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Changing the teaching of mathematics for improved Indigenous education in a rural Australian city

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Abstract Transforming teachers and their approach to teaching Indigenous students requires partnerships with the Indigenous community, planning, small steps, and funds. This article illustrates how teachers can change when funds are available to assist schools and communities to implement appropriate and effective professional development, to establish partnerships between school and community, to revise teaching approaches and curriculum, and to value family and Aboriginal cultural heritage. The larger study involved four schools in a Stronger Smarter Learning Community in a small rural city, the whole city community, and the interaction among the schools. Interviews with principals, teachers, Aboriginal students, and their community highlighted the increasing interaction between the Aboriginal community and the schools, the increasing warmth and welcome extended both ways, and the impact that these approaches are having on curriculum, teaching, and learning. This article presents the impact in one of the schools involved in the mathematics project. The findings illustrate how the projects facilitated changing teachers' perceptions, skills, and practices and implemented curriculum, and resulted in a culturally responsive, place-based mathematics education.

Keywords Indigenous education · Primary education · School and community partnerships · Teacher professional development · Ethnomathematics · Culturally responsive education · Mathematics education

Introduction

Concern has been expressed at the gap between Indigenous Australian numeracy and literacy scores and State averages on National (called NAPLAN) testing at Years 5 and 7 in schools (Department of Education Employment and Workplace Relations 2011). To address these issues, at Commonwealth and State government levels, there are policies and strategies

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encouraging schools to partner with their Indigenous communities in order to provide improved quality education for students (Department of Education Employment and Workplace Relations 2008; Department of Education Employment Work Relations 2009; NSW Department of Education and Community 2008; Slack-Smith 2008). The National and State governments have funded a number of projects to support change including the initiatives that are discussed in this article. The study explores how a school in a rural city of New South Wales (NSW) Australia improved its mathematics curriculum, teaching, and learning by participation in three key projects and several other projects. The school was simultaneously one of a hub of four schools for a Stronger Smarter Learning Community (SSLC) (Stronger Smarter Institute Queensland University of Technology 2010), the lead school for a cluster of Make It Count (MIC) schools (Australian Association of Mathematics Teachers 2009), and an enthusiastic participant in a regional initiative using the 8-ways approach to Indigenous education (Yunkaporta and McGinty 2009) [further details of these projects are provided below and details of all schools in Owens (2012)]. This focus school was selected because it was involved in all three projects.

I was involved in the evaluation of the SSLCs nation-wide (The Core Research Team Faculty of Education 2013) by providing a case study report for the Glenroi Heights hub of SSLC schools. The evaluation and writing up of the case study on the SSLC occurred 1 year into the project, but the principals and other teachers of the schools had been involved in Stronger Smarter Leadership Training from 4 years earlier and onwards. However, the Principal at Glenroi Heights Public School had made plans 3 years earlier again and taken action to build relationships with the community and use available funding to make a difference.

The evaluation of SSLCs involved the collection of extensive documentation and interviews of teachers, staff, Aboriginal students, parents, and other community members. In addition, informal conversations and meetings during visits to the schools, yarn ups (gatherings for sharing stories), and observations of events in the schools were important in developing the case study. It is upon these data and the case study report that this paper is based. This article refers to the situation in one of the four schools using the interviews and documents from this school but informed by the information gathered in the four schools and their Aboriginal community. The interviews and documents were analysed to evaluate how the teachers through the projects individually and together were becoming culturally responsive and providing education cognisant of the Indigenous community. The discussion concerns how transformative changes have impacted on mathematics education in the school. The discussion is significant for any teacher who teaches mathematics to Indigenous students including the teacher who is not a specialist in mathematics education but teaches across the range of primary (elementary) school subjects. It is not only a change in mathematics education but a change in approach across the subjects. Nevertheless, there was evidence that specific changes were being made to mathematics teaching and engagement of students in mathematics.

Involvement in three main projects

Stronger Smarter Learning Communities are set up by the Stronger Smarter Institute (SSI) to ensure greater impact and sustainability of the SSI approach to Indigenous education. This approach is centred on "high-expectations and relational approaches to Indigenous Education. … Its overall aims and objectives are to transform schools through the building of leadership capacity and thereby to sustain and grow improved student outcomes within

Indigenous communities" (Stronger Smarter Institute Queensland University of Technology 2010). Each SSLC has a hub school that has a successful ongoing transformation to improve attendance, engagement, expectations, and student outcomes, and the Principal has undertaken SSI Leadership Training. The Stronger Smarter Leadership programme is a minimum 12-month commitment and requires commitment to two face-to-face forums and all programme components. The first forum enhances collaborative and cultural competence and leadership capacity to facilitate change, engage Indigenous community, and transform learning contexts. This is taken back to plan and implement small changes in the workplace, followed by review and discussion with participants and the SSI team, further implementation, online discussions, and forum. The SSLC is part of the ongoing support and spread of transformative ideas and practices.

Make It Count is a project of the profession of mathematics teachers working with schools and their Indigenous communities to develop approaches that enhance Indigenous students' learning; to document and share effective models of teacher professional development, whole school change, and community engagement; and to build the community of practice and be a catalyst for further action. It involved schools with a reasonable proportion of Aboriginal students but not a large proportion. The two MIC schools in the SSLC hub had a 10 % proportion of Aboriginal students. Schools were able to plan how they wished to be transformative with few guidelines but some generative approaches developed during meetings of schools' principals and staff and those advising them.

The 8-way project is a State NSW Department of Education and Communities' Western Region project to encourage cultural competence of teachers in the schools. The professional development was undertaken by the 8-way developer Tyson Yunkaporta who encouraged school ownership of the project. This project promotes education through:

- connecting through the stories that are shared;
- picturing pathways to knowledge;
- seeing, thinking, acting, making, and sharing without words;
- keeping and sharing knowledge with art and objects;
- working with lessons from land and nature;
- putting different ideas together and creating new knowledge;
- working from wholes to parts – watching then doing; and
- bringing new knowledge home to help the family/community. (School document on 8-ways; see also Yunkaporta and McGinty 2009).

Each point is represented by a symbol that is frequently used in teaching plans at this school to emphasise where it meets one of these points. The focus school took on such ownership of this project that they have a mural in their front office, a detailed plan with strategies, links to elements of the Quality Teaching and Learning Framework (a NSW State schools' expectation), and typical teaching and learning experiences. They decided that the point on working from wholes to parts linked to students watching the model and doing and then to assessing the students' implementation. Their mural therefore had nine points. By contrast, at Glenroi Heights Public School, there was little impact of the 8-way project as Tyson Yunkaporta concluded that this school was already achieving its goals the "Glenroi way".

The schools and their communities

This article is the story of one of four schools in Orange, a rural city on Wiradjuri country in NSW Australia that is finding ways to improve the numeracy of its Indigenous students.

The city's Indigenous population consists mainly of families who were resettled by government into the town and their descendants and relatives. The socio-economic circumstances and cultures of the communities have been impacted by the oppression and policies of colonisation (Parbury 2005). For some children with changes in departmental policies and school approaches, they are only now learning to which language group they belong (mostly Wiradjuri, Gamilaroi, or Barkanji but there are several others in NSW). None of the families up until now have spoken their language except for some words and phrases, sometimes in an Aboriginal English dialect (interviews and informal discussions with community members).

There are four quite different schools in the SSLC with the hub school being Glenroi Heights Public School (GHPS).[1] GHPS is a middle-sized school in an area with 97 % unemployment, 40 % of enrolment is Aboriginal and when the current Principal began at the school, there was 50 % attendance, a deficit model of education, and plenty of excuses about students' backgrounds for poor performance (interview with the Principal and interview with Assistant Principals who also have classroom teaching responsibilities). Bowen Public School is a small school with a transient population of children and with a low socio-economic catchment and a large proportion of Aboriginal students (interview with Principal). Orange East Public School is another small nearby school with just over 10 % Aboriginal population and a more mixed socio-economic catchment. These last two schools have a number of recently arrived immigrant families, for example, from Africa. The final school is a large well-established school with a growing number of Aboriginal students (60–70 still below 10 %) identifying as Aboriginal. It is significant that more students in the schools are acknowledging their Aboriginal heritage. It is this last school which is the focus of this article.

Theoretical perspectives

The story of this school extends the role of ethnomathematics in cities with highly colonised effects on thinking and status. Ethnomathematics is the mathematical thinking, understanding, and techniques that are embedded in cultural thinking (D'Ambrosio 2001) where "ethno" refers to a group of identifiable people and not necessarily an Indigenous or linguistically identified group. Most school-in-community studies linked to ethnomathematics involve community that is largely Indigenous and often maintaining a distinct language other than the dominant national language such as English (Lipka and Adams 2004; Teasdale 1992; Thornton and Watson-Verran 1996) or where the students are bilingual and immigrant (Planas and Civil 2009; Skovsmose et al. 2007; Téllez et al. 2011). By contrast, this study is set in a rural school where the Aboriginal language is only now being revived and cultural recognition is being acknowledged.

The key issue is not that of mathematics per se but of the ownership of the mathematical thinking and how that might be shared in and out of the school classroom Owens et al. (1998, 2011). In this respect, it is the people involved and their relationships between each other and the land that is of key importance. For Indigenous communities, the roles and relationships of the Elders are central. "Cultural revitalisation encourages Aboriginal people to seek out and perform cultural authenticity as compensation for exploitation and oppression" but the schools may still react negatively to the revived cultural approaches if they are perceived as "incongruent with dominant school culture" (St. Denis 2007,

[1] Three schools wanted their names to be included in reports.

p. 1080). However, the stories of injustice, racism, and the impact of colonisation are now part of the community's culture to be recognised by teachers (O'Sullivan 2011; St. Denis 2007). Without specific policies that permit an Indigenous voice and recognition of Indigenous knowledge and the associated rights, there will be little progress in establishing a continuity of education (Owens et al. 2012).

The question remains whether we are talking about ethnomathematics or culturally responsive teaching (Castagno and Brayboy 2008; Gay 2002). Tutak et al. (2010) considered ethnomathematics as separate to culturally relevant or responsive teaching but they suggest both provide for equity in mathematics education. Yet their description of culturally responsive teaching based on Gay (2002) covers ethnomathematics "developing a knowledge base about cultural diversity, including ethnic and cultural diversity content in the curriculum, demonstrating caring and building learning communities, communicating with ethnically diverse students, and responding to ethnic diversity in the delivery of instruction" (Gay 2002, p. 36). Ethnomathematics as a community's way of thinking mathematically when it is incorporated in schools is also a means of attaining social justice (Gomes and D'Ambrosio 2006) but one which is not always appreciated by critics of ethnomathematics who see it as only an introduction to mathematics superseded by school mathematics or a cultural application of mathematics (Pais 2011).

In fact both the Australian Curriculum and the National Council of Teachers of Mathematics have an equity principle including high expectations and strong support for all students. Nevertheless as Gutstein (2006, 2007) pointed out, there is little guidance about how to achieve these. The three projects implemented in this school have attempted to provide a way forward.

The importance of any transformation of education in terms of social justice is

> not the demand for recognition of a group's specific identity, but the demand for recognition of people's standing as full partners in social interaction, able to participate as peers with others in social life. That aspiration is fundamental to justice and cannot be satisfied by the politics of redistribution alone. What is required, therefore, is a politics of recognition that aims at establishing status equality, not at validating group identity. (Fraser et al. 2004, p. 377)

In order to participate, Indigenous communities often need to reclaim aspects of their identity and to shed feelings and behaviours resulting from racism around "difference". Fraser argued that through material distribution of resources and political decision-making, all participants are expected to have independence and a voice. Indeed, "the social status order must express equal respect for all participants and ensure equal opportunity for achieving social esteem" (Fraser 2010, p. 363, p. 363) especially in terms of cultural values and patterns within the institutions and the equality of social interaction. In other words, the school and community partnerships support recognitive social justice in which the partnerships have a voice in the decisions in the ways funding supports the opportunities for equity (Apple 2004; Hickling-Hudson and Ahlquist 2003) through a critical pedagogy that questions relationships in education and learning and can be linked to relationships with place (Gruenewald 2008). In this case, the social status order recognises Indigenous Australians as having a special relationship with place and knowledge that is not seen as just the starting point for engagement that then looks at following in a non-Indigenous way what the State and National curriculum require in terms of outcomes. Instead, cultural ways of thinking are part of the knowledge related to place and a basis of ethnomathematics (Owens 2010, 2013; Owens et al. 2011).

Thus, ethnomathematics which emphasises socioculturally developed ways of doing and thinking mathematically forms a basis for our discussion. However, a critical ecocultural perspective questions curricular expectations and ways of teaching providing a way that culture, place, and ecologies are considered in education (Barnhardt 2007; Gruenewald 2008; Owens 2013). Ecologies relate to relationships between people and their relationships to place and between places. In the case of this study, a small rural city based initially on good agricultural land and early gold rushes continued to grow as a relatively wealthy community. The environment is relatively cold and has a special mountain. It is, however, Wiradjuri land, and there were disputes and lack of recognition of these rights. Furthermore, it was a city into which the government settled people in the second half of the twentieth century from other language groups but with whom the Aboriginal people still maintain close ties. In fact, there is considerable movement back and forth between towns further west, north, and northwest of the city. So in addition to the links between land and people in this city, there are also Aboriginal links between the families of this city and other places. There are also pockets within the city where Aboriginal people tend to live and where unemployment is surprisingly high. Within this ecocultural background, education occurs and so the form of critical pedagogy referred to in this article has an ecocultural perspective.

Students need a transition situation that supports developing identities and lessens risks to their cultural identities (Spencer 2006). Transition situations are best negotiated by partnerships. Gervasoni (2005) noted several principles and processes for successful community engagement including the establishment of authentic relationships as

> a basis of community engagement. Such relationships are based on openness and trust, and are formed at both personal and institutional levels… Relationships require time and "nourishment" to form and develop. This must be acknowledged by the (institution)[2] and supported by appropriate work structures and practices… The partnership requires plans for sustainability … and mutually beneficial goals supported by good communication strategies to raise awareness in the community of the institutional willingness to tackle inequalities and sociocultural injustices (Gervasoni 2005, summary).

Strong community partnerships are reflected in mathematics teaching when there is a whole school and community effort (Howard et al. 2003; Matthews et al. 2005) and when the voices of parents, teachers, and Aboriginal children are heard (Matthews et al. 2005). Educational systems need to enact this collaboration by developing curriculum documents through community partnership and shared ownership. However, the enacted curriculum changes when cultural understandings develop and there is a decolonising of the curriculum, teachers' thinking and approaches, and even that of the community as emphasised in Maori mathematics education developments (Te Kotahitanga 2008) and Sámi programmes (Jannok Nutti 2008).

In such projects, schools explore the funds of knowledge of the schools' communities resulting in teachers valuing Indigenous and non-mainstream knowledges and hence encouraging school systems to build authentically on Indigenous and community knowledges (François 2010; González et al. 2005; Owens et al. 2011). There is change in teachers' ways of thinking and educating. Experiences are personal and purposeful, and informed by Indigenous communities facilitating an ecocultural pedagogy (Chinn 2007).

[2] The original report referred to universities and the Australian Catholic University in particular.

Ecocultural pedagogy fosters connection and attachment to local places and provides interrelationships between one place and another. Gruenewald (2008) says "to know anything about this world is to know its places" and to value them. Ecocultural education contextualises opportunities to explore the ecological, social, and political dimensions of those places and recognises Indigenous conceptions of place as an inseparable link between person and country (Cameron 2003). An ecocultural pedagogy involves educating within a local and ecological context, identifying and challenging oppressions of race, class, gender, (and nature), decolonising, and reinhabiting place-based knowledge (Gruenewald 2008). However, this becomes a challenge for schools working under centralised curriculum and high-stakes testing regimes (Apple 2004).

Part of the emphasis in professional development for an ecocultural pedagogy is to develop the cultural competence of the teachers in making professional judgements about pedagogy and the content of the mathematics to teach (Averill et al. 2009; Johansson 2008; Perso 2005; Te Kotahitanga 2008). In practice, this occurs

> when educators create learning contexts within their classroom; where power is shared between self-determining individuals within non-dominating relations of interdependence; where culture counts; where learning is interactive, dialogic and spirals; where participants are connected to one another through the establishment of a common vision for what constitutes excellence in educational outcomes. (Te Kotahitanga 2008)

Tuinamuana (2007) in Fiji and González et al. (2005) in the USA also show that critical pedagogy with an inquiry-oriented paradigm results in a hybrid way of teacher thinking that serves their students better than a curriculum based on the majority view of mathematics and psychological theories. Furthermore, when school mathematics is imposed without regard to cultural background, it encourages a belief that mathematics is rote practice of procedures rather than about understanding and relevance (Lave et al. 1989).

Cultural and communication competences are critical for teacher education as illustrated in the Swedish Indigenous Sámi projects in which teachers learnt to communicate, learn from, and involve Sámi families, often in out-of-class cultural experiences and ways of knowing (Johansson 2009; Owens et al. 2011). In many cases, teachers and communities decolonise their thinking by learning about different approaches, trying appropriate changes, experiencing change in student attitude, behaviour, and mathematical performance, and through affective experiences that unsettle their current ways of acting and thinking. As a result, transformations occur (wa Thiong'o 1998; Paredes-Canilao 2006; Smith 2005). Nevertheless, this professional learning takes time and input from others (Castagno and Brayboy 2008). In the current study, the input was from a community of practice, namely other teachers, school employees, and other educational professionals, but it was also from the partnerships with the Indigenous Aboriginal community. In practice, this requires plans and structures, spaces for talking and learning, and involvement of appropriate people.

There are some possible pitfalls in attempts to bring about change. When teacher professional development is short term for a seminar or a day, it may fail to be transformative because there is no real engagement of beliefs and attitudes and practice. Furthermore, "teaching focused on improving student achievement data actually bypasses learning. It champions the end result, or at least one end result, over everything else. It may be effective, but it does not equate with meaningful learning, by students or by teachers" (Gale 2006, pp. 22–23). Such professional development may not permit teachers, who already have considerable skills, knowledge, and values about teaching and their students,

to have an input into their development instead of being consumers. Teachers need to assess the larger issues related to school decision-making such as neo-liberal approaches to assessment and funding, global trends, employment, community, and intra-school relationships. Furthermore, teachers need to listen to their Indigenous communities, and their communities need to know how to bring about change in the schools. Decisions about what is success, what is taught, and how it is taught lie with the teachers and the communities rather than with imposed policies and projects. Thus, it is important to establish a community of practice over a period of time.

Teachers within a school become an effective community of practice when they have a strong set of goals, expert mentoring, and coaching in preparation and in the classroom, sustained professional development through collaborative professional communities, personal and career development, and informal support within and beyond the school. Professional development within the community of practice is organised around real problems of practice with a focus on specific curriculum content and classroom and community relationships (Garii and Silverman 2009; Rouse 2007). However, the community of practice reaches beyond the classroom and school and involves an extension of how the school staff develops as a result of their connection with their community. As Siemon (2009) points out, there can be an interesting change when the Indigenous community of practice meets the school's mathematics community of practice. Discussion assists the development of a shared knowledge with continuing equitable interaction at the intersections of the communities of practice (Lovat and Toomey 2009).

I was interested in analysing the case study data collected for the evaluation of the SSLC project to inform our understanding of an ecocultural perspective of mathematics education incorporating transformative change, culturally responsive teaching, and ethnomathematics in a school community that has been affected by colonial oppression.

Methodology

Relevant issues from the case study methodology

The nature of the data for the case study was decided by the evaluation team of SSLCs. It was to be based on interviews and documentation. These data were collected after the schools had been participating in the project for a year. Thus, the interviews covered the perceptions of teachers and others about the changes that had occurred over the previous period of time. Such interviews can lack information as it is retrospective but they provide a holistic and sustainable perspective as thoughts have become reified and behaviours established. The data are considered in terms of what is effective and what might inform our theoretical understanding of teaching mathematics in rural communities with a significant minority of Indigenous students who may speak another dialect of English but not a different language and whose cultural groups have been strongly impacted by colonial policies and education over the years.

For the evaluation case study, ethics approvals were obtained from our Universities[3] and the Department of Education and Communities. The researchers negotiated with the schools and the Aboriginal community what should be the focus of the case study, who should be interviewed, and what documents could be considered as evidence of the schools

[3] The case study was part of an SSLC evaluation project which included researchers from The University of Newcastle.

engaging the Aboriginal community and the students in learning. Interview schedules and information letters were prepared for the principals, staff, students, their parents, and community members. We met with the Aboriginal Education Consultative Group and community representatives, two principals from the two larger schools, and an Aboriginal teacher to discuss what they regarded as important issues. Just as the data collection was beginning, a new Principal began at the focus school who approved of the data collection but was understandably hesitant for the school's name[4] to be used in research publications. The Deputy Principal was Acting Principal immediately before the retrospective data collection, and so she responded to the principal's interview, follow-up checks, requests for documents, and organisational matters. All research processes had the approval from the SSI who provided training for the researchers in terms of the overall evaluation of SLCCs, protocols, relationships between researchers and communities interviewing and recording procedures, and the Stronger Smarter approach.

I, the researcher, live in Wiradjuri country in another large rural city and have friendships with a number of Wiradjuri and Gamilaroi people living in the city (some people for over 15 years prior to coming to my city). I completed my second year of study of Wiradjuri language and culture and continue participating in my own local Aboriginal Education Consultative Group. Prior to the interviews, as the researcher, I visited, held meetings, and yarned for 6 months in the schools' community in order to be familiar with the socio-historical contexts of participants and the schools' community and regional educational contexts. I[5] have had considerable experience in interviewing Indigenous people, or rather yarning or talking with and listening to Indigenous people. The Local Aboriginal Research Assistant lives in a nearby rural city, undertook a practicum at one of the schools prior to being appointed to this position, and met up with relatives and other community members in the community. The Local Aboriginal Research Assistant undertook all interviews with the community members, parents, and children. The researcher interviewed teachers and other staff, both Aboriginal and non-Aboriginal. In total for the SSLC case study, over 42 people were interviewed—see Table 1[6] for details of transcribed interviews. The evaluation case study was the story of these schools' involvement in the SSLC—see Table 1 for more details on enrolments and teachers. It should be noted that the rural city is small, and the Aboriginal community spreads across it so that community knowledge from Elders and community provided near one school is largely applicable to other schools.

There were interview schedules to guide discussions. For example, the interview of principals included the following questions:

- Could you please tell me a little about yourself and your school and your Aboriginal leadership experiences?
- Could you describe your understanding of the concept of dynamic models of staffing?
- What do you understand by the term Aboriginal identity and how is it promoted in your school?

[4] Individual staff members gave approval for their names to be used but I have chosen not to use them in this article.

[5] My background includes more than 35 years of awareness and action on Aboriginal issues in NSW and research with Indigenous colleagues over that time, mostly in Papua New Guinea (PNG) where I lived for 15 years but more recently with Aboriginal people in NSW. This long-term connection with Indigenous ways of thinking influenced my interviewing and analysis.

[6] Unexpected circumstances reduced the number of intended interviews.

Table 1 .

School	Number of children	Aboriginal children (%)	Number of teachers	Number of other staff (many Aboriginal)
School enrolments and staff				
Glenroi heights	222	40	22	8
Bowen	174	33	13	6
Orange East	255	9	14	3
Focus school	643	7	42	5

School	Teachers including principal and community	Other staff who are part of the community including Elders	Other community members including parents and Elders	Students
Number of interviewees from the schools				
Glenroi heights	6*	2	2	6
Bowen	2	1	6	2
Orange East	3#	0	0	3
Focus school	5	1	0	3

* 1 mature-aged but recent graduate who was Aboriginal and had been a Teacher's Aide, two with about 5 years of experience, the rest very experienced. In the other schools, very experienced teachers were interviewed as they were mainly executive teachers. All teachers in primary schools teach mathematics. As a rural city, teachers tend to live in the same city or on nearby farms

1 recent graduate but rest very experienced

However, taking a yarning, listening approach permitted interviewees to ask questions and turn the discussion onto some of the issues they felt were significant and important to mention. Thus, the interviews were carried out sensitively with due consideration to people's time and culture. By establishing relationships prior to interviewing, the researchers were able to develop a degree of trust especially around the purpose for the interviews. Interviews with Principals were about an hour with at least three more informal sessions of about 15 min each. Interviews with teachers were between 20 and 30 min, with children about 10–15 min and with the community and other staff about 20 min together with informal short discussions although a couple of group interviews were 40–50 min each. We also attended a couple of yarning sessions held mainly for Aboriginal employees across the city, many of whom were teachers or assistants in schools. These approaches for interviewing are in line with those suggested by Fraser (2004).

Documents consisted of school policies, action plans, and strategies; school brochure and website; annual school reports, weekly newsletters, and Aboriginal children's newsletters; brochures on organisations connected to and promoted by the school; summaries of data from National school testing; lesson plans; Aboriginal Education Officer's schedules; school murals and displays, and Wiradjuri learning plan.

In the analysis, I[7] particularly noted dominant discourses relating to the three projects (SSLC, MIC, 8-ways Aboriginal approach to teaching) to interpret and understand the stories. I read three case studies based on similar interviews and documents prepared for other NSW Regional SSLCs. Similarities and differences highlighted significant features of the Glenroi Heights SSLC. For example, certain Aboriginal women had created opportunities for women in two of the SSLCs' Aboriginal communities, and this was noted in several interviews in both SSLCs. Thus, there was an attempt to develop the analysis from the points raised as important by the interviewees or in the documents. The story line was developed and checked with other data sources and refined.

The critical analysis of the data is informed by the above theoretical discussion. Several themes emerged when the data from the schools were being collated and a content analysis of the interviews occurred. These themes form the basis of the following discussions. Because the case study was the story of the schools, a narrative research perspective has been employed (Fraser 2004) but in a holistic manner rather than line by line so that the implications and intent of the speakers are not lost. Nevertheless, cultures (both those of the teaching community and the Indigenous community) are the foregrounds (Skovsmose et al. 2007) to be critically considered in the analysis. A summary of the reality of the social structures is provided with interpretation and even challenges of possible beliefs, assertions, and assumptions generated by the school and community during interviews. I present this as the story line emerging from the data as one would expect in a grounded theory study and provide interview data that enriches this story. In Indigenous communities, important ideas are presented in story form, and I use the term story to engender links to both the qualitative grounded nature of the study and the Indigenous context.

[7] The Local Aboriginal Research Assistant chose not to participate in this phase of the study because of her own study time constraints although she had several analytical conversations with me as she was gathering data about the interviews and the community and these points have influenced the analysis.

The findings: the emerging story

The importance of funding and a critical mass for change

At the time of writing, there are now 44 teachers in these schools and surrounding schools who have been trained through the Stronger Smarter Institute (2010). Some attended SSI residential forums in Queensland with participants from across Australia but others attended training in locally held forums. Upon application, the two schools in the SSLC hub with a high proportion of Aboriginal students received Priority Schools funding and two with a low proportion of Aboriginal students received funding through the MIC project together with another large school in the city. The school which is the focus of this article was the lead MIC school since it was achieving well for its Indigenous students. This provided them with the necessary monies to participate in SSI Leadership Training and to fund plans to support their transformative steps. It became apparent that the three projects (SSLC, MIC, 8-ways) worked together to have a synergistic impact on the schools, particularly the focus school, its policies and practices, its teachers, and mathematics curriculum.

There were additional projects such as Dare to Lead with a focus on technology to encourage Indigenous students' leadership and other projects for changes in technology in the classroom and across schools. All schools had access to Norta Norta funds to assist Indigenous students individually if they were below the middle bands of achievement on national testing. This involved setting up Personalised Learning Plans. In addition, schools made use of Positive Behaviour for Learning approaches with general school approaches and individualised plans for students requiring this assistance (interviews with Executive Teachers in all schools—these teachers have Executive responsibilities as well as teaching in classrooms). These plans were prepared by teachers in collaboration with students and parents although in the focus school sometimes working parents were called on the phone or the plan was sent home for feedback (Deputy Principal, focus school). Across the schools, the emphasis is on learning, not behaviour (Glenroi Heights Public School Assistant Principal and Curriculum Consultant). Preschools, women's groups, and Elders groups were also financially supported through government departments and non-government organisations.

All these projects encouraged students to have a positive self-esteem including in mathematics. Students were encouraged to take ownership of their own learning of mathematics. Teachers with community were able to find time to make mathematics link to community and things that the community valued. Teachers were encouraged to be more precise about how they presented the mathematical concepts to students. For example, the teachers' lesson plans and Aboriginal Education Officer showed that teachers clarified for themselves and the children, the critical concepts in, for example, measurement. They discussed units, where to start measuring, and how the units were joined if they were measuring the length of a snake they had made from modelling clay. Furthermore, the rainbow serpent is important in mythology to Indigenous Australians.

Bringing the projects together

The focus school was chosen because it was involved in all three projects. The teachers emphasised mathematics in their interviews. However, this school had less than 10 % Aboriginal students, many parents were working and although schools draw on specific areas, some parents selected the school in the hopes of improving their children's

education. Initially the Deputy Principal and former Principal had participated in SSI Leadership Training. With MIC funding, other teachers were able to attend this Leadership Training. The focus school

> was given open slather to use it (MIC funds) in any way we wanted. We went to South Australia for the inaugural invitation with all of the schools and explanation about the project. We met some wonderful Aboriginal mathematicians and scientists and leaders of MIC, and Elders in their community. … And we came up with a plan and we decided as a team that we would … make a difference with teacher engagement, because … then … the children would just come on board. (Deputy Principal)

The MIC meetings themselves influenced the Deputy Principal's ways of thinking partly through meeting and forming relationships with the respected people involved in MIC while the earlier Smarter Stronger Institute training extended over a year and was critical and inquiry based. It brought about changes in attitudes, approaches, planning, and relationships. The redistribution of monies to bridge the gap was significant in establishing social equity (Apple 2004) but only because the staff had a long practical, professional development course from Smarter Stronger Institute. The practical changes included playing out new attitudes to themselves and to the children but also to the way they were planning mathematics lessons. They incorporated the 8 ways into their planning.

Changing from a deficit model of social justice—the contextual impact

The ethos at all the schools was a deficit model that focussed on the low socio-economic and family backgrounds of the students as excuses for poor attendance, results, and behaviour. The SSLC leads school (Glenroi Heights) Principal set about to make changes. She set in place small steps and plans like visiting every family twice a year, encouraging the local community's women's group, focussing on curriculum instead of behaviour, involving parents in Positive Behaviour for Learning, emphasising key values like respect and high expectations, and working with the local community through employment opportunities and yarning circles. Now the teachers are enthusiastic, focussing on learning and not behaviour, planning culturally responsive curricula and implementing these in the classroom, and having parents and community coming regularly into the school. The school's attendance is now around 90 %, and Aboriginal students, teachers, and other staff are involved in leadership, and national assessments for Aboriginal students have increased noticeably. This positive change infiltrated all the other schools including the focus school and their community since staff from all schools attended SSI training together and there was a growing SSLC. There were discussions around modified curricula that make links to the children's lives, teaching that makes children successful, and children feeling a greater sense of belonging at school and wanting to attend school. All these will assist students to learn mathematics better.

Early triggers for change came from the community. The Women's Group realised they wanted a playgroup to prepare their children for school and to assist them as parents in raising their children. It was set up in the Glenroi Heights area, but there were also playgroups associated with other SSLC schools. In the process of change, several community members have received advocacy training to encourage them to express their voices, child care training, and some have been employed. Regular meetings of personnel at senior management, management, and service delivery levels of government Departments also occur focussing on collaborative support for the families. Early mathematical

play activities and a sense of input into the lives of their children have in general assisted children to begin school mathematics with a stronger conceptual and skill base and sense that their families also appreciate the mathematics being taught in school.

Stronger Smarter Learning Community schools provided each other with both informal and more formal assistance while other networks which reached beyond these four schools also promoted support. The overlapping Pre-2 networking involved the principals connecting online to plan joint activities and to discuss issues that frequently related to SSI principles. Through the Connected Classrooms,[8] Wiradjuri classes were available in the focus school. Yarn Ups held regularly at the lead SSI school were open to the Aboriginal community and other school staff. This provided an opportunity for sharing across the schools, especially among the Aboriginal staff. The focus school made use of learning plans for mathematics developed by the two schools with a high Aboriginal population. From the various funds,[9] the focus school was able to employ an Aboriginal Education Officer who provided a friendly Aboriginal perspective into the teaching. This was personal advancement for the Officer and a means of connecting well with the community and the students and a two-way influence with the teachers. She was able to make suggestions about how to engage the children in the teaching of mathematics. The network and mentoring provided a community of practice that was changing the ethos from a deficit model in a practical way. Such an approach was argued by Rouse (2007) as effective for sustainable change. The partnerships with the Aboriginal community showed the changes were extending beyond the school into the community and across schools.

The Deputy Principal of the focus school realised that deficit models of assistance were inappropriate following her SSI Leadership Training which challenged all the teachers to appreciate their own underlying roots regarding values about themselves and others, their capacities, and ways of growing.

> I knew probably nothing about Aboriginal education leadership prior to attending the Stronger Smarter Leadership course, and I did that probably three years ago. Since attending that course, I have Aboriginal leadership, and my role as a leader with Aboriginal people, and our Aboriginal students have become a focus in what I do. And I've become more of a listener to our Aboriginal community and a co, a working partnership with them to achieve the outcomes and dreams that they see for their children and encourage other teachers to do so as well and have those high expectations of teachers that it will be done. (Deputy Principal)

However, funds assisted teachers to follow their plans.

> (Make It Count) funding was just a means of being able to do something that we really felt strongly and passionate about. … We've often referred to some of the tools that we learnt in some of the (Stronger Smarter Institute—SSI) workshops and … been careful about the deficit talk …So … being through the Stronger Smarter Leadership programme has really supported what we wanted to do in the school. (Deputy Principal)

One of the teachers from the focus school also assisted SSI in one of their conferences by presenting a paper on the issues of a deficit model (Principal from lead SSI school). Particularly in mathematics, teachers were expecting the children to be able to do

[8] Online videoconferencing across schools.

[9] On the number of Aboriginal children alone, the school would not be able to employ the AEO full time.

mathematics and they were making the learning experience more relevant, no longer textbook driven but driven by child engagement.

Professional learning for teachers and transformative change

This same Executive Teacher discussed how he had slipped into a deficit model and that SSI Leadership training had helped him refocus:

> Stronger Smarter reminded him of who he really was—friendly joking, supportive, and a people-person—and how he could be that kind of teacher and a leader. This in turn led to a more positive relationship with the students. By adapting the 8-ways approach to the mathematics programming, other teachers are now saying they can see how it is benefiting all students. Stronger Smarter training … was very much the best inservice that I've done … because it is very empowering (Executive Teacher 1)

The professional learning was challenging and critical. They had to plan to replace what they saw as poor pedagogy and relationships with Aboriginal students and to overcome the hegemony of a deficit model. It was the impact of the SSI training that encouraged teachers to stop making judgements about families (Glenroi Heights Public School Principal). Another experienced teacher also illustrated the powerful personal involvement of SSI Leadership training:

> (Stronger Smarter course was) enormously thought provoking, stimulating. …I thought "We're here to learn some things, particularly to learn some things about ourselves and from each other". … it opened a whole world to me that I had only seen at a distance. It has changed the way I interact with kids, with all kids you know. I thought if it works for Aboriginal kids it's going to work for all of our kids. So, some of the approaches around consistently high expectations … and avoiding deficit thinking and deficit language struck both a personal chord which has produced some change, and also struck a chord that works with the staff particularly here. (Executive Teacher 2)

Professional learning across the schools was essential for change. This provided not only cultural understanding but also ways of programming especially in literacy and numeracy. In the focus school, most of this came from the regional 8-way project. This teacher explained how it changed his teaching style:

> I think it's probably gone together with stuff that we are doing about 8-ways and MIC maths… broadening what I do, … some things that are culturally significant and looking at learning styles, and you know in reflection, my learning style was reasonably stuck in the rut of … talk and paper.… (my style changed) to be more inclusive so that more kids have a chance to achieve. …(I) use more narrative, …more non verbal, …more action learning. (Executive Teacher 2)

The changes in colleagues encouraged other staff to take on principles from Stronger Smarter (SSI) with enthusiasm. Executive Teacher 3 who had not undertaken SSI training was so impressed by these changes, and she was able to discuss the enacted curriculum in the school in terms of the philosophies of SSI and 8 ways:

> That scaffolding with the 8-ways within that program and … it's got to be a process not a product, something that teaches how to do it and something that we can grow, not just maths but a way of teaching (Executive Teacher 3)

A change in the teachers' approaches to students was matched by the integration of Aboriginal perspectives using the 8-way framework into their lesson planning. By representing the approach as tributaries of a river with 9 key points, the school showed their ownership of the approach for their school. These initiatives were begun and supported by whole-of-school relationship with the Aboriginal community through meetings with Elders, listening to Elders, establishing yarning groups, and other ways of raising the importance of Indigenous culture and the children's heritage within the school environment.

The SSI training provided the teachers with a framework and language by which to extend their professional learning, decision-making, and changes within their school. For example, they were able to discuss the past, recognise where they wanted to go, and plan for change in the present. They were able to talk of high expectations. Thus, a community of practice based on an ecocultural perspective that took account of the Indigenous community's perspective was developing. The community approved of the emphasis on high expectations, and this was noticeable in the comments from students themselves. The school captain was an Aboriginal boy, and an Aboriginal girl was also a leader. The students mentioned they like the school because they learn, and they want a good education to get a good job. That is what they expected. When the small number of students who were interviewed at the school were asked what subjects they liked at school, they said maths, art, and sport. While this school tended to have more students from middle socio-economic groups, there were similar comments from students in the other schools. The Aboriginal Education Officer confirmed the increase in high expectations:

> the teachers have got that (high expectations) for the kids, … me too … and the kids expect that of themself as well, so we will try and work in together. (Aboriginal Education Officer)

Another key impact of SSI training was that each person was able to put small steps for change in place. The Deputy Principal noted that she and the former Principal returning from SSI wrote an Aboriginal action plan around teacher leadership for improved Aboriginal student outcomes, understanding and responding to Aboriginal learners, and engaging the Aboriginal community in school. They focused on community leadership and collaborative planning using the approaches of various government-initiated approaches and an adaptation of Reading to Learn for mathematics. Each aspect was expanded in terms of "what we want to achieve, how we will measure success, what barriers might we encounter, how will we overcome the problems, and detailed steps with responsible person(s), resources, time, and changes to look for" (Deputy Principal). The teachers in this school felt that the modelled and stepped approach with engagement at the start of the lesson often through a story would strengthen the achievements in mathematics. For the mathematics planning, the format consisted of noting how the various 8-way processes were incorporated into the plan. Many times this related to land links and non-verbal communication processes (supplied lesson plans and comments from the Aboriginal Education Officer on her role in the classroom). From interviews and the lesson plans provided as documentary evidence, there was a start on these links. There were clearer links in lessons on position and geometry but few references, mostly a narrative or story problem, in other topics. Linking SSI leadership training with the other two projects was a practical way of initiating sustainable changes in curriculum planning and implementation.

Building cultural identity

Building an emphasis on cultural identity was achieved through art, dance, playgroups (comments made across all the schools), and through programming and planning with an 8-way focus in numeracy within the MIC project. Across the schools in the city and surrounding area, there were three separate days in particular with an Aboriginal cultural emphasis. These were the Cultural Day in which Elders took small groups to tell stories, make artefacts, or carry out other cultural activities; Aboriginal Maths Fun Day; and NAIDOC[10] Week. In each case, schools across the community participated. These were seen as significant events that supported the regular ongoing emphasis on Aboriginal culture in the schools. In the focus school, the inclusion of art, Aboriginal staff, an Aboriginal newsletter, a small community centre in the grounds for the Aboriginal community, and language classes were critical in encouraging children with their positive Aboriginal identities. This was to be extended in the establishment of an Aboriginal community garden around which cultural knowledge could be shared but also mathematics and other lessons could be held. Cultural identity was expressed in the art depicting the 8-way processes for learning and other art in the school. The Wiradjuri language classes included cultural understandings with lessons revolving around the Wiradjuri advice from an Elder:

> *Marunbumi-ya mayingguwalbang-gu. Winhangagigi-la-dha. Ngung-gi-la-dha. Yindyama-la mayinygalang-gu. Bangga-ya-la. Gulbala-dha murraya-la marrumbang-gu.* Be kind and gracious to strangers. Care for each other. Share with each other. Give honour and respect to all people. Cause quarrelling to stop.
> *Nga-nga-dha garray-gu bila galang-gu. Yandhu garray-bu bila-galang-bu ngangagirri nginyalgir.* Look after the land and the rivers. Then the land and the rivers will look after you all.
> *Ya-l-mambi-ya mayiny-galang. Marun-bunmi-la-dha. Marraga-la-dha. Walan-maya mayiny-galang.* Teach the people. Love each other. Hold together and empower the people.
> *Gariya yaabul yala. Dhulubul ya-la.* Do not tell lies. Speak the truth.

The development of 8-way processes listed above illustrates some of these underlying principles. They were also implemented in the playground where the teachers were starting to diversify approaches through:

> some teacher interaction with them (specific children) at that time. We've also looked at what we're doing to draw small groups of people out of the playground with things like an activities room, and use of the computer lab and library in broader ways than we previously would have. (Executive Teacher 2)

The long period over which SSI training runs and the mid-session review of small step projects was really important for this school to focus more on community. The Deputy Principal said:

> we've had a number of yarn ups, … done a lot of listening, a lot of relationship building, a lot of chatting. … We have different parents come all the time. Some are

[10] National Aborigines and Islanders Day Observance Committee has encouraged yearly celebrations of Indigenous culture and education.

> regulars. … We try to keep focused on what our parent, our community body initially told us that they'd like us to provide …
> The Aboriginal garden, we've had some meetings on that. …we are at the stage where we need to sit down now and find out the story that they would like the garden to tell and the plants and things that they think should be appropriate in the garden before we put it together. … (We've applied for funds.) … It will give us an opportunity to take the children into the garden to do maths in that, we'll be forming our own little Land Links area inside our school grounds too. … A lot of the ideas that the community gave us fit in with this. (Deputy Principal)

The Aboriginal Education Officer is a key to involving the community, in setting up the garden and an enclosed pagoda for the community centre where community can easily find her and where they have a space with which they identify. Each of the other requests from the community was happening too. However, the ongoing community involvement was still growing. The Deputy Principal commented:

> we've got two families, two lots of kids that identify as Aboriginal but the family don't (particularly). … The kids really do and the parents are actually pretty supportive of that and they have said you know, look that's fine. (Deputy Principal)

One particular comment heard at the school on a number of occasions was that increasing numbers of children were identifying as Aboriginal with an awareness of the Aboriginal family and language group heritage. Numbers had increased from 6 % to 7.8 %. This was mainly a result of the students feeling comfortable to identify as a result of Aboriginal leadership and encouragement (e.g. from the Aboriginal Education Officer, having the Cultural Day and the Elders and parents meeting with staff and being around the school), and children's yarning circles. A story told informally to me by the Aboriginal Education Officer was also mentioned in the Deputy Principal's interview:

> we sat in a circle and said "tell us something about yourself, your mob". And a number of kids didn't know who that was, … so we asked them to go home and find out so that they could … share that with each other. And they'd come to school the next day really excited because "I know what I am now". Another little boy turned up that wasn't on our list, so he stayed there and he said he was Gamilaroi. And I rang his mum … and she said "Thank you so much. I'm really pleased he has. Now I can have these conversations with him. His dad is Aboriginal … I'll let his father know that he's identified himself". And he became such a strong advocate in our school because he's one of our senior boys. It was as though it was quite a relief. … (Aboriginal Education Officer) … when they were doing some work on Sorry Day (Reconciliation Day) … said one of the little boys who hasn't identified but she knows is Aboriginal, got quite emotional. She said a lot of the kids did …. And he said "I had no idea it was all about this". (Deputy Principal)

The Deputy Principal provided the busy staff with ideas for recognising Reconciliation Day in their classrooms. There were many examples of the senior staff and the Aboriginal Education Officer sharing ideas with the rest of the staff. The increased acceptance of Indigenous cultural approaches such as those espoused in the Aboriginal Education Policy and the 8-way project, and the emphasis on strong, smart, respectful, responsible Indigenous students with high expectations (based on Stronger Smarter principles) were also encouraging children to identify as Aboriginal. The students in their interviews appreciated the Aboriginal art work at school and identified with it. They liked the special days like

Reconciliation Day,[11] and the joint schools activities like the Cultural Day, the Aboriginal Maths Fun Day, and NAIDOC[10] Week. They would go to the teacher or Mrs … (Aboriginal Education Officer) for assistance at school, and parents and friends helped them with homework. They also noted that there was no bullying at the school. Aboriginal parents (they apparently were working) were not available for interviews to confirm their involvement in the school's partnership with them. However, the city's Aboriginal community was involved in the joint school activities. The demographics of the schools and the SSLC community of practice and support are playing a role in the ways in which the schools can achieve a closer liaison with the community.

The fact that the school was strengthening children's cultural identity was paralleled by the community and children identifying with mathematics. This was clearly evident with the Aboriginal Maths Fun Day, but it was also evident in mathematics lessons. The links between school curriculum including mathematics and the various cultural activities such as the establishing of the school garden were being discussed by the community and children.

Although the teachers were able to appreciate the changes in their thinking, the assistance of the Aboriginal Education Officer, the recognition and valuing of Aboriginal culture in many different ways in the school, interactions with the students, and changes in the classroom approaches were having an impact. While the teachers were facilitating change, modifications were occurring at the child and community level encouraging sustainability (Stronger Smarter Indigenous Education Leadership Institute, nd).

Developing the mathematics curriculum

"We don't use text books at school for maths at all" (Deputy Principal). However, they had made use of Reading To Learn Maths principles pioneered by both the lead SSLC school who also provided a mentor and the Principal of another SSLC school. The benefit is in building the confidence of students that they can be high achievers. The Deputy Principal noted these lessons were useful for procedural knowledge but lacking on the problem solving. The school was implementing the Aboriginal Education Policy by adding approaches, marked by symbols for the 8-way processes, into their lesson plans. The teachers were comfortable that they were not being disrespectful and the children actually brought these symbols into their presentations in the subject Human Society and Its Environment (Deputy Principal). For the teachers' lesson planning, they adapted a number of resources. Teachers planned stories and land links in particular but also recognised the importance of each of the other principles listed above in the description of the 8-way approach. The teachers were clear that these made a difference to their teaching and the children's learning. As Executive Teacher 2 said, he uses "more narrative, more non-verbal and more action learning". They were enjoying teaching more, and the students were enjoying learning more. So far they had not yet developed significant links to culturally based mathematical thinking, but the teacher–student interactions are now more culturally appropriate.

In the focus school, the Elders and community were wary about influencing the mathematics per se (Deputy Principal on meetings with community about MIC). However, the Deputy Principal commented on the involvement of the community:

[11] This is a day in which the school/teachers/non-Aboriginal students remember reconciliation with the Aboriginal community. It was held just before the interviews with the students.

> anywhere where we need permission from the Elders and a guide … (of) what we can and can't use and things like that. They were really excited about that and being involved and actually coming in and working in the classroom with the kids and designing things so that when we are using say a bingo card with the kids, that it's not just the token Aboriginal symbols there, there's actually stuff there that is relevant to the kids. And we are using, instead of using counters we might use some of the local seed pods …. So, it's living with the outside and using that local knowledge. Basically that's where we want to head and that's where that body (of Elders) is going to help us at making those links to the outside that we are just not aware of.

The parents too needed appreciation of how their culture could link to school mathematics. The Aboriginal Education Officer commented:

> When we had the maths meeting I talked to the parents about the land links in that, so it was good, and how we used them at school. And how I'd been talking, especially with the little infants with their maths. I take them outside and we drew snakes and then they had to measure it with the paddle pop sticks, little things like that, yes they are using it, and yes that's working really … well. (Aboriginal Education Officer)

Taking an Indigenous focus in teaching mathematics in this school with a small percentage of Aboriginal students was important especially for their Aboriginal students but also for the other students in the school who lived in this city with a sizable Aboriginal population.

In terms of outcomes in 2009 on National testing, 86 % of Aboriginal students were at or above the minimum standard for numeracy overall and 92 % in Year 5. For Years 1–6 in all Strands of the mathematics syllabus, a higher percentage of Aboriginal students than non-Aboriginal students tended to be in the middle band—sound knowledge—and fewer in the next higher category (school data summaries). Data around National testing are inconclusive as there were only five students assessed at each year.[12] However, as Executive Teacher 1 commented if there is positive change in teachers' attitudes and approaches to their Aboriginal students' education, there will be change in students' attendance, enjoyment at school, and learning. Newsletters documented the achievements of students including the Aboriginal students in many areas of the curriculum, not necessarily assessed by National testing.

In summary, although only one school with a relatively small Aboriginal population was the focus of this article, the emerging story illustrates how people making plans in partnership, teacher professional learning, and funding can make a difference. The difference occurs when a wider, cultural view of mathematics, more appropriate classroom and school ethos, and the reduction in unrecognised discrimination expand the expectations for achievement. When cultural background is acknowledged in the schools, there is an influence on the way the children are taught mathematics supplementing improvements in the teachers' expectations, values, and attitudes. The other schools in general reflected these same changes, but the relatively open interviews lead to fewer specific discussions on mathematics. It was not possible in the timeframe provided for the research to confirm transformative change through extended observation in the classrooms before and after teachers' professional learning. However, the teachers' reflections, children and community interviews, and documentation did support this emerging story.

[12] There were only around five students in Years 3 and 5 over three years of testing so individual variance possibly affected the fluctuating percentages in middle and higher bands.

Discussion

The teachers were made aware of their ways of thinking about Aboriginal students and about themselves as teachers of Aboriginal students especially through the Stronger Smarter Leadership Training. In this way, they were engaged in the intersection of the two communities of practice. The school teacher identity met with the ways of thinking of the Indigenous community creating a change in the ways of thinking of the teachers as a community of practice (González et al. 2005). As described by the teachers, there were changes in their thinking about themselves and their interactions with students. There were changes in their practices, their perception of teaching, their goals, their planning, and their relationship with the students and the Indigenous community. However, unlike the Siemon (2009) project, much of the learning and change has come from external interactions within the systems of the three main projects 8 ways, MIC, and Stronger Smarter although other projects also facilitated practical changes. Without the input of this professional learning, there may not have been much change. Nevertheless, the projects did result in revived cultural approaches that were not perceived as incongruent with dominant school culture and an Indigenous voice and associated knowledge and rights were recognised within the school. The aspects of social justice emanating from a focus on ethnomathematics were beginning. Mathematics was seen to have a link to culture. Culture was seen as strengthening mathematics. While much of the focus was on culturally responsive pedagogy through the 8-way project, the impact of Stronger Smarter principles ensured both an intersection of communities of practice and ethnomathematics. Despite cultural and situational changes for this largely resettled community, ethnomathematics developed through their respect and links to land of the original Aboriginal community, a Wiradjuri group. Thus, an ecocultural perspective is warranted in discussing this educational development in this rural city.

Furthermore, the social justice embedded in ethnomathematics was evident in the high expectations of the school's participants. However, the desire for ethnomathematics to be developed was limited by the general education policies on testing. While it was not possible to establish a strong statistical case for change in outcomes on National testing, there were higher expectations. Students expressed high expectations and some achieved leadership goals. Personal beliefs are not necessarily reflected in test results. An over emphasis on the latter was a concern of Gale (2006), Siemon (2009), and Owens et al. (2011), and this is reflected in this study. The school's high expectations were not only about good test results but also about identifying as Aboriginal, being comfortable in yarning groups and with the family's cultural background inclusive of the impact of colonisation which included movement of families from their homelands, being comfortable at school and attending, and taking on leadership roles. In this way, there was equity in establishing goals between the school and Aboriginal communities. On this basis, it would be possible to extend the funds of knowledge of the community into the classroom.

The professional learning had an effect on the ways in which the school was planning its lessons in terms of providing culturally responsive teaching. In terms of the interactions in the school, there were regular yarning sessions and educational negotiations were beginning. The Aboriginal Education Officer, though not from the State, provided an important conduit between the school and the Aboriginal community. She was frequently tutoring students individually or in small groups and she could take them outside to learn concepts in a more appropriate way. In other words, she was aware of her own colonised ways of thinking and so recognised a more appropriate way herself. This was strengthened by the

Land Links approach recommended in the 8-way programme. Teaching of mathematics was changing through out-of-class lessons, the clarity of purpose, the use of narrative, and a change in relationships with students.

The SSI professional learning was a powerful means of ensuring that the effects of colonisation on Indigenous people informed teachers' thinking about social justice as emphasised by Apple (2004), St. Denis (2007), Paredes-Canilao (2006), Owens et al. (2012), Castagno and Brayboy (2008), and others. The fact that the teachers were expressing and providing examples in practice of the importance of a social justice model that was not a deficit model is a critical point as this is difficult to achieve. Beliefs and behaviours are quite strong especially when they are supported by an ethos or community of practice that presents the opposite (Gutstein 2006, 2007). Nevertheless, there were changes in the school's ethos that were well documented and expressed in the interviews. In particular, this was evident when teachers who had not participated in SSI training were able to describe its impact on other teachers and on mathematics teaching in the school.

The school was working towards ethnomathematics through a stronger critical eco-cultural education in that they were beginning to implement the recommendations of the Elders and community. For establishing the garden, the Elders gave an appropriate lead in its development and there was an expectation that it would promote knowledge that was more closely linked to mathematics, be it school mathematics or community ways of reasoning (González et al. 2005). As Chinn (2007) discussed, it is not always easy for teachers to appreciate the Indigenous knowledge without the assistance of others to unpack this knowledge in the first instance, and the SSI training and support from the other schools and consultants had begun this process. In the case of resettled communities and rural city communities, it is argued that an emphasis on the ecology of the school community recognising the impact of colonisation on the community, their links to their own lands and in situ communities, the school education and employment advances, and the ways of the community as it has developed in the city over the years, together with the emphasis on the local Wiradjuri understanding of place is best described as an ecocultural approach.

From the interviews and the documents such as newsletters, there is a stronger emphasis and encouragement for recognition of an Aboriginal voice in the school decision-making, and for students to identify as Aboriginal with pride. This is a significant achievement in terms of the social status order discussed by Fraser et al. (2004, see also Fraser 2007). It is not clear how this might impact on mathematical understanding other than improve school mathematics learning but it may make a difference in the content and pedagogical content knowledge of teachers as they listen and yarn with their Aboriginal community in a similar way to that discussed in Te Kotahitanga (2008). In the future, there may be a stronger culturally responsive teaching and ethnomathematics as shown by Owens et al. (2011) when Aboriginal communities, including a Wiradjuri community, were able to share their diverse mathematical knowledges. In this case and in Chinn (2007) case, there were personal experiences that challenged beliefs and brought about change over time. The focus school had not yet reached what Gruenewald (2008) would call a critical placed-based education but the garden might be a strong impetus for this ecocultural perspective for ethnomathematics education in addition to what has already been achieved in the school. The fact that the school was large, had a relatively small proportion of Aboriginal students, coupled with the motivation of Aboriginal parents in terms of expectations (for the school was known for its broad range of academic achievements) may be impacting on the partnership between the school and Aboriginal community.

Nevertheless, the SSI trained teachers were able to discuss the past and to recognise where they wanted to go in terms of their relationships with students and their planning of

curriculum and specific lessons. They expressed their view of social equity, and their intention for an Aboriginal voice in the school and curriculum. They were putting in place their plans for change that valued and recognised non-mainstream knowledge, and they were recognising the collaboration of school and community in education. Professional development incorporating ongoing plans and steps was facilitating ethnomathematics in terms of an ecocultural perspective that was impacting on relationships between students, teachers, and community. It was impacting on classroom practices and learning, and on students' understanding and pride in their Aboriginal identity.

Conclusion

Teacher and school transformations have been established as keys for change in Indigenous education. The change in the community of practice went beyond that of sharing in the teaching strategies and tools (lesson plans). There was a change in habitual practices, thinking, and milieu as illustrated by the spread of teaching approaches to staff who had not undertaken SSI leadership training (e.g. Executive Teacher 3). It is clear that values, attitudes, and relationships with students changed (Lovat and Toomey 2009; Rouse 2007) through teachers being responsive to these challenges in a supportive environment (Owens et al. 1998). The long SSI leadership training with its peer support, various funds to provide support in classrooms and planning meetings, and changes in processes such as the implementation of Personalised Learning Plans and lesson plan formats all facilitated teachers to be transformative. The teachers initiated small step changes but only with consultation and mentoring and significant two-way sharing of cultural and intellectual knowledge by the Aboriginal community locally and nationally (through the three projects).

Changes occurred in identities especially in terms of how they saw themselves as teachers and their roles as teachers within an Indigenous community (Fraser 2007). While the funding was indicative of some redistribution of wealth, and there was recognition of culture and perspectives in the school reflected in the classroom, there was representation of these social justice changes in policies and processes, group meetings, yarning circles, and leadership roles taken by Indigenous staff and community members (Fraser et al. 2004). Nevertheless, there were concerns around the ongoing position of the Aboriginal Education Officer and funding. In other words, the distribution of funds was for projects that required the school leadership to set up processes that would continue into the future which was likely to occur given the drivers now within the community. In comparison with the findings of Castagno and Brayboy (2008) who reviewed the shortcomings of education for Native Americans in terms of racism including a white-dominated curriculum and pedagogy, and the report on similarities between Australia and the USA by Hickling-Hudson and Ahlquist (2003), there was grass-roots change in the SSLC. As the Principal of GHPS said at the end of her interview,

> We need to be asking and including the (Indigenous) communities. Not telling them what we expect them to do. That's a cry from most people, and the politicians just don't seem to be able to get it. … A couple of people have said to me here, teachers come and go but the community stays. … It's that ownership.

The study also raised the issue of ethnomathematics in rural city communities. There is more than just a social equity issue in a rural city environment being played out (François 2010) but an ecocultural critical pedagogy is developing (Owens et al. 2012). This large

school with a small proportion of Aboriginal students now has a number of processes to maintain the momentum. These processes include establishing a garden that can be used easily for mathematics lessons; recognising the value of land links, outside lessons, non-verbal teaching, and stories; and building relationships with the community. Thus, the school has a firm foundation for an ongoing emphasis on ecocultural education appropriate for the Indigenous students with a growing partnership with the Indigenous community. In time, not only will the school be incorporating processes of teaching but also the mathematics content will be more culturally based as teachers and community discuss mathematics in terms of cultural knowledge (Owens et al. 2011).

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