at Monash. He has directed much research in England including the project "Effective Teachers of Numeracy in Primary Schools", and was deputy director of the five-year Leverhulme Numeracy Research Program, examining teaching, learning and progression from age 5 to age 11. References. Brown, M., Askew, M., Hodgen, J., Rhodes, V., & Wiliam, D. (2003). Playful learning constitutes a set of principles for motivating content learning through engaging in technology-based joyful challenging tasks. 6. Embodiment perspectives on teacher education. How should embodiment inform the design of teacher education and professional development? Theory-Driven Design for Embodied Mathematics Education. Observing these same actions is less effective, suggesting that motoric image schemas may have primacy for making certain general conjectures. The research also clarifies that it is not simply that all actions facilitate thinking and learning.