The Mathematical Needs of Urban Indigenous Primary Children: A Western Australian Snapshot

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This study considered ways of improving mathematical outcomes for urban Indigenous students. It focused on three primary schools in Western Australia and identified factors that were perceived to be having an impact on student learning. These included expectations for students, attendance rates, parent involvement, student literacy levels, student engagement, and test literacy. Base-line data were gathered to identify mathematical needs — conceptual understanding, place value, calculating beyond finger counting, and an action plan for 2010-2012 was developed to address those needs and to counter factors that may have had an adverse impact on student learning.

Note: In this paper, both the words 'Indigenous' and 'Aboriginal' are used. It is acknowledged that use of the word 'Aboriginal' is considered to be inappropriate in some Australian states and its use here is not intended to cause offence. The 'word of choice' in this paper is 'Indigenous', except where a direct citation from another source is made.

Introduction

This paper will document the progress of a study aimed at investigating the mathematical content knowledge, and engagement with mathematical learning of urban indigenous primary school children in Western Australia. The study is associated with the four-year *Make It Count* project conducted under the auspices of the Australian Association of Mathematics Teachers (AAMT). That project aims to identify practices that will enhance the mathematical learning of such children and, in doing so, " . . . will focus on the school as the unit of change, with all components of the school community — students, teachers and paraprofessional staff, school leaders, parents and parent groups, and the wider community engaged and having roles to play" (AAMT, 2009, p. 1). This paper outlines the study in its establishment phase.

Background

Perso (2003, p. 16) likened the cause of many difficulties faced by Indigenous children in schools as being akin to a clash of cultures, stating that "Aboriginal children bring to these schools a cultural orientation that is not well understood and is often perceived as being deficient". This is exacerbated by the fact that teachers, most of whom do not come from an Indigenous background, do not fully appreciate the fact that Indigenous children are subject to two quite different sets of family and community expectations. This situation is well encapsulated here:

> Before they can begin to master their school 'subjects', many students must learn the language, relationships, rules, procedures, and behaviours of school and school learning whilst maintaining their Indigenous identity. The difference between these two environments can be quite stark for

> many students and this additional 'learning load' is one factor that requires understanding and support. (Perso, 2009, p. 1)

Perso (2009) underlined the need for teachers to develop 'cultural competence' in order to "... demonstrate behaviours and attitudes that engage, build and maintain relationships with Aboriginal and Torres Strait Islander peoples" (p. 1). Consequently, Perso (2009) developed a *Pedagogical Framework for Cultural Competence* that poses for teachers sets of questions related to various aspects of learning such as expectations and consequences, contextual learning, learning styles and use of language.

This is in keeping with an assertion made by Sullivan (2009) that students' prior knowledge and background must be acknowledged and built upon and that teachers need to look at children not only from a 'mathematical viewpoint' but also consider their complete socio-cultural background. Khan (2009) also supported the notion of 'cultural competence' noting that it needs to develop from a systemic level of awareness to respond to the needs of Indigenous children, and that ultimately, it depends on the effectiveness of the individual teacher. This point, that the "teacher student relationship is monumentally important", was also made by Quinn (2009), and that success is more likely when the curriculum is relevant and appropriate.

Frigo (1999) arrived at similar conclusions in identifying a number of key themes that seemed to exist, mainly relating to the need for culturally appropriate content and strategies to reflect the learning needs of Indigenous children. She particularly noted the complex nature of issues related to language and mathematical learning. In addition, Frigo also noted "It is crucial that teachers are encouraged to have high expectations for all of their students and therefore of themselves" (p. 27).

Difficulties such as cultural differences associated with numeracy and literacy learning by Indigenous children have been acknowledged in Australia (Perso, 2003) and overseas (Agirdag, 2009). These are compounded by the requirements related to 'mathematical language'. Parkin and Hayes (2006) studied the use of word problems with Indigenous children, noting that many were competent with the mathematical processes involved but struggled when problems were embedded in an apparent 'real-life' context. They felt that this was due to children "... not being able to access the language of maths ..." and that this in turn meant that they "... had no way of interpreting the problem, identifying the mathematical processes and consequently completing the task" (Parkin & Hayes, 2006, p. 23). Indigenous children in Australian schools could be regarded as ESL (English as Second Language) learners. For some of them, the language spoken at home is an Aboriginal dialect or 'Aboriginal English', a type of 'kriol' language, or a mixture of English and a local dialect.

Recent literature from the United States presents a number of ideas that would seem to be applicable to the Australian context. A study of four United States schools with at least 30% of their populations being English Language Learners (ELL) revealed that ELLs in the four schools demonstrated substantially higher proficiency in statewide testing than ELLs in other schools (Aleman, Johnson Jr., & Perez, 2009). The authors attributed the high success rate to four factors. First, the schools set high expectations for ELLs, based on a set of well-publicised benchmarks and collaborative planning among teachers. Second, instruction was focused on deep conceptual understanding as opposed to procedural knowledge, characterised by much student discussion, explanation and writing, as well as constant teacher feedback. Third, a 'culture of appreciation', based on

mutual respect for all members of the school community, was evident. Indeed, "Parents perceive that teachers and principals value their children, their children's cultural backgrounds, and themselves" (Aleman et al., 2009, p. 68). Finally, strong, intelligent and caring leadership from school principals in establishing and pursuing clear goals through a team-oriented approach was a vital factor.

Recently, Agirdag (2009) in studying the schooling of language learners in Belgium suggested that the 'meaningful' involvement of parents, family, and the community in schools was a crucial ingredient of success for English Language Learners. He promoted the idea that the use of children's 'home languages' alongside the general language of instruction (such as English) is preferable to insisting on excellence in say, English, as the first priority. Indeed, "…excluding students' home languages from the classroom does not assist them; rather, it may hinder their learning process" (Agirdag, 2009, p. 22).

The ideas expressed in the work of both Aleman et al. and Agirdag are supported by Ramirez and Soto-Hinman (2009) who reviewed experiences in a number of United States schools with ELLs. They suggest that the learning experience for ELLs can be greatly enhanced by avoiding culturally based stereotyping, misconceptions and misinformation, and promoting openness and involvement of parents and families. They advocated 'opening the schoolhouse doors' and making the school more welcoming and less reliant on the cultural heritage of its teachers but rather that of its children, parents and community. Schools are encouraged to make use of the great resource that is the parent body there before them. "Parent involvement practices do not require teachers to do everything. Recruit, recruit, and recruit parents to work with you" (Ramirez & Soto-Hinman, 2009, p. 81).

Returning to the local context, Howard and Perry (2008) identified the importance of recognising the unique ways in which Indigenous children learn mathematics and the importance of pedagogical reform to acknowledge this. They concluded that all parties involved:

> should collaborate to talk about, reflect upon and make decisions about appropriate actions that need to take place within schools and homes to enhance Aboriginal children's mathematics learning [and] assist teachers in discussing and identifying ways in which Aboriginal children learn mathematics (Howard & Perry, 2008, p. 7).

Context

Three primary schools situated in the eastern suburbs of Perth are involved in the project. One is an independent Indigenous school, one a state government run Indigenous school, and the other a state government run mainstream primary school. These three schools form the project cluster and have student populations shown in Table 1.

School	Controlling body	Indigenous population	Non-Indigenous population	Number of classes
School #1	Independent school board	48	0	2
School #2	W.A. Education Department	130	1	7

School #3	W.A. Education Department	50	370	17

Table 1: Statistics of participating schools in the cluster

The schools were purposively chosen as they are of differing types and have different constituent populations. Each school considered factors impacting on mathematics outcomes for its children and planned actions that would aspire to improve those outcomes. Hence, the initial plans, which form the basis of the project, varied from school to school. The plans were to be designed by key members of each school community (the Principal, teachers, School Board members) in collaboration with the researchers, who assumed the role of 'academic friends'.

Methodology

The initial phase of the larger project was established to investigate the following three questions:

1. What are the needs of this group of Indigenous children in the learning of mathematics?
2. What factors impact these children's mathematics learning?
3. What factors within the school context could be used to enhance children's learning of mathematics?

A qualitative, case study approach was used to gather data to answer the questions and to understand the situation in a detailed way. The main data gathering techniques were semi-structured interviews, document analysis, classroom observation, diagnostic interviews, and focus group discussions with the two classes of children (the initial intention of using a survey instrument was abandoned when many children's difficulties with reading was noted). The method for developing an action plan for each school varied with each school context. In School 1 for example, a broad perspective on the questions was gained by interviewing a range of participants from the school and its community — Principal; staff; Aboriginal and Islander Education Officer (AIEO); School Administrator; children; Chair of the School Board; and an Elder from the Community. These interviews were audio-recorded and were used to inform the development of the initial school profile. In addition, the researchers visited classrooms in the cluster schools and informally observed teaching in action. A similar process was followed in each of the other schools.

In School 1, base-line data about student numeracy and mathematical content knowledge were gathered from diagnostic interviews with children in Years 1 to 7 conducted by teacher education students. The interview instrument used was the interview schedule developed in the Early Numeracy Research Project (ENRP) (Department of Education of Victoria, 2001) and the interviewers were given specific training in its use. In addition, and as a means of triangulation, data from the students' achievement on NAPLAN tests were collected in the initial stages of the project. In Schools 2 and 3, base-line data were gathered from the implementation of First Steps in Mathematics diagnostic tasks as well as from NAPLAN results.

Results and Discussion

The following discussion is informed by the three research questions, an abridged version of each being offered here as a set of organisational headings.

Mathematical needs of this group of Indigenous children

Counting and place value are two key ideas that underpin mathematical understanding and initial data gathering focused on the children's knowledge of these concepts. Most children were confident in counting by ones both forward and backward when numbers were relatively small but referents such as fingers were often used, even by older children. Similarly, most children were able to recognise, write and name number symbols appropriate to their age level, and most were able to order numbers by size. There appeared to be a need for children to experience a broader view of counting including skip counting, counting from different start points, and moving beyond two digit numbers to bridge one hundred and one thousand. The ability of children to partition numbers in flexible ways seemed to be limited and this impacted on their ability to calculate beyond simple but age appropriate addition and subtraction situations.

Generally, the major need appeared to be for greater flexibility in thinking by the children. This is partly reflected in the previous comment about counting but also encompasses the need to use a range of calculation strategies, particularly with regard to children using their own mental strategies and being able to share and discuss them. As well, they need to be able to make links between addition and subtraction, and multiplication and division. Overall, there appeared to be a need for a much greater focus on the development of conceptual understanding, rather than procedural knowledge. Children generally used a very limited range of strategies when working mathematically and this needed to be broadened.

Children's literacy levels appeared to have a significant impact on their mathematical learning. In particular, a lack of 'test literacy' was felt to contribute to NAPLAN results that were below benchmark achievement. Some teachers in the schools expressed anecdotally that children performed better when given the opportunity to work on similar tasks on a one-to-one basis with a teacher or aide, whereas they tended to give up when confronted with the literacy requirements of test items in a test situation. In general, a lack of knowledge of mathematical terminology detracted from children's ability to solve problems, but also the presence of misconceptions about common terms like 'before' and 'after' caused difficulties for some children. In many instances, children had difficulty in explaining their thinking and this appeared to affect their confidence in solving problems.

Factors impacting on children's mathematical learning

One factor that was identified across all three schools was the need to raise expectations among teachers, parents, students, and the wider community. This was seen as having a 'flow on' effect on children's attendance, engagement, and learning, and was seen as a key that underpinned the Cluster Plan.

Children's rate of attendance was identified by all three schools as a significant factor though the nature of this varied across each school. In School 1, attendance on particular days of the week was better than on some other days that were not considered as 'school days' by some families. Similarly, attendance at family occasions such as funerals meant

that some children were absent for extended periods. Generally, schools considered that about half of the children attended regularly and that about half did not do so.

Attention span of children was noted as an area of concern. A number of children struggled to engage with tasks and were keen to finish them quickly regardless of the result. As well, many children were easily distracted by activity and movement and were interested to see what others in the room were doing.

There appeared to be considerable variation, in some schools more than others, regarding the level of use by teachers of 'hands-on' or manipulative resources. In one school, it was acknowledged that there was a general lack of such resources while in another, there were resources available but teachers were not versed in how to best use them to help children.

The contextual relevance of activities was expressed by some teachers as possibly having an adverse impact on learning. Children appeared to be more engaged when mathematics was embedded in a context that was relevant to their interests, such as sport, and where there was some incentive attached to attending and learning. There appears to be scope in the three cluster schools for embedding mathematical concepts in contexts such as gardens, sport, food and nutrition.

Factors within the school context that could enhance learning

Each school has a different context and hence the possible factors that could enhance learning vary from school to school. Notwithstanding, the issue of parent and community involvement in schools was identified as a common factor. In two of the schools, this problem was exacerbated as a large number of parents lived up to 30 kilometres from the school campuses and did not have their own transport. It was felt that there might be a link between this and the rate of student attendance and consequent engagement in mathematical learning and that ways to improve the level of parent involvement should be investigated.

A program of 'family days' has been used in two of the schools and it was felt that an extension in the frequency of this program, as well as targeting mathematical activities as a part of the family days, might attract more involvement from parents. Another aspect of the plan to increase parent involvement is to encourage them to visit classrooms and see their children involved in mathematical learning experiences. Initially, this might involve parents participating in informal sessions to make simple hands-on resources for classroom use.

Teacher professional learning, particularly in mathematics teaching, had varied considerably across the three schools, and a similar situation existed regarding the presence on staff of teachers with specific expertise in these areas. It was generally accepted that targeted professional learning in raising student expectations and in programs such as First Steps in Mathematics would benefit staff and would be likely to have a positive impact on student learning. Also, the three schools planned to share staff expertise across the cluster.

It was felt that there is likely to be a complex, almost cyclical relationship among many of the above factors and that effective strategies would be needed to 'break the cycle'. Figure 1 represents the relationship that was thought to exist in the cluster schools.

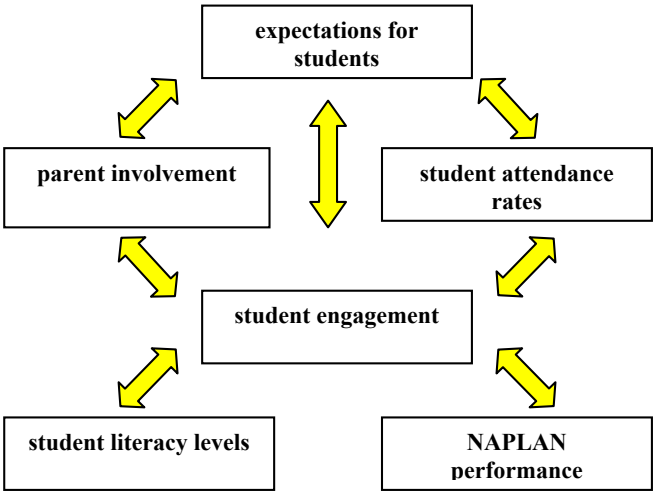

Figure 1: Cyclical relationships among common factors in Cluster Schools

A 'Cluster Plan'

Following consideration of the above common concerns and issues, a Cluster Plan was developed to address them. This plan also addresses the three research questions described earlier. The main features of this plan, with examples of planned actions, are outlined in Table 2. Within the Cluster Plan, there is scope for each school to meet the specific needs of its own students within its own unique context.

Overview of outcomes and examples of planned actions	Research question
Raise expectations for student learning _ Targeted specific professional learning in expectations _ Specific strategies to improve attendance rates	Question 2 related to factors on learning
Professional development of teaching and support staff _ Shared professional learning and staff sharing across cluster _ Targeted development of conceptual understanding	Question 3 related to school context factors
Increase parent involvement in educational program of schools _ Extend concept of 'family days' with numeracy focus _ Train parents to make resources and as classroom helpers	Question 3 related to school context factors
Increase student engagement _ Embed concepts in high interest activities like sport, Indigenous art, and gardens	Question 2 related to factors on learning
Target specific aspects of curriculum that require development _ Develop conceptual understanding rather than procedures _ Develop mathematical literacy base to improve test literacy	Question 1 related to mathematical needs of children

Table 2: Summary of Cluster Plan

Conclusion

This study approached the issue of Indigenous children's mathematics attainment from three viewpoints – specific numeracy and mathematical needs, student related factors that impact on that learning, and factors related to school contexts that could enhance that learning. First, there appear to be a number of aspects of mathematics in which the Indigenous children at these three schools require specific assistance. These are related to the need to develop conceptual knowledge as opposed to procedural knowledge and linked to this is the need for greater flexibility in the use of key concepts such as counting and place value. Children's literacy levels and test literacy greatly impact on their mathematical learning and test achievement. Second, the level of expectations for, children's achievement, as well as their rates of school attendance, are identified as key factors in their learning. Children's engagement and the use of a range of hands-on resources are also significant. Third, the need for targeted professional learning of teachers to address identified mathematical and numeracy needs is important, as is the need to increase parent involvement in schools.

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