Final Report to the Office of the NSW Board of Studies

Evaluation of the Mathematics in Indigenous Contexts (K-2) Project

June 2007

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A report prepared for the Office of the NSW Board of Studies

Erebus International

June 2007

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Acknowledgements

The evaluation team is appreciative of the efforts of staff of the Board of Studies, New South Wales, in assisting the project team to complete this project. In particular, we wish to thank Mr Kevin Lowe and Ms Suzanne Ziemes for their assistance throughout the project.

We also wish to thank the principals and staff from the schools who participated in the case studies conducted as part of this project. We are grateful for the way they were able to accommodate our inquiries, often at very short notice. We are very conscious of the demands made on schools, and acknowledge the imposition we often make on their time. We are appreciative of the time afforded us, and the insights they were willing to share.

While the information presented in this report draws on the contributions of a range of stakeholders, responsibility for the accuracy of the findings and the conclusions drawn are, however, the responsibility of the evaluation team.

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Evaluation of the Mathematics in Indigenous Contexts Project

Executive Summary

Introduction

The attainment of numeracy skills is widely considered to be one of the key pre-requisites for participation in modern society. In consequence, schools and school systems devote considerable time and energy to the teaching of numeracy. However, as data from National Benchmarking in Australia clearly show, not all students attain satisfactory outcomes from these schooling experiences. Indigenous students, as a group, achieve lower level outcomes than other students on these benchmark achievement tests.

The Mathematics in Indigenous Contexts (K-2) project, initiated by the Office of the NSW Board of Studies was designed as an exploratory study of an approach to addressing this disparity in achievement. Erebus International was engaged by the NSW Board of Studies in early 2006 to evaluate the Mathematics in Indigenous Contexts (MilC) Project. The following report provides an overview of the background to and purpose of the project, the evaluation activities undertaken during the Review and the key outcomes identified as a result of the conduct of the project.

Background

Children come to school with a range of differing prior experiences with numeracy. Some children make the transition from informal prior to school situations to the formal school setting better than others. However, not all students progress as quickly as others. The gap in achievement levels has been recognised for some time and is well documented.

Mathematics education is embedded in a particular cultural context. Mathematics is a socially constructed way of encoding, interpreting and organising the patterns and relationships emerging from the human experience of physical, spiritual and social phenomena, and learning mathematics is therefore a form of enculturation. The mainstream school Mathematics curriculum is based on what has been described as the Western Mathematics paradigm. There are many differences between this and the framework in which Aboriginal mathematics is embedded.

In addition to the need for awareness and understanding of a child's cultural heritage, there is a need to be aware of and value a child's linguistic heritage. Teaching practices focus on the need to work through processes with the child and to talk about mathematics, to discuss and make explicit

mathematical ideas and concepts. The focus on language is even more important when the home language is not the school language.

The 'good teaching practice' in mathematics lessons observed in a number of culturally diverse classrooms in urban and rural NSW (many of the latter containing significant numbers of Aboriginal children) were characterised by a 'process' approach, with lots of 'talking and doing'.

The current project was designed to reflect these principles of good practice in the individual projects developed by the participating project schools.

The current project

The current project involved 7 primary schools in the South Coast of NSW, from which 18 teachers and approximately 450 students from Kindergarten to Year 2 participated. In most of the participating schools, at least 2 teachers were involved. The project aimed at:

- increasing awareness among teachers of the additional support needed for Aboriginal students in numeracy learning;
- developing Mathematics learning activities that reflect and demonstrate a range of teaching and learning strategies, and assessment practices, which will assist Aboriginal students being able to demonstrate their numeracy understanding;
- developing clear links between schools and parents and community that support effective teaching and learning practices and encourage them to become active partners in school curriculum development and delivery and so assist students become active numeracy learners;
- developing an understanding of the particular issues for Aboriginal students in the transition period from prior to school to school; and
- exploring the potential of learning teams to support sustained curriculum change in Mathematics.

Methodology

The methodology for this project employed both qualitative and quantitative data gathering techniques. The qualitative strategies were selected to ensure the richness of the contextual experience in each school, was adequately captured. The quantitative approach was employed to measure any possible changes in student learning in Mathematics during the period of the project.

The major qualitative component involved semi-structured interviews with participating teachers, principals, Aboriginal Education Assistants (AEAs) and parents at various stages in the project. (See Appendix 1 for further details of these interview schedules). The purpose of these interviews was to gather data about:

- stakeholder understanding of the project,
- factors that have helped or hindered project implementation,

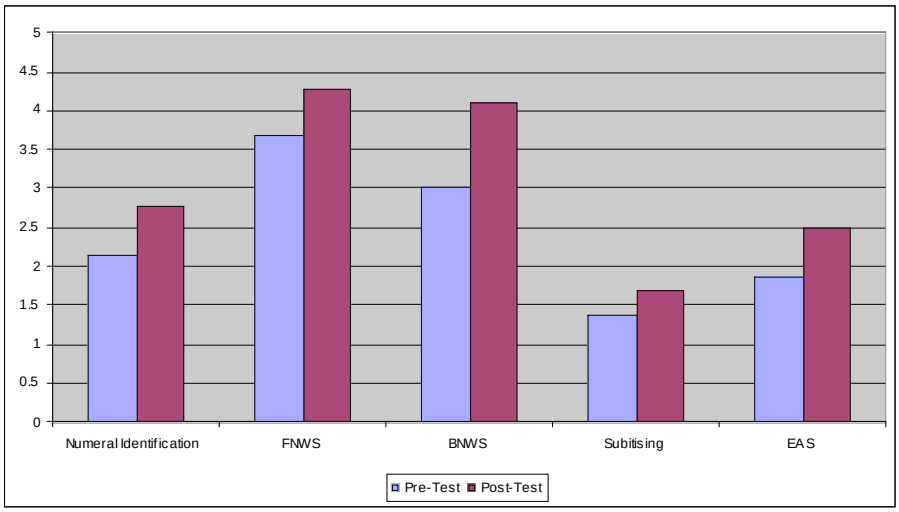
- perceptions of impact on students; and
- suggestions for enhancing the approach.

Growth in student learning was measured in two ways: comparison of learning outcomes at the beginning and end of the project (pre-and post-testing), using SENA (Schedule for Early Number Assessment), and analysis of student work samples, collected in the early stage of the project, the middle of the project and towards the end of the project.

Major Findings

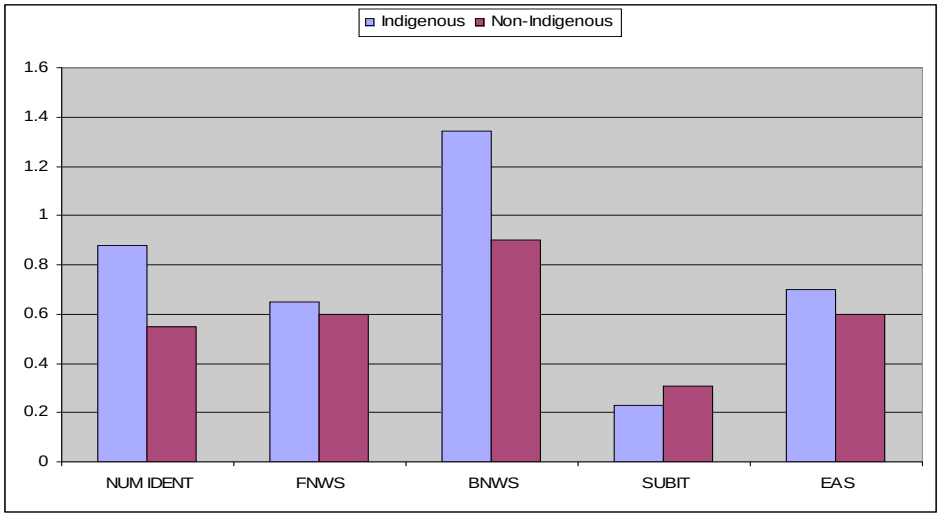
Results from the Schedule for Early Number Assessment (SENA) were used as the primary means for identifying any changes in student learning outcomes that may have occurred as a result of this project. These results indicate that on average, students participating in the Mathematics in Indigenous Contexts (K-2) project showed progress on each of the SENA sub-scales (see Figures E1 and E2 below). No student showed weaker post test scores than they had recorded on the pre-test, although a significant number of students scored the same result on both the pre-test and post-test.

Figure E1: Project Schools SENA Pre and Post Test Results



(Key: FNWS – Forward Number Word Sequence; BNWS – Backwards Number Word Sequence; EAS – Early Arithmetic Strategies Subitising –number sense)

Figure E2: Difference in pre and post-test scores for Indigenous & non–Indigenous students



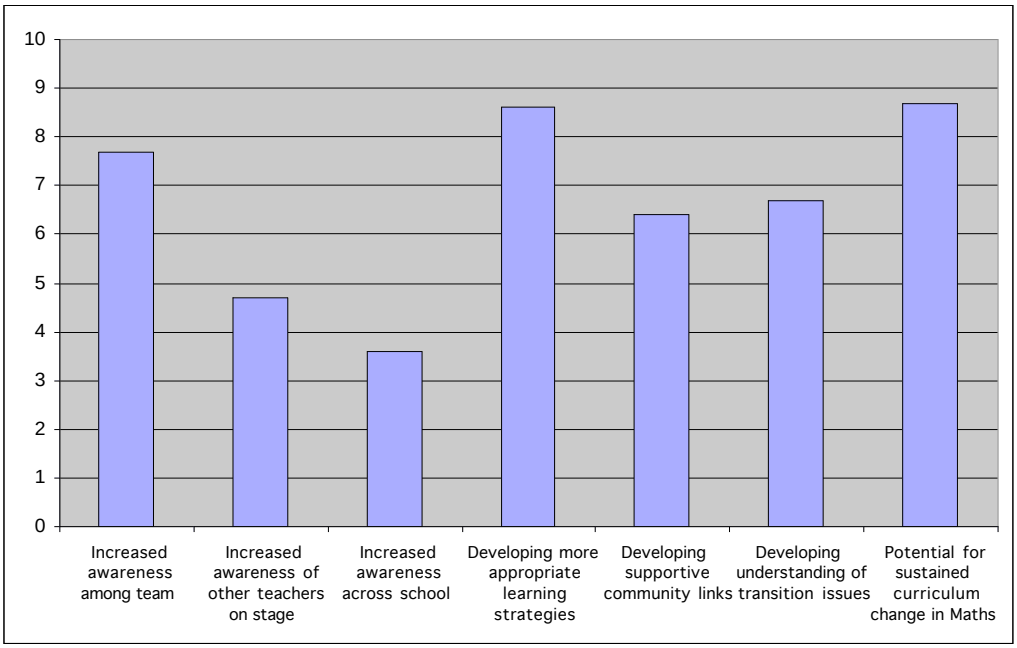
While these overall results are encouraging, some caution is needed in drawing conclusions from these results. In a project such as this, it was not possible to identify a matched "control" group, so it was not possible to compare alternative approaches. It may be that the progress is a consequence of natural maturation, or would have been achieved through the school's previous approach.

Teachers from each of the participating schools believed that the experience was largely positive and that they had gained some benefit from the project. For example, participating teachers had a better understanding of the context of the local Indigenous community. The "strengths based approach', which underpinned the project, allowed teachers to better understand what knowledge, skills and values that children bring from their home situation to the classroom, rather than concentrating on the deficits they are perceived to have. From a pedagogical perspective, all of the participating teachers said that they now had a much clearer understanding of the ways in which children go about solving mathematical problems and had acquired strategies for helping students to articulate their thought processes. They now had a better basis for understanding why children were providing correct or incorrect answers and a more informed basis for corrective strategies. The majority of participants considered that they had an increased level of awareness of the additional support needed for Aboriginal students in numeracy learning *among the team of teachers who had participated directly in the project*.

However, in all of the schools (with one exception), the project was rated as less successful in increasing awareness of the need for support for Aboriginal students for other teachers across the Stage or across the school as a whole (see Figure E3 below). Clearly, teachers who were not directly involved in this project and not exposed to the associated professional development did not display the same level of increased awareness shown by those who were more directly involved. A significant challenge for the future will be to develop a model and process whereby greater transfer of knowledge takes place and

where the greater engagement of Aboriginal students and their families in Mathematics is not confined to a few classrooms in the school but is a mainstream approach.

Figure E3: Teacher Perceptions of Project Outcomes



All participating schools rated highly the impact of the project in developing Mathematics activities that reflect and demonstrate a range of teaching and learning strategies and assessment practices which will assist Aboriginal students to demonstrate their numeracy understanding. The use of the SENA tests in particular is likely to have contributed to this positive rating. The project can be considered successful in giving teachers a strategy whereby students can verbalise their mathematical understanding and reasoning, giving teachers insights into areas that have been mastered and gaps that need to be addressed. This outcome was a consequence of strengthened understanding of good teaching practices generally, and benefits both Aboriginal and non-Aboriginal students.

Positive ratings were also given by the majority schools in relation to the extent to which links had been established between the school and community to support effective teaching. All schools believed that they had made progress on the journey in reaching out to the community to encourage families to become more active partners in learning, but the majority of schools acknowledged that there were significant issues to be addressed in their communities before further progress can be made.

Likewise, the majority of schools had made some progress in relation to the extent to which they had increased their understanding of the particular issues for Aboriginal students in the transition period prior to school. All participating schools recognised that there will be further benefits from deepening their understanding of the Indigenous context of their school and community.

All of the schools considered that the project had significantly contributed to embedding in practice the potential of teams to sustain curriculum change in Mathematics. The learning model employed for this project, using pairs of teachers within the same school, helps significantly to ensure continuing focus on the desired outcomes and to maintain momentum for the project in the face of many other competing priorities for teacher time.

While only anecdotal evidence is available about changes in student behaviour, teachers commented that they had observed more positive attitudes by student towards mathematics lessons. The advantage of such explicit approaches appears to be equally applicable to Indigenous as non Indigenous students. In line with the findings of previous research studies, this project has demonstrated the benefits of teachers' using visual and very practical materials, providing hands-on experiences when teaching Indigenous students in the early years of schooling.

Lessons for the Future

The *Mathematics in Indigenous Contexts K-2* project highlights a number of lessons at the school/organizational level and the classroom/teacher levels. These are summarised below.

Leadership to Drive the Change

There needs to be strong and active leadership at the local school community level if the project is to be a success. In those schools where a leadership team was established, a variety of vested interests were represented and managed. Strong and active leadership was required to ensure that information about the approaches explored in this project was disseminated beyond the teachers initially involved. Further support from the leadership team is necessary for teachers in other grade levels to become actively involved to understanding and to try out new approaches student learning

A Structured Approach including the use of explicit language

While the teachers participating in the projects ranged in experience from beginning teachers to those with more than 30 years service, all commented that they had taken a very structured and purposeful approach to the teaching of both literacy and numeracy. While many teachers use inductive and inquiry based approaches in their work in the human sciences, teachers in this project saw real advantages in using a more deductive approach in the teaching/learning process.

In some cases this structured approach gave teachers a "hook" to hang onto when they were uncertain about new content or new approaches. However in the case of both literacy and numeracy teaching, there was strong support for identifying, listing and practising the key steps to be undertaken in any numeracy or literacy lesson. Such an approach was also underpinned by the regular use of explicit language with students. Teachers report that students responded well to the use of explicit language as they quickly understood the sequence of steps involved, thereby building confidence in their own capability as they repeated particular steps.

The Use of Teacher Empowerment

A strong lesson that emerges from the *Mathematics in Indigenous Contexts K-2* project is the need for teachers to be empowered to take responsibility for their own classroom based activities and how they would teach their students. In contrast to some situations in which teachers felt compelled to "cover the syllabus content" or "complete all of the exercises in the textbook", whether all students were mastering this content or not, the relatively unstructured nature of this project provided teachers with the opportunity to shape the learning experiences for their own students and to take responsibility for the outcomes achieved. The project provided teachers with the time to ensure that students were developing the fundamental learning needed to progress to more complex topics.

The Impact of Professional Development on the Change Process

Teachers participating in this project indicated that they would have preferred to have had the opportunity for structured professional development at key milestone points during the project. On each of these occasions, teachers would have had the opportunity to share achievements and challenges with each other in a mutually trusting context, receive professional development about the teacher skills necessary to implement the next phase of the project and identify the outcomes to be achieved before the next milestone point.

Generating Short Term Gains

In a small number of project schools, the teachers received recognition for their efforts in the project. This may have come from within the school via the school principal or from district office staff. Where significant stakeholders sought opportunities to acknowledge and praise participating teachers for the work being undertaken, the commitment and success of those teachers appears to have been greater throughout the project.

Consolidating the gains

Any project that seeks to change school practices must take account of the wider cultural context within which the project operates. For schools, this involves appreciating the needs of staff as well as those of students, families and their community. While the strategies and resources developed by participating teachers were arguably successful in enhancing the mathematics outcomes of students involved in this project, the challenge of ensuring the gains are consolidated at least within the school context remains. This is most likely to be achieved when there is alignment between the school community's values (what it believes is important) and the educational experiences provided for students. In those schools where there was an enduring focus on student outcomes, effective teaching using the strategies explored during the project appeared to have greater chance of sustainability. The alignment between what is valued in the school and its community, what is taught and what is learnt by students is recognised as a key ingredient in achieving sustainable change.

For the most successful schools, the common starting point for consolidating change has been "to begin with the end in mind". In these local school communities, there has been considerable debate about what could be achieved from the project and how it could be made to happen. The level of ownership in these communities has been shown to be a major facilitator of project success.

Conclusion

All Australian schools exist in an Indigenous context, whether they currently enrol Indigenous students or not, by virtue of the nature of Australia's Indigenous history. While the requirement to include Aboriginal perspectives across the curriculum has been in place in NSW for many years, the extent to which this happens, and the way in which it happens, is likely to vary greatly from school to school. For those schools that do have Indigenous students, the imperative to respond to their needs is sometimes more apparent. A considerable effort has been directed towards improving Indigenous student achievement through a range of programmes over a number of years. But the continued achievement gap indicates that far too many students continue to "slip through the net".

All of the evidence reviewed above indicates that if this gap is to be closed, intervention in the early years is essential. This project has illustrated that with structured professional development support, teachers can be encouraged to adopt strategies and to develop resources that are beneficial in making mathematics more meaningful for Indigenous children. The challenges for teachers in accepting new ways of thinking and new ways of teaching are substantial. The teachers involved in this project should be commended for the manner in which they have engaged in this undertaking.

1

Introduction

The attainment of numeracy skills is widely considered to be one of the key pre-requisites for participation in modern society. In consequence, schools and school systems devote considerable time and energy to the teaching of numeracy. However, as data from National Benchmarking in Australia clearly show, not all students attain satisfactory outcomes from these schooling experiences. Indigenous students, as a group, achieve lower level outcomes than other students on these benchmark achievement tests (see for example, NIELNS, 2000; MCEETYA, 2007). For example, the 2004 national benchmarking test results (most recent publicly available data) show that while more than 93 per cent of all students meet the Year 3 numeracy benchmarks, less than 80 per cent of Indigenous students did so. The gap in achievement between Indigenous and non-Indigenous students grows in later years of schooling, with less than 70 per cent of Indigenous students reaching the Year 5 numeracy benchmark, and only 52 per cent of Indigenous students reaching the Year 7 benchmark (Report on Indigenous Education and Training, 2004, p.46)

The Mathematics in Indigenous Contexts (K-2) project, initiated by the Office of the NSW Board of Studies was designed as an exploratory study of an approach to addressing this disparity in achievement. Erebus International was engaged by the NSW Board of Studies in early 2006 to evaluate the Mathematics in Indigenous Contexts (MIIC) Project. The following report provides an overview of the background to and purpose of the project, the evaluation activities undertaken during the Review and the key outcomes identified as a result of the conduct of the project.

All Australian State, Territory and Commonwealth Education Ministers have agreed on a national goal that states 'that every child leaving primary school should be numerate, and be able to read, write and spell at an appropriate level' (Department of Education, Training and Youth Affairs, 2001). The National Aboriginal and Torres Strait Islander Education Policy (AEP) (Commonwealth of Australia, 1989) articulated that the long-term goal for schools should be 'to enable Aboriginal attainment of skills to the same standard as other Australian students throughout the compulsory schooling years' (p.15). This goal has been reflected in successive State and territory plans for Aboriginal education. For example, in NSW, the *Two Ways Together* 2005-12 strategy has the objective for Aboriginal students to match or better the outcomes of the total student population within 10 years. For example, the NSW Aboriginal

Education Training Strategy 2006-2008 has proposed the goal that by 2012, Aboriginal student outcomes will match or better outcomes of the broader student population. Specifically in regards to numeracy, the target is that by 2012, all Year 3 Aboriginal children will achieve Band 2 or higher on BST Numeracy. There are some signs of early success in that the gap between Indigenous and non Indigenous students in the early years is narrowing however it is clear that extensive further work will be required before parity is achieved.

Numeracy is a term that, while commonly used, has no agreed definition. For some, it is a term that is synonymous with mathematics, quantitative literacy or mathematical literacy. While there is disagreement among theorists about the differences between these concepts, there is strong resonance among all definitions with the view that numeracy must be thought of more broadly than what happens in the mathematics classroom alone (Steen, 2001, p.58).

According to the report of a national numeracy conference in Australia in 1997, funded by the Commonwealth, numeracy is the effective use of mathematics to meet the general demands of life at home, in paid work, and for participation in community and civic life (Australian Association of Mathematics Teachers, 1997). The statement continues:

> *"Thus numeracy is:*
>
> - *distinct from literacy;*
> - *more than number sense;*
> - *not only school mathematics; and*
> - *cross-curricular."*
>
> (Australian Association of Mathematics Teachers, 1997, p.39)

More recently, the report *Numeracy, a Priority for All: Challenges for Australian Schools* (Department of Education, Training and Youth Affairs, 2000) re-emphasises that current Australian approaches in the early and middle years of schooling broadly include the development of students' mathematical knowledge, skills and understandings, and the fostering of students' capacities and disposition to make effective use of this learning. Approaches tend to emphasise providing support for learning and enabling students to effectively deal with the general demands of their lives. (p 4)

The importance of numerate citizens in a technological age is recognized universally (Department of Education Training and Youth Affairs, 1999; Her Majesty's Inspectorate, 1998; National Council of Teachers of Mathematics, 2000). Steen, in his article on quantitative literacy, argues that "considering the deluge of numbers and their importance in so many aspects of life, one would think that schools would focus as much on numeracy as on literacy, on equipping students to deal intelligently with quantitative as well as verbal information." Other countries have similarly recognised that, to "develop an informed citizenry and to support a democratic government, schools must graduate students who are numerate as well as literate" (Steen, 1999, p.8). This goal is also recognised by the Organisation for

Economic Co-operation and Development (OECD) countries involved in the Programme for International Student Assessment (PISA) Organisation.

Numeracy learning in the early years

The research literature on how young people acquire numeracy skills is vast, and there is considerable debate about the most effective means for schools to support students to learn (see for example, Doig, McCrae and Rowe, 2003). Furthermore, there is no agreed approach for all students to acquire literacy skills in the early years of schooling. Despite these differences, the importance of children developing numeracy skills cannot be refuted. In light of the research evidence that suggests that early differences in numeracy learning are perpetuated, and indeed widen throughout schooling, the early acquisition of numeracy skills is therefore paramount.

There is evidence that a key factor in children's later academic success is the quality of parental interaction with them in the earliest years. The motivation given to children by their parents, the quality of the learning environment in the home, the degree of contact and involvement of the parent with the school and the support of well trained, dedicated teachers at the school are seen as the most significant factors in children's educational success (Carrick, 1989). All children are capable of learning, some more readily than others, but each child is an individual whose development and progress are influenced to a degree by the environment in which he or she grows. It is arguable that parents have a lasting and much stronger influence on the attitudes, beliefs and personalities of their children than formal schooling. Those children who are brought up in an environment which fosters their all-round development begin their formal schooling with a great advantage over those, who through no fault of their own are not so fortunate. Skills on entry to formal schooling – such as observation and language skills which are closely related to later achievement – are themselves closely linked to the way in which development and learning are fostered in the home, for example through stimulation of the child's interest, provision of appropriate learning experiences and encouragement of the child's efforts to learn.

This emphasises the importance of education and support for parents in early childhood development to help promote success for all children. Providing seamless support services and early intervention is an essential part of any comprehensive attempt to address the needs of children and families. But in itself it is not sufficient. Targeting measures to support children and families who are at risk or having difficulties is necessary, but it works best within a system available to everyone. Early child development and parenting initiatives must include all children, as well as those with special needs.

Every culture structures and interprets children's behaviour and development (Rogoff, 1993; Bowman, 1994). As the recently released draft South Australian Curriculum, Standards and Accountability Framework states:

> *Culture shapes values, and while certain values are central to all members of a community (for example, child protection) the wider, yet sometimes more specific values held by families are*

varied. It is through culture that children gain a sense of identity; that is who and what they are. Children are best understood in the context of family, culture and their community.

In addition, the social and economic contexts of the family play an important part in each child's development. Contextual factors such as financial uncertainty, poverty, isolation, and inadequate living conditions can be particularly influential. Any or all of these factors can impact on the child's health, nutrition, and access to medical and community services. These factors are relevant to each kind of early childhood setting and the curricula offered by them. Early childhood settings, working in close partnership with families, can often play a significant role in supporting families, thus assisting to redress disadvantage.

Culture, families, social and economic factors all influence a child's growth and development and particularly his or her emerging identity, which must be respected and also assisted to develop. Early childhood settings must, therefore, be seen as a partnership with families and set within a community focus.

To be successful participants in society, children need to develop a range of skills, such as the ability to communicate, analyse situations, take part as a member of a team, and use information gained in a variety of ways. They need to develop new ways of seeing and doing as they go through life. All children come to centres and schools with a range of skills, experiences and knowledge. Some of these coincide with the centre or school culture, others do not. These attributes need to be acknowledged and built upon for new learning. Because of the critical nature of the early learning period, it is essential to capitalise on it by providing learning experiences specifically directed to individuals or groups of children.

The role of education authorities is, therefore, to identify children's strengths and needs and ensure all children have access to and take part in a rigorous, balanced curriculum that takes account of:

- children's active involvement in their own learning
- the interconnectedness of language and learning
- the previous experiences of the learner
- the feeling of competence in the learner
- time to develop and refine understandings (see Nixon and Gould, 1996).

Like literacy, the foundations of numeracy are laid in the experiences of children in their early years (Diezman and Yelland, 2000, p.48). Considerable research suggests that the quality and quantity of early mathematical experiences are the main factor in determining subsequent achievement (Stevenson and Stigler, 1992; Young-Loveridge, Peters and Carr, 1997). Many of these experiences occur in informal ways in the home and through play and interaction with peers and adults. There is growing recognition that the experiences and environment provided to children in the first five years of life play a significant role in their performance at school (Taskforce on Families in Western Australia,

1995). It is not only the opportunity for exposure to mathematical concepts that occurs in the home that is important here – it is also the attitudes, expectations and encouragement given by parents and other adults that leads to later achievement at school.

Children therefore come to school with a range of differing prior experiences with numeracy. Some children make the transition from informal prior to school situations to the formal school setting better than others. The majority appear to make great progress in mastering curriculum content during their first year at school (Suggate, Aubrey, & Pettitt, 1997). Tymms *et al.'s* study of children's development during the first year of school also showed a "massive difference to the attainment of pupils in Reading and Maths" (Tymms, Merrell, & Henderson, 1997, p.117). Further, as Doig and de Lemos have demonstrated in the Australian context, this progress continues into the second and third years of school (Doig & de Lemos, 2000). It is worth noting that the lower levels of school attendance recorded, on average, for Aboriginal students (see for example the 2004 National Report on Indigenous Education and Training), may have longer term impacts on later achievement, since these important early learning experiences may be missed.

However, not all students progress as quickly as others. As Mulligan *et al* (1987) note, some children are unable to move from concrete to abstract thinking, or to visualise mathematical situations at all (p.366). The gap in achievement levels has been recognised for some time. For example, the report of the 1995 to 1997 Queensland assessment program commented that the performance of Aboriginal and Torres Strait Islanders was 'more than extremely below that of the rest of the population' (Queensland School Curriculum Council, 1998, p.18). In a similar vein the National Report on Schooling in Australia 1999, states that the information supplied by States and Territories indicates that 'little progress overall has been made in improving the numeracy outcomes of Indigenous students and, in many cases "outcomes for 1999 were below those of previous years" (Buckby, 1999, p.55). Since that time, successive years of data from benchmarking studies in literacy and numeracy indicate that the gap in performance between Indigenous and non-Indigenous students in the primary school years (particularly for girls) is narrowing. However, the performance gap remains substantial, particularly in later years of schooling (National Report on Indigenous Education and Training, 2004).

The size of the problem is reflected in results cited in a Discussion Paper for the *National Review of Education for Aboriginal and Torres Strait Islander People* (1994), which reported that:

- about one in five Aboriginal and Torres Strait Islander students achieve at levels above the average for students as a whole;
- overall, the literacy and numeracy achievement of about 45% of Aboriginal and Torres Strait Islander students is lower than one standard deviation below the mean achievement level of other Australian students;

- the differences between Aboriginal and Torres Strait Islander students and other Australian students in literacy and numeracy achievement are smaller in urban areas and greater in rural (including remote) locations;
- in urban locations, about 27% of Aboriginal and Torres Strait Islander students achieve at levels above the average for students in urban locations as a whole; in rural (non-town) locations about 20% of Aboriginal and Torres Strait Islander students achieve above the average for students in rural (non-town) locations as a whole; and
- Aboriginal and Torres Strait Islander girls consistently record higher achievements in literacy than boys, but there is little difference in the achievements of girls and boys in numeracy. These gender patterns are similar to those for all Australian primary school students. (pp. 23-24)

Development of numeracy by Indigenous children

A review of the research literature conducted by Frigo (1999) in relation to numeracy development of Aboriginal students and its implications for the NSW K-10 Mathematics Syllabus and the associated *Aboriginal Numeracy Forum (*2001*)*, highlighted a number of critical issues related to the development of numeracy skills for Aboriginal students. These issues are mirrored in the data on the numeracy skills of Aboriginal students as measured in the New South Wales Department of Education and Training Years 3 and 5 Basic Skills Test (BST) results. These results demonstrate that gaps between the overall cohort of Year 3 and 5 students and Aboriginal students have failed to close.

This achievement gap persists despite the development of programs through the National Indigenous Literacy and Numeracy Strategy (NIELSNS, 2000), which attempted to focus State and Commonwealth programs to lift the level of literacy and numeracy of Aboriginal students to that of other Australians.

While the reasons for these disparities are not always clear, more recent research provides indications of strategies that may well have a positive impact. While most of the research is limited to the number strand of the early childhood curriculum, it does provide insights into how effective numeracy programs could be created. However, there is very limited empirical research relating to the teaching of Numeracy in Indigenous contexts. For this reason, understanding how Aboriginal children learn mathematics and how teachers can best respond to these learning needs must draw on the wider body of literature concerned with general teaching and learning strategies which enhance educational outcomes for Aboriginal children.

As Adams, (1998) notes, Aboriginality is not in itself a reason to expect poor educational outcomes. Several reasons have been proposed to explain why their outcomes, as a group, are lower than those for other students. Adams hypothesizes that poor educational outcomes may also be related to poverty and to the covert discrimination and racism experienced by many Aboriginal children, ranging from low teacher expectations to peer harassment. Many Aboriginal children, particularly those in remote areas, experience health problems (especially hearing loss resulting from otitis media). Many

are ESL learners or speak a non-standard dialect at home or have parents with low literacy levels. These children experience an education with predominantly non-Aboriginal teachers who are often ill-equipped to meet their needs and in a learning setting which is not culturally appropriate (Batten, Frigo, Hughes and McNamara, 1998).

Munns and Connelly (1996) linked the poor educational achievement of Aboriginal students in a Sydney inner-city primary school to a mismatch between the culture of the home and the culture of the school. The students' behaviour at school was characterised by lack of risk-taking in the classroom, fear of being shamed and refusal to work which often resulted in absence or suspension from school.

Whether recognized by teachers or not, Mathematics education is embedded in a particular cultural context. Mathematics is a socially constructed way of encoding, interpreting and organising the patterns and relationships emerging from the human experience of physical, spiritual and social phenomena, and learning mathematics is therefore a form of enculturation. Mainstream school mathematics curricula are based on what has been described as the Western Mathematics paradigm (Cooke, 1995, cited in Frigo, 1999). There are many differences between this and the framework in which Aboriginal mathematics is embedded.

Mandawuy Yunnipingnu explains some of the differences between Western Mathematics and Yolngu learning methods and their mathematics as follows:

> *It is different in that it is centred on kinship; centred on a system that is governed in a social sense - how we relate to each other and how things are run; everyday normal sort of things. We learn and abide by the kinship system and it can be applied to Western areas where Yolngu people have traditionally had trouble grasping concepts, such as mathematics and the sciences. In mathematics you have recursive processes and even though it is an ongoing thing it keeps on coming back - similar in that after 10 you keep on counting from one to the next ten. By applying the recurring themes of our kinship system. This is an area to which Aboriginal students can be linked. There are similarities which can help us grasp the concepts of mathematics and ultimately enable Yolgnu people to function in a contemporary world. (Potter, 1994, p.3)*

Harris (1989; 1990) provides some further illustrations of the difference between the Western and Indigenous mathematical cultural contexts. Harris relates stories that show the importance of East, West, North, South, up and down to the Warlpiri children she taught, even from a very young age. Left and right were not considered as essential directions in your body and they found these terms more difficult. Harris' research suggested that some Aboriginal parents viewed their children's spatial ability as a measure of intelligence in the same way that Anglo-Australian parents valued their children's ability to count as an indication of intelligence. Likewise, the Aboriginal children in Harris' research were likely to have different concepts of time, a different time orientation and different values of time from non-Aboriginal teachers working from a Western mathematics syllabus. In Aboriginal cultures time is cyclic,

the past repeats itself (for example, through skin names) and the passage of time is related to events; whereas Western time is linear, dates are fixed to past knowledge and time is divided into measurable quantities.

Several authors have argued that many previous attempts to develop mathematics education programs for Aboriginal children failed because they did not recognise the diverse circumstances of Aboriginal communities and the wide range of individual needs of Aboriginal children. Watson (1988), for example, has argued that Aboriginal children might actively resist engaging in the learning involved in mathematics, rejecting Western cultural concepts that are value laden. Graham (1988) argued that acknowledgment must be made of the bi-cultural situation of many Aboriginal students. Where necessary, students need to be given time to develop numerical concepts, and where visual-spatial skills are a strength of students, this should be recognised and developed while 'where there is a conflict between ways of perceiving, talking and thinking about reality, they must be presented as alternatives' (p.131).

More recently, Howard (1997) investigated the complex issues which result from imposing a Western education and mathematics on Aboriginal children. He concludes that:

> *Aboriginal children want to learn mathematics, they want to do well and they want to maintain their identity. There are critical implications for the overall mathematics program of any school. Teachers need strategies that address the Aboriginal child's learning of mathematics. The evaluation of the quality, accuracy and appropriateness of the mathematics curriculum for Indigenous students continues to require attention. However, for many Aboriginal children... the mathematics classroom becomes an alien place characterised by tensions and conflicts about relationships and the value of what they are being taught. (Howard, 1997, p. 17)*

An example of how this might be implemented in practice is shown by the model of curriculum planning at Yirrkala Community School, which incorporates both Western and Yolgnu mathematics. Western mathematics includes counting, working with numbers and play money, and describing space using coordinates and compass bearings. Yolgnu mathematics includes drawing large maps that illustrate kinship webs and homeland connections, recording chains of obligation through details of ancestral journeys, division based on a Yolngu point of view (for example, sharing food along status lines) and describing space through analogues (Jones et al., 1995). In the New South Wales school system the current curriculum framework seeks the integration of such different "ways of knowing" and western knowledge systems.

Drawing from a review of the literature, Graham (1988) presented a number of pointers for educators, including the following:

- that mathematics is about communicating, sharing and making meaning rather than a top-down passing on of information;

- that the learner is the meaning maker and makes meaning from past experience and from the environments around them; and
- that teachers need to know their students and to understand the significance of social and cultural differences which may exist.

Aboriginal and Torres Strait Islander children come to school from diverse backgrounds in terms of cultural and linguistic heritages and with a range of experiences and abilities.

Indigenous Learning styles

Since the 1980s, considerable research has been conducted into the kinds of learning styles that appear to be favoured by Indigenous students. A commonly argued viewpoint is that the mismatch between Western teaching and Indigenous learning styles might inhibit effective learning. Further, a lack of awareness of differences in cultural background, which forms a basis for community values and social practices, may affect the interaction between teacher and student (Malin, 1994). Many of these studies (often in relation to students in remote schools rather than urban settings) have identified that much learning by Indigenous students occurs through informal means. Harris (1984), for example, identifies the following preferred learning strategies:

- learning by observation (where the child is initially a passive observer);
- learning by trial and error;
- learning in real-life situations;
- context-specific learning; and
- person orientated instruction, where knowledge is valued because of who gives it.

Whether these learning strategies are unique to Indigenous students and not characteristic of effective teaching generally, are perhaps a moot point. Nicholls, Crowley and Watt (1996) for example, argue that these learning styles reflect those of many working-class children and are not exclusive to Indigenous people. Frigo (1999) concludes that what is important is that this type of learning preference contrasts with the teaching styles of many Western classrooms, which emphasise verbal instruction, demonstration and artificial activities that take place outside a real-life context. It is important to note here that the question of teacher recognition of and responsiveness to different learning styles apply to all students, not just those from Indigenous backgrounds. (see for example, the Australian Quality Teaching Framework).

Aboriginal children may experience greater social equality with adults and more independence and freedom; they often have a range of practical abilities used at home, and can be trusted to perform these tasks; use Aboriginal English, silence, indirect courtesy and avoid eye contact; they may show a strong sense of affiliation to peer groups; and may try to avoid making mistakes when approaching new tasks (Howard, 1994).

Useful teaching strategies may therefore include:

- contract work, independent work stations, forums for evaluation and more freedom through choice;
- trust activities and allowing children to experience trust;
- exploratory talk and shared experiences rather than direct questioning;
- group work, peer and cross-age tutoring and having class layout so children can monitor peers; and
- patience, reaffirming the child's identity and creating a safe environment.

A synthesis of the research on effective teaching strategies which acknowledge the contexts of Aboriginal children suggests a number of recurring themes in teaching programs which have been found to be successful with Aboriginal and Torres Strait Islander students are those that encourage teachers to:

- recognise the individuality of students;
- acknowledge and accommodate socio-cultural differences;
- acknowledge and accommodate differences in home background;
- provide a rich language environment;
- contextualise learning activities;
- respond to students' preferred ways of learning;
- value Aboriginal ways of teaching and learning;
- identify individual language and literacy needs;
- acknowledge and value Aboriginal English as a home language;
- develop positive relationships with students;
- incorporate a variety of teaching methods in their programs, including explicit teaching;
- incorporate a variety of assessment methods into their programs;
- work with Aboriginal educators; and
- adopt strategies to deal with hearing loss, homework completion and absenteeism

  (Harris and Malin, 1994; NLLIA, 1994, 1996; Batten et al., 1998).

Frigo and Simpson (1999) investigated the numeracy development of Indigenous children as part of the preparation for a new mathematics curriculum for New South Wales schools. An important aspect of this report is that it questions whether the structure of numeracy curricula reflects the numeracy development of Indigenous children. Bucknall has suggested a range of possibilities for improving Indigenous numeracy achievement. Among her suggestions is one that differed from most other writers at the time, namely that 'Aboriginal students need to become aware of how and where they and their families use [Western] mathematics' (Bucknall, 1995, 24). The notion is that understanding the usefulness of numeracy and how it relates to 'real life' can motivate and support children's learning. In pre-school and the early years such awareness would be a good start to Indigenous children's numeracy development.

There is some support for this proposition elsewhere in the literature. A review by the National Languages and Literacy Institute of Australia (NLLIA), 1996), for example, found that experienced and confident teachers took their students out of the formal school setting and tried to relate their learning to collaborative tasks in the community context, thereby bringing meaning and a shared purpose to the activity (p.338).

A different approach to numeracy for Indigenous children and one that is teacher-focused is the Tasmanian *Improving Numeracy for Indigenous Students in Secondary Schools* (INISSS) program. Its objective is to improve numeracy outcomes for all children, but particularly Indigenous children, in the middle years of schooling through a program of intensive teacher professional development (Callingham, 1999). The professional development program is based around the use of innovative tasks that pose realistic, intriguing and mathematically rich problems for children to solve. The results of this project to date show that 'the program appears to have met its goal of improving numeracy outcomes for all children, but particularly those of Aboriginal students' (Callingham, 1999, p.3).

At the other end of the country, Efthymiades *et al.* (2000) report that the Northern Territory's small-scale research projects have confirmed what other research has suggested are the key factors to consider in relation to effective numeracy practice. These key factors include the importance of appropriate professional development programs for local Indigenous staff and community members, the need for meaningful assessment practices and materials that demonstrate what children know, rather than what they do not, and that there should be "the development of 'tools' to assess these understandings in [the children's] first language" (Efthymiades *et al.*, 2000, p.36).

The present inability to make measurable improvements to the numeracy learning outcomes for Aboriginal students has resulted in programmes in the Australian Government Department of Education Science and Training (DEST) such as those developed through the *National Indigenous English Literacy and Numeracy Strategy* (NIELNS, 2000), which focuses State and Commonwealth programs on lifting the levels of literacy and numeracy of Aboriginal students to that of other Australians.

The NSW Office of the Board of Studies has undertaken the development of a number of research projects and held conferences specific to the teaching of mathematics and the development of better numeracy learning outcomes for Aboriginal students. A number of these recommendations highlighted the critical importance of teachers, schools and communities in addressing student needs. These included:

- developing the syllabus so that schools and teachers are encouraged to develop partnerships with homes and communities
- the teaching of mathematical language must be an explicit activity within the classroom setting.
- teachers need to be shown how this could be achieved through appropriately developed curriculum documents

- teachers need assistance in developing different pedagogical models, which aim to build the mathematical confidence of the students
- support documents should demonstrate a wide variety of work samples; and
- a critical role of support documents is to assist schools in working with Aboriginal communities to develop effective strategies for home learning and tutoring.

While the importance of each of the above points has been noted in a range of studies, increasing recognition is now being given to the critical nature of the success of the transition that Indigenous students make from home to school, including the role of parents and the language and mathematical concepts that they bring into the school context from home.

Planning to use children's prior-to-school numeracy as a starting point for further development has several implications for schools. Of these, two would appear to be crucial: the involvement of parents and the early assessment of what children know and can do. Involving parents in a non-trivial way allows the early childhood teacher to continue children's numeracy development and also enables parents to reinforce the practices and goals of the school. As Meaney points out, 'community members have expert knowledge about their [children]' (Meaney, 2001, p.4). The NSW *Report of the Review of Aboriginal Education* (2004) similarly notes the importance of programs that build on cultural knowledge and oral language skills of Aboriginal students to develop strong literacy and numeracy skills at a young age.

In her example of a strong link between home and school, Meaney both facilitated and studied the construction of a mathematics curriculum by a community of Maori parents because she believed that 'a sharing of ideas by parents and teachers about what and how mathematics should be taught could reduce the gap between the home and school culture' (p.3).

A recent study of parental involvement practices in Scotland found that a variety of forms of parent–school partnerships can be initiated, but the dilemma that this variety raised was 'to what extent ... should and can schools build partnerships with parents based on [the school] supporting [the parents and community] ... Or should the partnership focus on how parents support the curriculum of the school?' (Tett, Caddell, Crowther, & O'Hara, 2001, p.54). This is an issue that is seldom raised, and certainly one that is particularly pertinent to those working with Indigenous communities.

Frigo's (1999) review concluded that the themes that emerged from the literature on numeracy development and Aboriginal students are consistent with a wider body of research pertaining to effective teaching and learning strategies for Aboriginal children in general and effective strategies to enhance numeracy learning for all children, particularly those who do not come from a home background which already reflects what happens in school. She identified the following factors as key considerations for the development of numeracy materials for Aboriginal primary school students:

The teaching strategies suggested for numeracy activities should:

- reinforce that teachers' beliefs and understanding of their pedagogical practice is essential for effective numeracy teaching;
- equip teachers with a range of teaching strategies to reflect the diverse learning needs and ways of learning of their Aboriginal students;
- provide a supportive environment in which Aboriginal students feel confident as learners and risk-takers;
- recognise that mathematics classes are essentially a linguistic exercise and a very complex one for Aboriginal students given their diverse backgrounds and language needs;
- encourage the provision of positive, non-threatening, language-rich environments in mathematics classrooms; and
- support parents and communities in becoming or being further involved in their children's learning.

The content of numeracy materials should:

- value Aboriginal students' diverse cultural and linguistic heritages;
- make explicit the difference between Western mathematics and Aboriginal mathematics, and value both equally ;
- make explicit the link between community, home and school mathematics;
- provide realistic and real-life classroom contexts for mathematics activities;
- be developed in consultation with local communities and Aboriginal education workers; and
- be open to and encourage modifications of content and pedagogy to reflect particular students' interests and learning needs;

If these resources are to be used effectively in classrooms they should:

- encourage teachers to become aware fully of the complexity of the cultural and social contexts in which Aboriginal students learn mathematics;
- encourage teachers to explore and use the particular contexts, especially numeracy ones, for their Aboriginal students;
- encourage teachers to identify the particular learning needs and preferred ways of learning of each of their Aboriginal students;
- invite teachers to reflect on their practice and to identify and build on what works for their Aboriginal students; and
- reinforce the critical relationship between high teacher expectations, a positive classroom climate and student achievement.

The above factors identified by Frigo (1999) in relation to indigenous students are not dissimilar to those identified in the research in relation to learning of numeracy by all students generally (See for example, ACER, 2000). For example, Brown, (2000) in the United Kingdom found that the factors associated with increased numeracy attainment teachers have a shared commitment to focusing on children's mathematical learning rather than on provision of pleasant classroom experiences, on providing a challenging rather than a comforting curriculum, and on having high expectations of initially lower attaining pupils. She believes that these factors may be more important than other differences in teaching style. (Askew et al. 1997), found the highest gains in learning were associated with teachers with connectionist orientations and relatively low mean gains with transmission and discovery orientations. Connectionist teachers emphasised connections within mathematics and between mathematics and the real world, and were able to relate their teaching to children's thinking. Similarly, Efthymiades et al (2000) found that schools that had considered the following factors in their teaching of numeracy experienced greatest success:

- the important role of language;
- making connections with students' life (relevance and context dependent including employment opportunities and other life choices);
- care in relation to affective (emotional) issues;
- maximising 'redeemability' through programs which allow students to recommence their numeracy development if there are breaks in their education; and
- setting high and consistent expectations for student learning and maintaining positive beliefs that students can achieve.

The way that learning is managed is also important. In relation to the Count Me in Too programme in NSW, Bobbis (2003) found that schools that had most successfully implemented the structured numeracy programme shared the following characteristics:

- A whole-school or K–6 vision for the program with statements to that effect in the school management plan
- A supportive executive
- Well-informed parents who were also involved in the implementation of the program
- The inclusion of a budget to assist teachers with the assessment of children in the future
- An executive teacher to help with the co-ordination of the program.

Factors that militated against the adoption of Count Me In Too included

- Overload of information for many teachers
- The over-emphasis schools placed on resource production

- The need for more in-class support for the implementation stage
- Stage 2 teachers' over-reliance on a textbook
- Entrenched conservative teaching strategies of many Stage 2 teachers (e.g. chalk and talk, and whole-class teaching strategies)
- Teachers' lack of familiarity and comfort with group work
- Teachers' lack of desire to involve parents in the classroom
- The reduced use of concrete materials in many Stage 2 classrooms
- Lack of time for teachers to conduct the SENA and to make sufficient resources
- Teacher movement to a different stage each year with little concern for CMIT experience
- Lack of links with the (old) syllabus

In addition to the need for awareness and understanding of a child's cultural heritage, Frigo argues that there is a need to be aware of and value a child's linguistic heritage. She notes that current teaching practices focus on the need to work through processes with the child and to talk about mathematics, to discuss and make explicit mathematical ideas and concepts. The focus on language is even more important when the home language is not the school language. For some Aboriginal students in NSW, the home language may be an Aboriginal language; it may be a form of aboriginal English; or simply use terminology that has meaning in a particular family context that differs from that currently used in school settings.

The "good teaching practice" in mathematics lessons observed by Eckermann (1994) in a number of culturally diverse classrooms in urban and rural NSW (many of the latter containing significant numbers of Aboriginal children) were characterised by a "process" approach, with lots of "talking and doing".

Howard's research with Aboriginal Education workers suggests that two levels of learning occur in the mathematics classroom for Aboriginal children. At the first level, Aboriginal children have to learn to talk in a way that was acceptable at school, which was often different from the way they talked at home (Howard, 1997). Only once these differences have been reconciled can learning of mathematical concepts take place. Similarly, Dawe and Mulligan (1997) also point out the need for teachers to recognise and make explicit the difference between "mathematical" English and "natural" English. Enabling children to become "mathematically literate" is dependent on assisting them to make the link between their real worlds and the symbolic world represented in "mathematical" English. They also indicate that ..."Tackling teaching by conceptualising the children as thinkers about mathematical problems rather than empty vessels intended to be filled with knowledge implies that children should be given every opportunity to talk about their mathematical experiences..." (p. 32).

For all students, including those from Indigenous and non-Indigenous backgrounds, learning is more successful when it recognises and builds on the mathematical knowledge that Aboriginal students utilise outside the classroom. The National Statement on Mathematics for Australian Schools (1991) stated that 'students are more likely to respond to the experiences they have in school if they feel that those experiences relate to the lives of their communities' (p. 24).

Contextualising mathematics also means finding ways of providing experiences and strategies in which students can gain meaning and develop appropriate language to enable them to achieve the expected curriculum outcomes. Some research highlights successful strategies for doing so. Dawson (1991), for example, stresses the importance of teaching strategies which recognise and incorporate Aboriginal learning styles: watching and copying, little teacher-talk, students trying for themselves many, many times, real life performance, learning when you need/want to and friendly relationships so that people will learn with each other.

Bucknall (1995) noted that students can spend a lot of time ritualistically 'doing maths' without really understanding what it is that they are doing or being able to relate it to outside the classroom. She argued that teachers need to find out what kinds of mathematics exist in the students' communities as this forms the basis of the students' own mathematical knowledge base.

The findings of the 2002 Evaluation of the NSW Count Me in Too Indigenous programme (Howard and Perry, 2002) are also relevant here. Howard and Perry suggest that Aboriginal and Torres Strait Islander people live in cultures in which they interact and relate to all about them. This view of the world needs to be recognised by teachers in the mathematics classroom. This means that classrooms need to resemble mathematical homes, with teacher and child interacting and relating to one another in ways which take into account the social and cultural influences (Graham, 1988). In this model, teaching will move away from a focus on content and the use of materials that may not be relevant to the lives of Aboriginal children towards provision of opportunities for the learner to develop their understanding of mathematics through the social context in which they find themselves.

Howard and Perry (2002) found evidence that supports Graham's assertion that language and cultural factors are not the only reasons that Aboriginal students are unable to achieve their potential in mathematics. "Aboriginal children are being taught mathematics in our schools, but they are not learning the things that matter. Such knowledge is not just to do with getting sums right, though that is part of it. Rather, it is to do with the way people talk and think about what they know" (Graham, 1988, p. 132). This suggests that time needs to be provided for children to develop mathematical meaning through action in real life experiences, discourse about those experiences and reflection on what they have learnt. Aboriginal students thrive in a climate of collaboration and connectedness. If Aboriginal children are to see the relevance of mathematics "teachers must provide 'hands-on' experiences which convey the social meanings of mathematical ideas. The connections between symbols on paper and their representation of real-life situations must be explicitly made" (Dawe, 1995, p. 243).

In an attempt to directly address some of the implications of the above research for Indigenous communities the Office of the Board of Studies initiated the Mathematics in Indigenous Contexts K-6 project in 2002 to support the development and initial implementation of the new Mathematics K-10 syllabuses. A similar project for students in Years 6-8 was undertaken during 2003-05. Twelve schools in Western NSW and one from western Sydney were involved in these projects. In both projects, schools developed learning teams consisting of teachers, Aboriginal educators and community, who collaborated to develop culturally and contextually appropriate teaching and learning materials. These resources were designed to support Aboriginal students develop knowledge and understanding to extend their numeracy skills.

The Current Project

The current project represents the next phase of this project and will coincide with the final phased implementation year of the Mathematics K-6 syllabus. It provides an opportunity to:

- extend the current project to years K-2 in a group of 7 schools, including small schools to complete the K-10 cycle
- consolidate school implementation strategies through ongoing research
- broaden the range of types of project schools in different locations
- contribute to the review of the new K-6 syllabus
- support the Board's directive to '*develop teaching approaches and support materials for students who have performed poorly in numeracy learning'*

The current project has been designed to engage the following seven South Coast schools over the period March 2006 to October 2006 in the development of teaching and learning strategies in the early years of schooling for Mathematics with students in Indigenous contexts:

- Nowra Public school
- St Michael's Catholic school, Nowra
- Moruya Public school
- Mogo Public school
- Vincentia Public school
- Callala Bay Public school
- Sanctuary Point Public school

Following the Review of Literacy Development of Indigenous students in inner Sydney and the North Coast (2005), Erebus International was commissioned to evaluate the success of this Numeracy based project. The findings of the evaluation represent the essence of this report which follows.

Evaluation Objectives

The evaluation was designed to make judgements about the success of the project in terms of the following areas:

- increasing awareness among teachers of the additional support needed for Aboriginal students in numeracy learning;
- developing Mathematics learning activities that reflect and demonstrate a range of teaching and learning strategies, and assessment practices, which will assist Aboriginal students to demonstrate their numeracy understanding;
- developing clear links between schools and parents and community that support effective teaching and learning practices and encourage them to become active partners in school curriculum development and delivery and so assist students to become active numeracy learners;
- developing an understanding of the particular issues for Aboriginal students in the transition period from prior to school to school; and
- exploring the potential of learning teams to support sustained curriculum change in Mathematics.

In relation to each of the objectives, a range of intended outcomes was developed as part of the Terms of Reference for the project. Each of these outcomes/key indicators is represented in Table 1 below

Table 1: Project outcomes/key Indicators

Objectives	Intended Outcomes
• to increase awareness among teachers of the teaching and learning needs of Aboriginal Students in need of additional support in their numeracy learning	• to develop a shared understanding of the learning needs of Aboriginal students in relation to mathematics • to lift teachers' expectations of the numeracy learning of Aboriginal students • to identify and address the difficulties associated with numeracy learning • to develop appropriate teaching strategies to support numeracy learning • to lift the aspirations of Aboriginal students
• to develop multi-stage units of work that reflect and demonstrate a range of teaching and learning strategies, and assessment practices, which will assist Aboriginal students being able to demonstrate their numeracy understanding	• to determine the mathematical, knowledge, skills and understanding of the students in the classroom using a variety of sources of information (eg parents, students, teachers, CMIT and Basic Skills data, etc) • to use this information and the new *Mathematics K-6 Syllabus* to develop a unit of work that caters for several stages of learning within the one classroom • to develop a range of appropriate teaching/learning strategies and assessment activities that will assist the learning of Aboriginal students in particular • to improve the level of engagement of students with mathematics learning experiences

	• to further develop the units based on initial implementation and evaluation by students, parents and teachers
• to develop clear links between schools and parents and community that support effective teaching and learning practices and encourage them to become active partners in school curriculum development and delivery and so assist students to become active numeracy learners	• to provide opportunities for the exchange of information between teachers and the Aboriginal community • to develop teachers' understanding of the expectations of parents in relation to their child's numeracy learning • to develop parents' understanding of the new mathematics syllabus and the teacher's expectations of the students • to develop trust and respect between teachers and parents • to develop a curriculum focus for the AEA(s) • to collaboratively develop a homework framework that supports the development of Aboriginal students
• to explore the potential of learning teams to support sustained curriculum change in Mathematics	• to establish learning teams in each setting that includes two high school teacher, one primary school teacher, the AEA(s), a teacher mentor, an academic mentor, a Board of Studies Officer (manger of the project) • to describe the influence of the learning team on the development of knowledge about Aboriginal students' numeracy needs and the development of the unit of work • to determine the potential for the continuation of the learning team after the completion of the project

Methodology

The methodology for this project employed both qualitative and quantitative data gathering techniques. The qualitative strategies were selected to ensure the richness of the contextual experience in each school was adequately captured. The quantitative approach was employed to measure any possible changes in student learning in Mathematics during the period of the project.

The major qualitative component involved semi-structured interviews with participating teachers, principals, AEAs and parents at various stages in the project. See Appendices 1-2 for further details of these interview schedules. The purpose of these interviews was to gather data about:

- stakeholder understanding of the project,
- factors that have helped or hindered project implementation,
- perceptions of impact on students and
- suggestions for enhancing the approach.

In addition, qualitative data was also gathered by:

- video footage of each participating teacher implementing the approach in their classroom.
- teacher journals. All participating teachers were asked to keep teacher journals and record their reflections on the implementation of the approach

- Erebus International attendance at the Project Sharing day in Nowra. On this occasion each school presented the methodology and findings for its project, including factors that had facilitated/hindered the achievement of its outcomes.

Growth in student learning was measured in two ways:

- comparison of learning outcomes at the beginning and end of the project (pre-and post-testing), using SENA (Schedule for Early Number Assessment)and
- analysis of student work samples, collected in the early stage of the project, the middle of the project and towards the end of the project.

It is noteworthy that the SENA test is highly compatible with the key skills and understandings embedded within the "Count Me in Too" project. 'Count Me In Too', a program promoted by the NSW Department of Education, aims to increase teachers' understanding of what mathematical thinking their students are using to solve number problems. It informs teachers as to how they can scaffold students to use more sophisticated methods.

SENA is a set of tasks that assesses students' understandings of number formation. The SENA testing is performed on a one-to-one basis so that ultimate information about the student's thinking can be obtained. The tasks cover the mathematical themes of number identification, forward number word sequences, backward number sequences, subitising, counting, addition, subtraction, multiplication and division.

The information attained from the SENA testing is then used to map where the student is currently working in the 'Learning Framework'. The framework is made up of five stages starting with more basic skills, and increasing to more complex strategies.

Since almost all project schools were currently using the "Count Me in Too" programme for Numeracy and Subtraction, the employment of SENA testing was not seen to be an additional burden but was perceived to be a positive professional learning experience for teachers involved. This was the case not only because it added to the repertoire of measurement tools available to the teachers. The tool also gave the teachers a very direct opportunity to track students' thinking processes in determining the answers to Addition and Subtraction Algorithms.

Two separate data gathering visits to each school were undertaken by members of the Erebus International team. The first occurred in the early stages of the project during May 2006. The second occurred in late October 2006. In addition to these visits, data was also collected in each project school during project consultancy visits with the participating teachers by Ms Suzanne Ziemes, from the NSW Board of Studies, sometimes with the assistance with relevant jurisdictional Maths consultants. During these periods videos were taken of classroom lessons, capturing the nature of Mathematics lessons being taught and the ensuing interactions between students and the teacher.

The first data gathering visit (See Appendix 3: Letter to School Principals) was designed to achieve the following outcomes:

- Ensure that school-based stakeholders have a clear understanding of the evaluation component of this project
- Interview key stakeholders about their initial perceptions, plans and expectations for their projects
- Gather baseline data in relation to the establishment of the project within participating schools,
- Ensure that SENA pre-tests were completed or plans were in place for their completion
- Address any emerging issues in relation to the project, and
- Discuss possible arrangements for future visits.

The second data gathering visit was designed to achieve the following outcomes:

- Interview key school stakeholders including participating teachers, AEA's, parents and school Principal (where appropriate)
- Gather any available data including teacher journals and dated student work samples
- Ensure that SENA post-testing had been done or plans were in place for their completion
- Address any emerging issues relating to the evaluation component of the project

Between the first and second data gathering visits, telephone interviews were undertaken during the implementation phase to identify emerging insights, address any challenges with data gathering responsibilities held by teachers and to confirm details and requirements for the final data gathering visit in October.

The remainder of this Report is structured in terms of three separate chapters. Chapter Two is focussed on the major findings of the evaluation, starting initially with some general comments and then reporting findings relating to both students and teachers. Chapter Three highlights the major lessons learned from this evaluation. The fourth Chapter highlights conclusions and next steps that could be undertaken, in relation to the focus of the project.

2

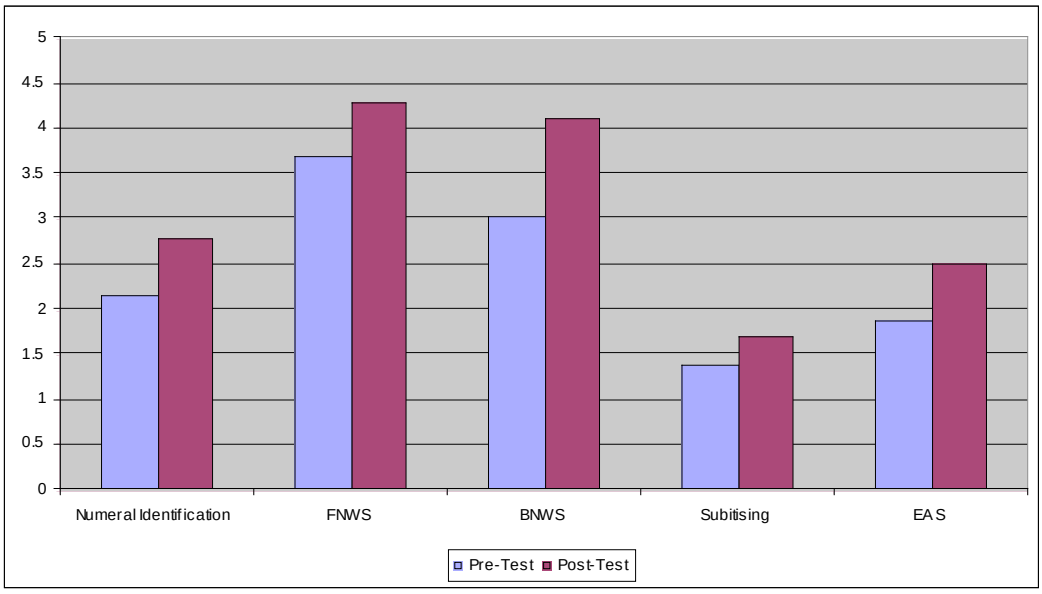
Major Findings

This Chapter provides details of findings from the analysis of student data from the SENA tests, and teacher perceptions gathered through the interviews and school visits and then identifies the factors that have positively and negatively impacted on the project.

Student Outcomes from the Project

Results from the Schedule for Early Number Assessment (SENA) were used as the primary means for identifying any changes in student learning outcomes that may have occurred as a result of this project. Figure 1 below compares the pre- and post project SENA results on the sub-scales tested in the assessment process for all students in all project schools. Direct comparison of school by school results is not possible because different approaches to testing were adopted in different schools. In some schools, only a sample of students was tested, while in others, the whole class was tested. However, these results indicate that on average, students participating in the Mathematics in Indigenous Contexts (K-2) project showed progress on each of the SENA sub-scales.

Figure 1: Project Schools SENA Pre and Post Test Results



(Key: FNWS – Forward Number Word Sequence; BNWS – Backwards Number Word Sequence; EAS – Early Arithmetic Strategies Subitising- number sense)

No student showed weaker post test scores than they had recorded on the pre-test, although there were several instances where the same pre-test and post-test score was recorded, and a significant proportion of students showed no growth (see Figure 3 below).

While these overall results are encouraging, some caution is needed in drawing conclusions from these results. In a project such as this, it was not possible to identify a matched "control" group, so it was not possible to compare alternative approaches. It may be that the progress shown in Figure 1 is a consequence of natural maturation, or would have been achieved through the school's previous approach. It may also be that these generally positive overall results (for both Indigenous and non-Indigenous students) may mask continued underachievement by particular students. It is possible to investigate this effect by comparing differential rates of development.

A possible future research project might examine the differences in outcomes achieved by a larger sample of students exposed to a standardized early numeracy intervention based on the principles of good practice identified in this project and those in schools not using this approach. Students would also need to be matched for initial levels of achievement, socio-economic status, and so on.

Figure 2 compares the difference in pre and post test scores for Indigenous and non-Indigenous students. The data indicates that, on average, Indigenous students as a group made greater progress during the pilot project than non-Indigenous students on each of the SENA sub-scales except "subitising". (Subitising is the ability to recognise the number of objects in a small group – one element of the larger concept of "number sense"). The average growth between pre and post tests was greatest on the backward number sequence scale (counting back). While no statistical significance can be attached to these results (because of the small number of students involved), and care must be exercised in interpreting the data as not all Indigenous students may have been correctly identified by the schools, the results are nonetheless encouraging.

Similar trends can be seen in Figure 3, which compares the percentage of Indigenous and non-Indigenous students showing no change between the pre-test and post test. Figure 3 shows that overall, a significant proportion of students demonstrated no growth over the course of the project. However, on all SENA subscales except "subitising" fewer Indigenous students had no change between their pre-test and post-test scores.

Figure 2: Difference in Pre and Post-Test scores for Indigenous and non –Indigenous students

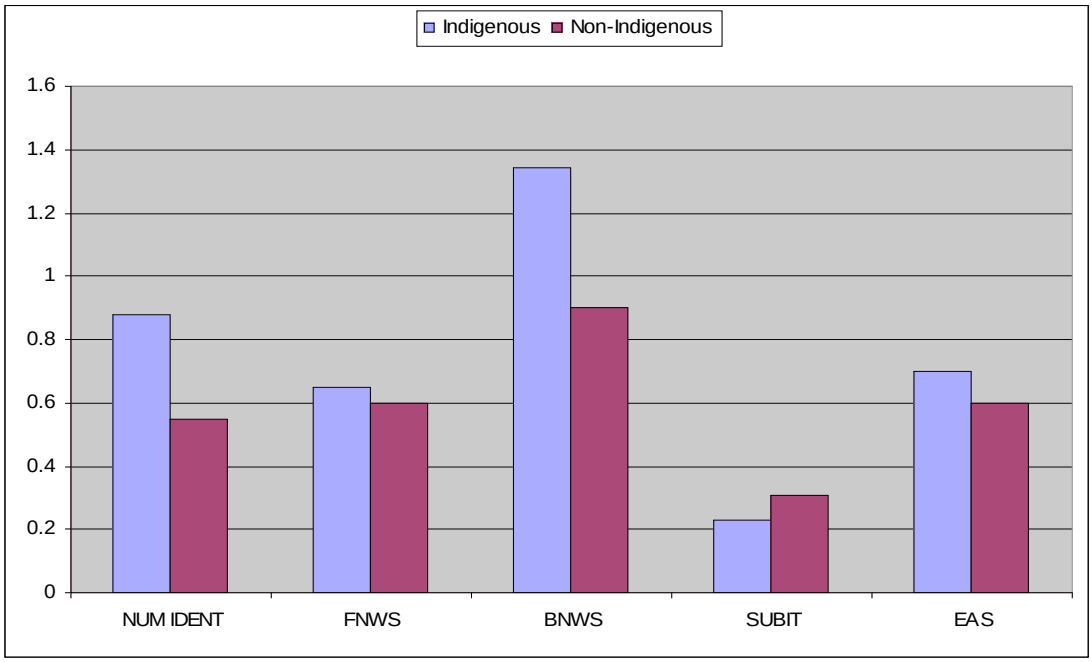
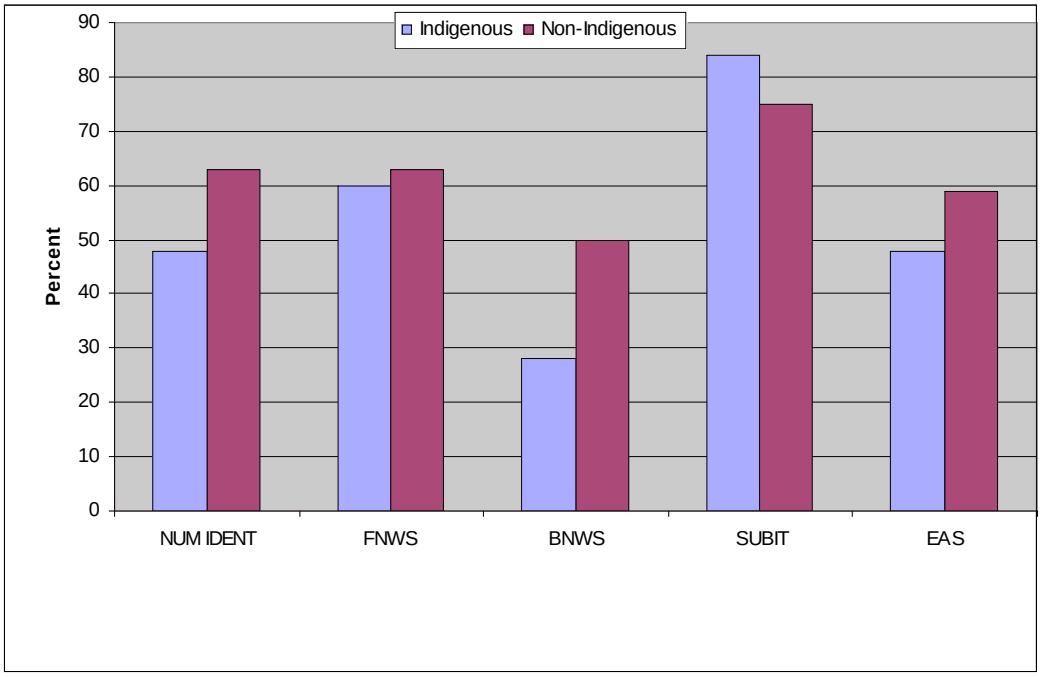


Figure 3: Percentage of students showing no improvement on Post-Test



The results of the SENA testing are reinforced by observations made by teachers during the project. For example, one school summed up its perceptions of outcomes for students as follows:

- All students were developing positive, enthusiastic attitudes to maths.
- Aboriginal students were responding in a positive way to being 'the experts' in their area of interest.
- Students are more articulate and creative in their mathematical thinking and explanations.
- Self confidence is developing.

Similar comments were expressed by all of the teachers participating in the classroom. Increases in student confidence and willingness to participate in class were noted even when the SENA tests had not increased. Of interest, it was noted on several occasions that the students who had not shown much improvement were students whose school attendance had been interrupted by illness or family circumstances. How schools can most effectively cater for students in these circumstances is another matter, however, the point is made that a failure to show progress on a particular measure at a particular point in time does not invalidate the essential elements of this project as worthwhile directions for the teaching of early years mathematics.

Teacher perceptions of project outcomes

In addition to the available evidence for demonstrating student learning throughout the project, it is equally evident that teachers also found the experience instructive. As previously indicated, teachers undertook regular diary entries in journals, others captured photographic evidence and all teachers prepared presentations for project sharing at the end of the project. The range of qualitative evidence clearly indicated significant learning for many young teachers.

While interviews with teachers in schools consistently indicated benefits in project participation, one recurring theme was reported around helping teachers understand how students think mathematically. A number of teachers indicated that the project helped them to build insights about the mental processing in which students engage to derive an answer to a mathematical problem. In some cases, these teachers had been working with students for over twenty years. For the first time in their careers, they were able to track students' thinking towards their answers and work with them to produce the correct answers.

Similarly, one teacher reports that an Indigenous student made the comment that *"Maths is like Chinese."* This comment did not imply that the student could not understand Mathematics. On the contrary, he understood that Mathematics was like learning a language and he was now learning the rules of the language. By understanding these rules and applying them, he was beginning to solve mathematical problems that had previously been a mystery to him.

Such a discovery does not dismiss another key learning for many teachers around the preferred mathematical learning style of many Indigenous students. Through the provision of visual approaches, based on concrete materials, many Indigenous students were facilitated in their learning to understand

the language and rules of mathematics in a more meaningful and concrete way. As one teacher indicated, "*.....now I don't have to rely on repetition as much in mathematics, because I know more about how the kids learn and I can lock into that to help them"* It should be noted that the use of concrete materials is not the only appropriate strategy for teaching mathematics in an Indigenous context, indeed the challenge for teachers is to assist students to move beyond reliance on concrete materials to more abstract approaches.

At a more general level, the opportunity to participate in the project has reinforced teaching techniques in mathematics for teachers. One teacher recorded the following comment in her Journal:

> "*I feel that the more variety you give students to reinforce the concept you are trying to teach, the more effective their understanding will be. Being able to relate what they already know into a new situation adds to their understanding".*

Such new insights also give teachers the confidence to try new ideas with students and confront new frontiers in terms of their own techniques for learning mathematics. In a similar way, another teacher made the following comment relating to her learning about the most effective way to work with two of her Indigenous students:

> *"I have noticed you need to present new concepts, skills or information in a variety of ways to help children who learn in various ways. Both Lilly and Jamie are quite visual learners but need lots of practice to develop new skills....."*

Some 6 weeks later, the teacher responded to her new learning with the following comments, suggesting she has now developed a range of strategies for addressing individual differences between the two students: "*After giving Lilly the Deanes Blocks to work with, she is now more confident. It worked!!.....Jamie still doesn't understand expanded notation. I will get the Koori mentor to work with him"*

Interacting with students in the classroom has been only one form of teacher professional development throughout this project. The opportunity for ongoing dialogue as teachers work in teams has been recognized as a valuable tool for professional learning by many teachers in the project:

> *".....So Kathy manned the video while Kerry assessed and Tracey and I recorded. We assessed 12 students in all. The professional dialogue after each assessment was invaluable. The girls really knew what to look for and picked up on the language the students were using. I learned heaps..."*

In one of the project schools, the principal made some pertinent comments in the Journal relating to the learnings that the young members of her staff had achieved:

> *"I was initially concerned that the teachers had little direction in the early stages of the project, but my fears were totally allayed today (3 months after project*

commencement)....The way that mathematics is being taught, has setup a structure for best practice in teaching Koori kids:

- *Small groups where students are placed in a non-threatening situation and willing to share thoughts and discoveries. This also allows for greater student engagement and interaction between student and teacher and continuous assessment happens in a less formal manner.*
- *The observing then doing where students are able to see what is being modelled instead of being at the back of a large group where they can't see.*
- *Ability to verbalize thoughts and making their thinking visual, providing an opportunity to speak in a large group and show what is going on in their head.*
- *The opportunity for the teachers to get to know the students' mathematical thinking and to carry out individual/continuous assessment.*

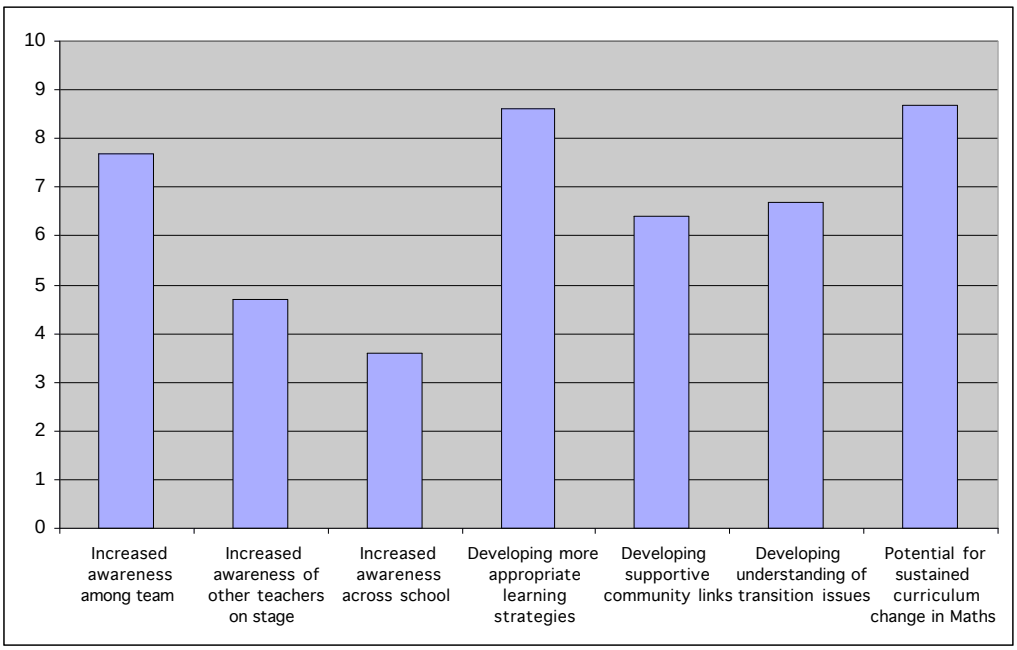
Such comments as these highlight the range of learnings made by participating teachers throughout the project. The real indicator of success however, will be the extent to which such learnings and changes become an ongoing part of each teacher's repertoire in the future teaching of mathematics. The potential for teachers to continue to apply new insights is enhanced because of the practical nature of their learnings and the early successes that they have experienced through this project.

Reflecting with the community, teachers from one school noted that they had now a better understanding of the importance of

- recognising and valuing Aboriginal Culture and community members
- making Mathematical concepts relate to their own lives ie. "purposeful."
- allowing for small informal group work.
- giving a briefing outlining what will happen in a meeting or a lesson.
- providing opportunities for children to manipulate the world around them.

At the conclusion of the October Project Sharing Day, teachers from the participating schools were asked to complete a short evaluation form rating the progress their school had reached in relation to the project's original objectives. These ratings are summarised in Figure 4 below.

Figure 4: Teacher Perceptions of Project Outcomes



As can be seen from Figure 4, teachers from each of the participating schools believed that the experience was largely positive and that they had gained some benefit from the project.

The majority of participants considered that they had an increased level of awareness of the additional support needed for Aboriginal students in numeracy learning *among the team of teaches who had participated directly in the project* (although two schools rated this area lowly. In one of these schools, the participating teachers were very inexperienced classroom teachers). This result is also reflected in comments made in teacher journals reflecting the insights that they had gained during the project. For example, one teacher commented on how she now had greater understanding of the importance to look behind the answers that students gave to comprehend their true level of understanding:

> *Kids really loved counting out loud – but quite a few couldn't match the numerals to the position without help. I was surprised at the confidence that children have at counting but they have just learned this by rote, with no idea of meaning.*

However, in all of the schools (with one exception), the project was rated as less successful in increasing awareness of the need for support for Aboriginal students for other teachers across the Stage or across the school as a whole. Clearly, teachers who were not directly involved in this project and not exposed to the associated professional development do not gain this increased awareness of those more directly involved. While acknowledging that this was a pilot project, a significant challenge for the future is developing a model and process whereby greater transfer of knowledge takes place and where the greater engagement of Aboriginal students and their families in Mathematics is not a marginal activity in the school but a mainstream approach. The school noted as an exception above

was a small school in which this project was given prominence as a whole school activity, was actively supported by the principal, and involved all students (regardless of grade level) in project-related learning activities. Likewise, in another school in which there was some increase in awareness of staff across the whole school, the project was linked to other frameworks applicable to the school as a whole. This school was similarly strongly supported by the principal, and was given a high profile in the school community, generating considerable interest among older students, teachers and parents.

All participating schools rated highly the impact of the project in developing Mathematics activities that reflect and demonstrate a range of teaching and learning strategies and assessment practices which will assist Aboriginal students to demonstrate their numeracy understanding. The use of the SENA tests in particular is likely to have contributed to this positive rating. The project can be considered successful in giving teachers a strategy whereby students can verbalise their mathematical understanding and reasoning, giving teachers insights into areas that have been mastered and gaps that need to be addressed. As noted above, the extent to which this has been an outcome that is a consequence of strengthened understanding of good teaching practices generally, was not always apparent.

Positive ratings were also given by most schools in relation to the extent to which links had been established between the school and community to support effective teaching. All schools believed that they had made some progress on the journey in reaching out to the community to encourage families to become more active partners in learning, but the majority of schools acknowledged that there were significant issues to be addressed in many communities before further progress can be made.

Likewise, the majority of schools had made some progress in relation to the extent to which they had increased their understanding of the particular issues for Aboriginal students in the transition period prior to school. It should be noted that the school that gave the lowest rating to this question did so, not because they considered the project had been ineffective in this regard, but because they considered that their level of knowledge in this area was already high.

All of the schools considered that the project had significantly contributed to embedding in practice the potential of teams to sustain curriculum change in Mathematics. The learning model employed for this project, using pairs of teachers within the same school, helps significantly to ensure continuing focus on the desired outcomes and to maintain momentum for the project in the face of many other competing priorities for teacher time.

Impact on teachers

It is worth recording that all seven schools participating in this project were enthusiastic about their involvement. School Principals, teachers and AEA's could readily see the benefits for the Aboriginal students in their care, as well as the other students in the class. The project was seen to be practical in

its focus and would potentially enhance the teaching repertoire and resources currently applied by teachers in the classrooms.

Moreover the project was seen not to be "something extra" that had to be done, but could readily be integrated into the ongoing core business of work already happening in the classroom. Many teachers were quite excited about the prospect of being supported to conduct pre and post testing to determine whether they could make a difference with their students by the end of the project. Indeed, for some teachers, participation in the project was their first introduction to a Mathematical testing tool that was relatively easy to administer and provided new insights about the way children processed mathematical information. The teachers therefore appreciated their exposure to this tool and saw it as a new professional learning experience.

From the perspective of teachers, it is apparent that the project has impacted on them in three separate but related ways: teaching methodology, interaction with students and the use of assessment tools. At the most fundamental level, the project has raised for teachers the enduring dichotomy of whether they are teaching subjects or children. In this era of a crowded curriculum and the increasing calls for accountability in relation to student results, many teachers feel compelled to cover a minimum amount of content each week, each term each year with their students.

This project has strengthened teachers' understanding of the benefits of building on children's prior knowledge and experiences, and move forward addressing each child's particular learning needs. In this project, teachers have had the opportunity to spend time with Indigenous and other children, exploring and discussing their thinking and problem solving capability. The project has encouraged teachers to use appropriate language and terminology that will become tools for the students in the future learning of Mathematics. Teachers have learned to make extensive use of visualization whereby, with the student, they sketch or draw the problem in such a way that it becomes more tangible for the student. These drawings then become the tools for exploring solutions using appropriate language. Where students have continued to express some difficulty, they have then used more examples and not continued into other areas, under the challenge of the need to cover a certain amount of content with the class.

> *.....After attending a Patterns and Algebra workshop I started giving a question at the beginning of each lesson. Children were told that as well as giving an answer they should explain how they got that particular answer. It was interesting to find out what strategies different students used. We are now encouraging children to demonstrate by way of drawing and explanation how they tackled the task. Even slower children will have a go.*

In this way teachers participating in the project believe that they have become more responsive to Indigenous students' needs, and now base their teaching around addressing these needs, rather than focusing on coverage of syllabus content. Similarly the teachers have expressed that they are now recognizing the need to provide students with more open ended activities, designed to extend them

and provide them with the opportunities to demonstrate understanding of key mathematical processes. It is noteworthy that teachers are suggesting that such activities are equally applicable to non-Indigenous students as well as Indigenous students. Nevertheless, teachers indicated the need to continue to provide concrete and visual learning experiences as these provide the greatest assistance for learning. The major challenge faced by teachers in this project, and teachers in general, is to assist all students to move beyond a dependence on concrete materials and engage in more abstract thinking. It was not evident that this occurred in all cases during this project.

In a similar way, the project has highlighted for some teachers the understanding that Indigenous students bring a certain language from the home to the school environment. The majority of teachers interviewed said they have become more aware of some of the characteristics of that home language as a result of involvement in the project. Of greater importance however, has been recognition of the need for teachers to use that language as the platform for teaching the Indigenous students the school language for Mathematics. In this way the students can talk about their learning, including thinking and problem solving processes, using a common language. Many teachers now also realise more clearly the role that they have to play in assisting Indigenous students to make the transition from home to school by more explicit articulation of terminology and concepts rather than assuming that all students come to school sharing a common understanding of mathematical concepts.

An analysis of the lesson videos reveals a variety of approaches to addressing these needs. However the common characteristics that may be gleaned can be summarized in the following way:

- Children located in the classroom in a way that ensures good eye contact with the teacher
- The initial use of concrete material, either commercially produced or realia from the local school environment
- Structured questioning from the teacher to ensure that students actively manipulate the materials
- In response to clear teacher questioning, students construct number sentences that represent answers to the teacher's questions
- Close checking of students' responses to ensure understanding of the relevant concept
- Further explicit questioning by the teacher to move children away from the concrete materials towards the use of abstract reasoning
- Repetition of this step on a number of occasions and using different questions until students begin to grasp the concept without ongoing reliance on the concrete materials

In a similar way, both experienced and inexperienced teachers commented during interviews on the more open ended, child centred approaches they are now adopting in the teaching of indigenous students without the restrictions of strict curriculum content coverage. Indeed the comment was made that the process of teaching numeracy was seen to be as important of not more important than the coverage of explicit content. Fundamental to this approach was the

clear and explicit application of instructions and the appropriate use of open rather than closed questions at key stages during the student's learning journey.

Many teachers now see the advantage of explicit teaching including the use of mathematical language as a tool for communicating with students as a starting point for closing the gap between home and school language. This recognizes that students particularly in the early years do not have a common understanding of mathematical vocabulary. It also highlights the importance of teachers' using language as a modelling tool for students in their learning of Mathematics. As a result of participating in this project, teachers now have a clearer understanding of the differences between home language (Aboriginal language) and school language (standard Australian English). More importantly however they see the advantages of explicit teaching, established through the use of explicit language. Such a trend is not dissimilar to the findings identified in the Aboriginal Literacy project evaluated by Erebus International in 2005.

> *Our school is looking at integrating cultural knowledge into the curriculum. We were counting by two's and [the AEA] discussed the animal footprints Aboriginal people observed. The students were very engaged.*
>
> *Today we made up subtraction stories. I found that getting children to tell stories really emphasised their understanding or lack thereof). I will repeat this daily as an introduction to maths lessons.*
>
> *Students played "Go Fish" in small groups. I recognised that the younger students didn't do a lot of talking at all. The older students dominated the discussion. The games themselves don't increase student's language. Before and after the lesson I asked students to look specifically at the words they used during this activity. The class brainstormed the different words that were used, such as next, before, after, first, second etc. I think students used these words more commonly after they were identified specifically.*

In addition to the use of explicit language, some teachers have seen the advantages of smaller group tuition. In these situations teachers can have closer and more meaningful interactions with students, using language and visuals with individual students to assist the explanation of key number concepts. These smaller groups are further enhanced in those schools where Buddy systems or Peer Tutoring has been introduced. These strategies appear to have been effectively employed in situations where teachers need to work in more one on one situations. Almost without exception, all teachers have found this a useful strategy, with both members of the Buddy system expressing satisfaction with the value of the experience.

There has been recognition by teachers in all schools about strategies in this project being applicable across a range of Key Learning Areas (KLAs). Indeed several teachers discussed their intentions to apply strategies such as more explicit use of language, small group work and peer tutoring in other KLAs.

Some schools have formalized the recognition of this development by developing units of work with literacy in an Indigenous context and Design and Technology in an Indigenous context in 2007.

The following quote from one teacher's journal highlights the value and recognition of the importance of using explicit language with Indigenous students:

> "*Some students needed explicit instruction on how to make "groups of", even though we have done this quite a few times. After I had gone through it using simple language step by step and then checking their understanding, they really started to get it. I even showed them how to write the number sentence."*

Teacher understanding of students' mathematical thought processes has been enhanced through the use of the Schedule for Early Number Assessment (SENA) testing protocols. While originally designed as a diagnostic tool, the individually administered SENA tests require children to "talk through" their strategies for solving mathematical problems. In this assessment, knowledge about how students arrive at their answers is considered to be as important as whether the student can provide the correct answer or not. The tool sheds light not only on students' achievements mathematically but has shown them the ways that that students calculate mathematically and where they may be encountering specific learning difficulties. While time consuming to administer, the SENA tests, for some of the teachers involved in this project, were of additional benefit in providing an evidence based platform for planning their teaching strategies, rather than relying on intuition as in the past. As one teacher noted:

> *SENA testing showed strengths and weaknesses that were not evident in class. [One student] is able to explain how she works things out – even if her thinking is not logical. She can draw a picture to show how she did the task.*

The value of the SENA testing in helping teachers understand student mathematical thought processes is illustrated by the example where students were previously marked on whether they achieved the correct answer. The SENA test revealed that students understood and could talk about the number combinations that were possible in achieving the correct answer.

An analysis of the lesson videos reflects the use of both one on one and teacher to whole class strategies in the explanation of numerical processes. More importantly however, it is more in the one-on-one situations that teachers during the project questioned students to understand their thought processes. The following questions were more frequently asked to understand students' thinking:

- Why do you say that?
- How else could you say that number sentence?
- Could you write that number sentence a different way/
- How do you know these two number sentences are saying the same thing?

Combined with explicit questioning and the use of visual materials teachers were able to demonstrate a growing understanding of the thinking processes behind a student's response and were then better equipped to identify where a student had made a mistake in his/her mathematical thought processes.

In summary therefore, for some less experienced teachers, the SENA tool was a significant source of assistance in using a new teaching methodology. The SENA instrument was reported to be a tool that enabled the teachers to more readily understand the value of "getting behind" students' answers.

Each of these experiences for teachers has resulted in a much more meaningful interaction with individual students, irrespective of race, culture or learning difficulty. While this learning cannot be cited just for Indigenous students, many teachers indicated that they understood the child's learning need more effectively and taught him/her as a genuine individual, taking account of the varying contextual, cultural and learning characteristics that are brought into the learning situation. This particular learning for teachers is particularly profound as it can be extrapolated across a broad range of KLAs and reflects the need to make more provision for individual learning differences in a much more meaningful way than had previously been the case.

The additional opportunity that this project has provided for teachers has been the opportunity to work with colleagues in a team based scenario. The majority of teachers interviewed, cited the real value of interacting with each other in this important area, through the sharing of ideas, resources and materials relevant to the topic. In some cases, teachers also engaged in team teaching, where they had the opportunity to learn different methodologies from each other that could be applied in a non threatening environment in the classroom.

From the perspective of teachers, the greatest benefit of this project would appear to be that it has enhanced the capabilities of teachers. The increased skills and insights that teachers have gained through participating in this project can be used at all times in the classroom and across a broad range of KLAs. For these reasons, the project has been very useful for those teachers engaged with it and it could be anticipated that these enhanced skills will have a sustained effect on student learning outcomes.

Factors facilitating the project

Recent research on managing change in schools (Fullan, 2003) clearly highlights the advantage of engaging senior leadership to ensure its ongoing support throughout the change project. Schools in this project were supported by senior leadership in a range of tangible ways. The schools were assisted at various phases of the project by consultants from relevant Regional Offices of the Department of Education and Training, who provided ideas, support and encouragement throughout the whole project. In addition the Catholic Dioceses Regional Office chose to provide additional funding for the project at one school through the offer of additional teacher relief. Due to the commitment and

enthusiasm demonstrated by the school team and the ensuing results, the Regional Office is considering an extension of the project into 2007 with this school. The symbolic nature of top leadership support is a significant factor in facilitating the success of any change project. This school demonstrated the efficacy of such support.

In terms of support, one member of the NSW Board of Studies provided ongoing support to the majority of schools participating in the project. The majority of these schools highlighted a number of advantages of that support. In her role as "critical friend", this person adopted the role of supporter, redirector, listener and encourager. The participating schools generally appreciated this level of support as her involvement was seen to be enhancing the quality of the project and the ultimate outcomes achieved for students.

While these factors may have facilitated the project from an external perspective, a number of factors enhanced the potential for project success within the school. Initially there is an abundance of research that highlights the need for any innovation or change within the school to be seen as a substitution rather than an add-on. At a practical level, teachers consider that if an innovation requires additional work on top of what is already being undertaken, enthusiasm and commitment will be limited. On the contrary, this project built onto much of the work already being undertaken in most project schools in relation to "Count Me in Too" as a way of numeracy already being taught in schools. In this way, the majority of teachers considered that the project did not therefore create additional work. Indeed their participation in the project gave them a more comprehensive understanding of SENA and its application, thereby enhancing their repertoire of assessment tools available to them for assessing student outcomes in key areas of numeracy. Consequently, the potential for project success was enhanced.

The emphasis on the development of appropriate teaching strategies, rather than on the development of resources was a further factor contributing to the success of the project. While some schools did develop resources as part of the project, these were used to facilitate implementation of strategies rather than as ends in themselves. The development of strategies, rather than resources, as an outcome of the project resulted in easier embedding of project outcomes into existing teaching practices and student work. In this way it encourages teaching in an Indigenous context to be integral to teachers' work rather than an added extra.

While the advantages of teacher teaming are highlighted later in this report, a significant factor in enhancing the potential success of the project was the engagement of the Aboriginal Education Assistants (AEAs). These people were seen to be integral to the success of the project at the school/community level because of the diverse roles they played. Initially they added credibility to the project and its purpose. They understood the needs of Indigenous students and therefore immediately saw the value of such a project and were able to communicate that to key school and community stakeholders.

Secondly, in a number of schools, the AEAs acted as the internal consultant to the project. They were readily able to provide advice on such a range of issues as the interpretation of some Aboriginal (home) language, Indigenous learning styles and ways to bring the environment into the classroom to enhance the teaching of numeracy in an Indigenous context. In addition, many AEAs provided the conduit between the school and the local community, informing parents of Indigenous students and other members of the community about the project, its intentions and the roles that parents could take in relation to helping their students with numeracy.

In many ways, the AEAs acted as the "glue" for the project by galvanizing the various stakeholders towards the common goals of the project. The evaluation clearly indicated that without the active participation of the AEAs, success within the project would not have been as great in many schools. This conclusion is drawn, cognizant of the fact that the AEAs adopted quite diverse roles in each school community, but always acting and responding to the needs of the local context.

The other significant factor which has assisted some schools to experience project success was the development of an overall action plan, accompanied by clearly identified outcomes and strategies. Where this occured, there was a clear understanding among all stakeholders about the desired outcome of the project and how those outcomes would be achieved. Clear milestone points were established and progress was regularly monitored against the review points in the plan.

Factors inhibiting project outcomes

While the overall rationale and design of the project clearly derive from a sound evidence base, a number of operational factors inhibited the potential overall success of the project. The major challenge for the majority of teachers arose at the outset of the project. At this time, the sponsors of the project, NSW Board of Studies, had an Information Day where project focus and expectations were openly discussed. Teachers from participating schools found it easier to implement the project when they were clear about the specific details of what was required of them.

From the perspective of the project sponsors, there was a deliberate attempt not to be prescriptive about the nature of the project to be established in each school to address the issue of "teaching mathematics in an Indigenous context". Based on the premise that every Indigenous context will have distinctively different characteristics, the sponsors were encouraging the participants to capture these unique characteristics and build them into the project as key dimensions. The intention was that the school should set its own direction. Many teachers operate best from a set of plans that are given to them to follow. However, the consequence of this can be the *de facto* adoption of the generic CMIT program as the basis for the school's project. The task of creating a unique plan can sometimes be more challenging, but as a number of schools demonstrated, the result can be superior when tailored to the local context. The project funding allowed participating schools time to reflect on and develop such plans.

Although all schools ultimately generated their own projects, taking cognizance of their own contexts and having developed a project they considered to be of value to their students, some teachers indicated that it took a long time to begin the project "because they were not quite sure what they were supposed to be doing". This may consequently have negatively impacted on the difference they were able to demonstrate in students' Numeracy achievements, as reflected in the testing process.

The value of a team of teachers working together to solve a particular learning problem cannot be underestimated. Indeed the majority of teachers could see from this project that the opportunity to share ideas and develop a shared solution can provide a solution which may be better than anticipated. Despite the perceived advantages of teachers working together to address a problem, many teachers commented that one preliminary task on the Information Day would have provided a valuable platform for teacher team deliberation. Many teachers have indicated that a whole group discussion of "numeracy in an Indigenous context" would have been a sound starting point for teachers. Indeed a number of teachers have now indicated that they didn't really address the implications of that statement until the project was well under way. Through an initial sharing session of all teachers, additional ideas may have been sparked leading to a more distinctive "Indigenous" approach being adopted in some schools.

The school visits clearly demonstrated that some schools had developed a quite distinctive approach for implementing the project. However the profile of the project within the school was not high and the longer term impact was therefore minimised. In those schools two key steps had not been undertaken. In the first instance the project had not received the active and visible support of the Principal. Where this support is evident, teachers have the opportunity to present project progress at staff meetings and other teachers often become interested in learning about the strategies being employed in the project. The potential for longer term sustainability of the effects of the project is enhanced. In those schools where there is an absence of leadership support, the outcomes of the project are not valued and generally teachers rapidly lose enthusiasm.

Concomitant with the tangible support of the Principal, the project becomes attached to a key whole school priority. In this way, the project and the participating teachers receive status and the outcomes of the project and subsequent project report becomes an important element of whole school life, with associated physical and financial support. Harnessing leadership support must be achieved at the beginning of the project, with a clearly identified role established for the Principal or delegated member of the leadership team, particularly in terms of communication and support.

3

Lessons Learned

Reflecting on the *Mathematics in Indigenous Contexts K-6 Project* highlights a number of lessons that can be learned at both the school/organizational level as well as the classroom/teacher levels. These are summarised below.

Leadership to Drive the Change

In each of the project schools, a range of stakeholders with varying backgrounds will affect the outcomes achieved: school principal, teachers, AEAs, consultants and parents in the local school. Gaining the participation and commitment of all of these stakeholder groups was observed to be a key pre-requisite for the success of the projects. The experience of this, and other projects, suggests that the necessary commitment does not arise spontaneously but must be planned for as part of the overall project strategy. Initially all key stakeholders must see an advantage in participating in such an initiative. Some would suggest that this may be described as the 'What's in it for me?' syndrome. Irrespective, it is imperative at the outset that all stakeholders must see a benefit if their participation is to be sustained. Secondly, to ensure ongoing principal involvement, the data also highlighted the need for the project to be positioned within the identified whole school priorities for the year. In those cases where there was a strong relationship between the school plan and the project outcomes, the potential for sustained success was enhanced.

The consequence of these two issues is that there needs to be strong and active leadership at the local school community level if the project is to be a success. The need for a structured leadership approach to ensure satisfactory implementation is imperative when one considers the potential conflicting priorities that can take the school and the teachers off course and away from the core business identified in the Whole School Plan. It is therefore imperative that a model of ongoing leadership be established to lead the implementation process.

As indicated above, the first step is to create a capable and influential leadership team at the school community level. In those schools where a leadership team was established, a variety of vested interests were represented and managed. Where there was no tangible input from the leadership team in the school, the project generally went no further than the classrooms of the teachers involved in the project.

A Structured Approach including the use of Explicit Language

While the teachers participating in the project ranged in experience from beginning teachers to those with more than 30 years service, all commented that they had taken a very structured and purposeful approach to the teaching of both literacy and numeracy. While many teachers use inductive and inquiry based approaches in their work in the human sciences, teachers in this project saw real advantages in adopting a more deductive approach to the teaching/learning process.

In some cases this structured approach gave teachers a "hook" to hang onto when they were uncertain about new content or new approaches. However in the case of both literacy and numeracy teaching, there was strong support for identifying, listing and practising the key steps to be undertaken in any numeracy or literacy lesson. Such an approach was also underpinned by the regular use of explicit language with students. Teachers report that students prefer the use of explicit language as they quickly understood the sequence of steps involved, thereby building confidence in their own capability as they repeated particular steps.

During the review one example was provided by a teacher who was using very explicit language with a Year 1 student. This had become a feature of her teaching style as she believed it assisted the students to follow a logical path in solving numerical problems. Using two dice, the teacher was working on the concept of subtraction. The teacher focussed initially on one and then both dice. The teacher was asking questions such as.:

- How many does this dice represent?
- How many does this dice represent?
- Which is the greater?
- How do you know?
- Can we count together?

Suddenly the student responded with "I know 5-1 is 4 because if I covered one of the dots on the dice, there is 4 left!"

The teacher then asked the child how he knew and he counted the four dots on the dice. The teacher commented that this student response was a direct result of using in explicit language in a pre determined sequence on many occasions. The student's response reflected the thinking processes that the teacher had required.

While only anecdotal evidence is available about changes in student behaviour, teacher's commented that they had observed more positive attitudes by student towards mathematics lessons. The advantage of such explicit approaches appears to be equally applicable to Indigenous as non Indigenous students. In line with the findings of previous research studies, this project has demonstrated

the benefits of teacher's using visual and very practical materials, providing hands-on experiences when teaching Indigenous students l the early years of schooling.

The Use of Teacher Empowerment

A strong lesson emerging from the *Mathematics in Indigenous Contexts K-2* project was that there are considerable advantages to be gained if teachers are afforded an opportunity to take responsibility for their own classroom based activities and how they teach their students. In this project, teachers of varying levels of experience were made aware of the parameters within which they needed to operate and were therefore prepared to accept the empowerment and the consequent commitment to the project.

The Impact of Professional Development on the Change Process

Despite the advantages provided through the relative autonomy of teachers in this project, there was also a preference expressed for the opportunity for structured professional development at key milestone points during the project. On each of these occasions, teachers would have had the opportunity to share achievements and challenges with each other in a mutually trusting context, receive professional development about the teacher skills necessary to implement the next phase of the project and identify the outcomes to be achieved before the next milestone point. In the case of the Mathematics in Indigenous Contexts (K-2) project, each school generated its own project approach. While there was an initial workshop to introduce teachers to the project, following professional development here was provided on a more informal and as-needed basis by the project Officer and regional consultants. Nevertheless many teachers commented that they would have appreciated the opportunity to share resources and to have received some input on what the research said about such topics as teaching Numeracy in the early years of schooling and effective approaches for teaching Numeracy to Indigenous students. On this occasion the project budget was not able to support more frequent professional development for all schools together. However, participating teachers strongly advocated that in any future project, professional development be seen as an important and integral dimension.

Generating Short Term Gains

A number of the teachers that participated in the project indicated that they had received recognition for their efforts in the projects. This may have come from within the school via the school principal or from the district or regional office. The effect of this recognition is significant, not only in providing legitimacy for the project but also increasing awareness of other members of the school staff about the project and the enhancements to teaching and learning sought. Where stakeholders in positions of authority (such as principals) acknowledged and praised participating teachers for the work being undertaken, the commitment and success of those teachers appears to have been greater throughout the project.

If the identified approaches to mathematics learning explored in this project are to succeed for a larger number of schools, opportunities must also be provided to "market" the good work that schools are doing, particularly in the early stages of their journey. In this way, the schools not only know that they are moving in the right direction, but also are acknowledged for results already achieved. In one sector this may already be happening in relation to the Numeracy project, with plans to extend the project, with funding to other school sites.

Consolidating the Change through Alignment

Any project that seeks to achieve change in attitudes and practices must take account of the wider cultural context within which the project operates. For schools, this involves appreciating the needs of staff as well as those of students, families and their community. While the strategies and resources developed by participating teachers were arguably successful in enhancing the mathematics outcomes of students involved in this project, the challenge of ensuring the gains are consolidated at least within the school context. This cannot occur unless there is alignment between the school community's values (what it believes is important) and the educational experiences provided for students. In those schools where there is an enduring focus on the outcomes focus for students that will assist them to become more capable in both Literacy and Numeracy, the effective teaching of these areas, using the strategies explored during the project has greater chance of sustainability. The alignment between what is valued in the school and its community, and what is taught and what is learnt by students is recognised as a key ingredient in achieving sustainable change.

For the most successful schools, the common starting point for consolidating change has been "to begin with the end in mind". In these local school communities, there has been considerable debate about what could be achieved from the project and how it could be made to happen. Once agreement had been established among teachers, AEAs, parents, and other community members, all parties then moved in the same direction supporting each other in assisting students to reach agreed outcomes based on a shared set of values. The level of ownership in these communities has been shown to be a major facilitator of project success.

Direct evidence of this success factor has been the collaborative development of a project action plan representing the outcomes of deliberations by each of the key stakeholders. Change in these school communities has even been accelerated where existing activities or initiatives in the project have been widely publicised to other teachers on the staff. Importantly there has been strong alignment among all stakeholders about what outcomes are important for students and how they will be realized in the longer term. A collaborative approach the teaching and learning process has been seen to facilitate these outcomes.

4

Conclusions

The Mathematics in Indigenous Contexts K-2 project can be evaluated at a number of levels. At the first level, it can be evaluated in terms of its effectiveness as a project *per se*, including the efficiency of the project management practices adopted. At a deeper level, the evaluation can shed some light on the effectiveness of the model implicit in the project's logic – in other words, whether the concept of teaching mathematics in an Indigenous context developed through this project has validity and broader applicability. Both questions are important, and both contribute lessons for any future attempts to replicate or extend the project.

In terms of the efficiency of the project management, the success of the project was dependent on three key factors:

- The clarity of definition of project purposes and expectations for participating schools
- The nature and extent of support provided to participating schools
- Relationships developed between project managers and participating teachers and school communities.

While the evidence gathered during this evaluation suggests that all schools considered their participation to have been of benefit to them in one way or another, they also suggested that if the project was to be extended to other schools, some improvements would be desirable. In particular, the majority of schools noted that they would have preferred clearer direction at the commencement of the project about the nature of the interventions they were expected to develop and implement.

Many teachers, particularly those with limited teaching experience, found it difficult "working from a clean slate". Participating teachers also said that they would have preferred to have had more detailed input about the concept of mathematics learning in Indigenous contexts. It is also fair to say that the school that had the greatest prior experience in developing resources for teaching mathematics in an Indigenous context entered into the project with different expectations to those of other schools and the project manager. Where participating teachers were clear about the concept of Indigenous numeracy learning, they were less reliant on generic approaches. In some project schools, the principles underpinning *Count Me In Too* formed the basis of the intervention implemented.

While this was not in itself a bad thing, as there are many similarities between the principles of CMIT and principles of effective teaching of Indigenous students identified in the literature review above (see for example Harris, 1984; Graham, 1988), it nevertheless ignores the fundamental focus of the project. The value of participating schools developing a sound project plan, with identified research questions, milestones and responsibilities has been amply demonstrated in this project.

It must be re-iterated that, as an exploratory pilot investigation, this project was intentionally non-directional and sought to identify how schools themselves constructed meaning about teaching in Indigenous contexts rather than impose preconceived ideas on teachers. However, the experience of this project will allow future professional development sessions to showcase the participating schools' efforts as case studies and provide practical examples of successful strategies that could employed and resources that could be developed.

In any pilot project of this kind, with a relatively limited budget, there will be constraints on the amount and type of support that can be provided directly to schools. The project model adopted was one which is sometimes described as providing "seed funding", in which participating schools are expected to use the available funds to find the best direction forward. In this project, the schools were located a considerable distance from each other and from the location of the project officer. While two regional mathematics consultants also helped to support the project, the amount of time they could contribute was also limited. Nevertheless, each school received several site visits during the project, and some schools received assistance in conducting the SENA testing as well as videotaping that was used to provide critical feedback on teaching strategies. Many schools found the videotaping to be useful, while others found the experience to be very threatening. The videotapes themselves will provide useful examples that could be used in any future professional development for other schools, and should be considered by any future participating school as an aid to self-reflection on the extent to which teachers are implementing appropriate teaching strategies. Consideration may also be given to more frequent sharing days at milestone points during the project. While this is also expensive, the benefits of early sharing of experiences between schools appear to be considerable. Teachers often say they learn most from each other. While a website was developed as a means of communicating about the project, it is not clear that the fullest potential was made of this as a source of information or vehicle for sharing ideas. This aspect may be explored more fully in future projects of this kind.

In providing the initial and ongoing support schools in a project of this kind, the nature of the relationship between the Project Officer and participating teachers is critical. This relationship is influenced by many factors; some professional, some logistical, and some personal. Managing a project of this kind is by no means easy, especially with the demands of time, budget and distance are considered. It is perhaps not surprising that the perceptions of the quality of the relationship of the various schools was mixed, with most extremely positive, but with others feeling that they had not received the kind of support they needed. The challenge for future projects will be to ensure that all stakeholders share a common understanding of needs and expectations from the outset.

On the whole, the project can be considered to be successful in encouraging teachers to think more about how they can address the needs of individual children, to think about the assumptions that they make about children's understanding of mathematical language, and to think about the challenges presented in engaging families and the community in their children's schooling. While the majority of teachers involved in this project already made considerable use of concrete materials in teaching mathematics, the benefits of providing a variety of visual and hands-on means of understanding mathematical concepts was certainly reinforced.

At a practical level, turning these learnings into practical, yet sustainable classroom strategies proved challenging for several teachers involved in the project. The support provided by the Project Officer and consultants and the availability of teacher release time was of considerable value in helping teachers make this transition, indeed without it the progress achieved is unlikely to have occurred in the majority of instances. Similar to the observations made in an earlier evaluation of the *Count Me In Too (CMIT)* program (Bobis, 2003), several common factors emerged as barriers to the implementation. These related mainly to issues of time, resources, and class management, and included:

- The initial feeling of being overwhelmed
- Uncertainty of how to implement the ideas generated
- The enormous amount of time needed to assess individual students
- Time to make resources at the start and then to keep up with the needs of children
- A lack of organisation and management strategies to successfully use group work
- Inability to secure reliable parent volunteers to help with group work in the classroom
- A lack of fit between the flexible and responsive approach inherent in the project and the school's syllabus. (For example, one school still taught their mathematics program primarily from a textbook series)
- Competing priorities for time and commitment to other projects
- A lack of continuity between teaching approaches between different Year levels.

While the teachers participating in the mathematics in Indigenous contexts project identified similar barriers in their own experiences, the project adopted a number of strategies to attempt to mitigate these barriers. These included:

- Initial professional development
- Reducing time burdens on teachers by requiring testing of only a small sample of students in the class (in most participating schools)
- Providing consultant support to undertake SENA testing
- Provision of teacher release time for planning and resource preparation
- Provision of consultant support (including visits by the project manager) during the project
- Involvement of Aboriginal Teacher Aides both in classrooms and as liaison with parents and community.

All of the barriers identified above can be successfully overcome in any future projects of this kind with forethought and planning and sufficient resources to provide teachers with the time for adequate preparation and reflection. None of the teachers involved in this project indicated that they would abandon the new ways of working with children that they had developed as a consequence of this experience. For them, there would be "no turning back the clock".

At a conceptual level, the overall design of the project and the project's intended outcomes all align closely with the principles identified in the literature review above.

It was noted from the outset that this project was not a specific, standardised intervention that lent itself to a classic experimental research design. Rather, teachers in each participating school developed its own set of activities that they considered appropriate to their own context. The kinds of activities and approaches developed varied considerably. This, together with the dissimilarities between the contexts of the schools, was such that drawing direct comparisons between schools was not possible or desirable.

There is scope for further consideration of the essential question of what it means to teach mathematics in an Indigenous context. Part of the motivation for this study was to observe how schools come to construct their own interpretation of the concept. The results are summarised in Figure 5 below. On the one hand, some school projects could be described as focussing simply on adoption of "effective teaching practices" that have applicability in any classroom. These include such things as providing practical hands-on activities, teaching explicit language, understanding children's prior experiences and knowledge as the basis for planning, and while adoption of these practices demonstrably led to improvement in children's learning during this project, there is nothing that inherently recognises an Indigenous perspective in these practices.

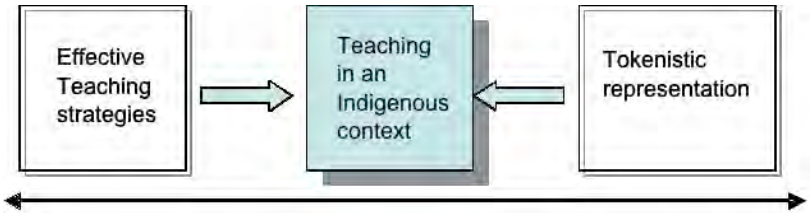
At the other end of the spectrum, are what might be called tokenistic efforts to reflect an interpretation of Indigenous culture in classroom activities and resources. Examples of this type of practice are using Aboriginal motifs to decorate resources, and using the colours of the Aboriginal flag in various ways. This level of activity is not unimportant, and is said to contribute to greater self-esteem, engagement and connectedness to school for Indigenous children. Yet there is nothing that is fundamentally different from previous mathematics teaching practices inherent in this approach, and nothing to suggest that any short term gains might be sustained throughout schooling. There is nothing that suggests that children's learning of fundamental understanding of mathematical concepts and processes will be any different than previously. As Buckskin argues, continuing to do the same as we have always done will not change the outcomes achieved by Indigenous students.

> *Schools must respect and understand Indigenous students and their cultures if we are to accelerate their progress towards educational equality. One of the major impediments to the educational success of Indigenous students is an unwillingness to modify arrangements—whether curriculum content, pedagogy, administrative structure, credentialing—on the basis*

that success must be achieved in precisely the same means as other students (Buckskin, 2000).

Somewhere between these two extremes lies a closer approximation to what can more truly be described as teaching in an Indigenous context, as described by Robinson and Nicol (1998), Haviland (2001) and Frigo (1999) earlier in this report.

Figure 5: Teaching in an Indigenous context: a continuum



This is not to say that identifying the nature of this context is an easy matter. As noted earlier in this report, the context of Indigenous people in Australia varies considerably and the communities involved in this project were no different. Few if any live in circumstances similar to those for Indigenous people in some Northern Territory and South Australia or Northern Queensland. For perhaps the majority of Indigenous families descendent from the traditional owners of the lands in the South Coast area, there has been a long history of employment in local industries including fishing and timber getting. Noticeably, there is a growing number of Indigenous people in the school communities that were part of this study who had gained or were pursuing tertiary qualifications, and who had high expectations for themselves and the children in their families. At the same time, there were also some Indigenous families who often came to the South Coast from other places, many of whom were unemployed, had low literacy levels themselves, and did not share the same aspirations as other Indigenous families. In addition, some of the schools in this project had no current enrolment of Indigenous children, and few Indigenous people living in the school community.

All Australian schools exist in an Indigenous context, whether they currently enrol Indigenous students or not, by virtue of the nature of Australia's Indigenous history. While the requirement to include Aboriginal perspectives across the curriculum have been in place in NSW for many years, the extent to which this happens, and the way in which it happens, is likely to vary greatly. For those schools that do have Indigenous students, the imperative to respond to their needs is sometimes more apparent. A considerable effort has been directed towards improving Indigenous student achievement through a range of programmes over a number of years. But the continued achievement gap indicates that far too many students continue to "slip through the net".

All of the evidence reviewed above indicates that if this gap is to be closed, intervention in the early years is essential. This project has illustrated that with structured professional development support, teachers can be encouraged to adopt strategies and to develop resources that are beneficial in

making mathematics more meaningful for Indigenous children. The challenges for teachers in accepting new ways of thinking and new ways of teaching are substantial. The teachers involved in this project should be commended for the manner in which they have engaged in this undertaking.

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Appendices

Appendix 1: Interview Questions

1. Progress generally since last visit (May 2006)

2. Factors that have facilitated or hindered the school's participation in the project since its commencement

3. Factors that have facilitated or hindered student learning outcomes throughout the project

4. Current or changed approaches to school planning for the teaching of numeracy, particularly in relation to Indigenous students

5. Current or changed approaches to teaching numeracy in the early years, particularly in relation to Indigenous students

6. Current approaches for assessing student learning outcomes in numeracy

7. The experience of the professional development received by participants throughout this project

8. Strategies implemented or planned through the project for teaching numeracy, including those that focus on the aspirations of Indigenous students

9. Level of increased awareness among teachers of the nature of support required to assist Aboriginal students in numeracy learning

10. New or innovative teaching/learning, assessment strategies that will assist young Aboriginal students

11. Increased understanding of the challenges confronting Aboriginal students in making the transition to school from home.

12. Strategies for the engagement of parents (particularly Indigenous parents) in the teaching of numeracy in the early years that have evolved from the project.
13. The potential value of learning teams in supporting sustained curriculum change in Mathematics