

Exploring the mathematical confidence of Indigenous preservice teachers in a remote teacher education program

Steve Thornton · Wendy Giles · Debbie Prescott · David Rhodes

Received: 30 November 2010 / Revised: 29 April 2011 / Accepted: 27 May 2011 /
Published online: 23 June 2011

© Mathematics Education Research Group of Australasia, Inc. 2011

Abstract This paper reports on the efficacy of an accelerated teacher education program (*Growing Our Own*) focused in remote Indigenous communities in the Northern Territory. The program is a joint initiative of Charles Darwin University and the Northern Territory Catholic Education Office, providing an intensive two-year program designed to educate Indigenous Teacher Assistants to full teacher status. We describe the growth in knowledge and confidence that has occurred through the program using the story of one of the students in the project, Philomena, as an evocative representation of the experiences of the participants in the program. This growth is particularly evident in one lesson that Philomena taught towards the end of the program in which she was able to challenge her previously accepted role as subservient to the non-Indigenous teacher. Our discussion highlights some key issues for improving outcomes for Indigenous children, including the potential mismatch between Western and Aboriginal ways of thinking in mathematics and developing the mathematical capacity of Indigenous teacher assistants in remote settings. We suggest that the mutual respect of the participants at various levels of *Growing Our Own*, the situated and purposeful nature of the learning, and the capacity of students to engage in that learning without abandoning their community responsibilities have been pivotal in enhancing educational outcomes in remote communities and in providing opportunities for Indigenous people.

S. Thornton (✉) · W. Giles · D. Prescott · D. Rhodes
Charles Darwin University, Darwin, Australia
e-mail: stephen.thornton@cdu.edu.au

W. Giles
e-mail: w.giles@ecu.edu.au

D. Prescott
e-mail: deborah.prescott@cdu.edu.au

D. Rhodes
e-mail: david.rhodes@kormilda.nt.edu.au

Keywords Indigenous · Preservice · Remote · Mathematical knowledge · Confidence

Come meet us half way
It's time for you to...
learn about us
You will learn real story about me in my own environment, in my own homeland
Come with me to my place
See me as I am
I will help you understand me
...
Come meet us half way
You will learn about us for who we are
This will help you to teach our children in a real way
It will help you at school
It will help you in the classroom
It will help you become wise
It will help you build strong respect towards us and toward yourself
The way of teaching Aboriginal children will start to become clear... clear...
and CLEARER if you willing to meet us half way with an open mind and
heart!
(Tobias Nganbe, speech at *Growing Our Own* launch, Wadeye, 29th May, 2009)

Introduction and context

It has long been of concern to educators in general, and Northern Territory (NT) schools in particular, that there are very few Indigenous teachers in our schools, and even fewer accessing teacher training through higher education providers (Fordham and Schwab 2007). In addition, remote schools in the NT are notoriously difficult to staff in a sustainable way. It is difficult to attract quality, experienced teachers, and to retain them for more than a year, as they can feel isolated and exhausted in the bilingual and bicultural environment (Lyons et al. 2006; Taylor 2010).

The lack of Indigenous teachers, coupled with the transience, poor preparation and inexperience of many non-Indigenous teachers, is one factor contributing to the well-documented poor school attendance in remote Indigenous communities (Fordham and Schwab 2007; Jorgensen 2010). If children do not regard the school, its English speaking staff and its curriculum as relevant to their emotional and educational needs, then the incentive to attend is reduced (Lewthwaite et al. 2010; Martin et al. 2009). In the absence of strong social pressure to go to school, the children often vote with their feet, resulting in poor attendance and consequent low academic achievement, particularly in literacy and numeracy (Northern Territory Board of Studies 2008; Northern Territory Government Department of Education and Training 2011a).

Universities are well positioned to collaborate more closely with schools to increase the confidence of Indigenous students in the relevance and attainability of higher education qualifications, particularly in teacher education (Ministerial Council on Employment, Education, Training and Youth Affairs 2006). Yet the total number of Indigenous students in teacher education courses at Charles Darwin University (CDU) is fewer than forty, and many of those do not intend to teach in a remote location (that is, out of Darwin). Attracting Indigenous students from remote communities is even more difficult than attracting those from urban communities as they have little access to resources such as the internet, libraries, computers and other students. The ability to travel and stay in larger centres to attend courses internally is restricted due to family and community obligations. Completing a professional experience placement in another school is a daunting task for an individual to organise, given their extensive family commitments, and a lack of resources and confidence. This is especially true for those who have rarely left their communities apart from short trips to regional centres. Therefore, CDU Education staff have recognised that our approach to Indigenous teacher preparation and recruitment needs to change. Such an approach needs to be strategic, purposeful and bold. In response to this need the School of Education at CDU, in partnership with the NT Catholic Education Office, has developed a community-based teacher education program, *Growing Our Own*, which enables Indigenous Teacher Assistants currently working in remote schools to gain a fast-tracked and relevant teaching qualification (Giles 2010). Unlike many of the non-Indigenous teachers, these teachers are likely to remain in the communities, and hence build a sustainable school environment that addresses the needs of Indigenous children.

This paper reports on the early implementation of *Growing Our Own*, and in particular upon its effect on the confidence of the Indigenous Teacher Assistants who are part of the program. This is a small program, restricted to schools in six communities with twenty-one preservice teachers, yet its importance cannot be overstated. Of these initial twenty-one Teacher Assistants, thirteen will graduate during 2011 as fully qualified teachers. These people are among the first in their community to obtain a University qualification. They will remain in their communities as long-term staff members, school leaders and as role-models for future generations.

In the following section we review the literature related to school mathematics teaching and learning for Indigenous students. We then describe the *Growing Our Own* program in greater detail, and highlight the importance of the supportive partnerships formed between the various partners in learning. The impact of the program is then described through Philomena's Story, including a detailed discussion of a lesson. We use Philomena's Story as an evocative narrative that is representative of the experiences of many of the *Growing Our Own* students, rather than as data in a more formal sense. We conclude with a brief discussion of the impact of the program on the students' very early experiences as fully qualified teachers, highlight some key issues and summarise the potential of programs such as *Growing Our Own* in developing effective teachers in remote Indigenous communities.

Literature review

It is not our intention to discuss in detail the gap between the numeracy achievement of Indigenous children and their non-Indigenous peers. This disparity has been recognised for a long time, it appears to increase with age, and despite the well-intentioned efforts of numerous intervention programs, limited progress has been made in closing the gap (Ministerial Council for Education, Early Childhood Development and Youth Affairs 2009; Taylor 2004). Rather, we highlight three key factors relating to knowledge, pedagogy and confidence that appear to contribute to the gap and discuss how programs such as *Growing Our Own* can enable local Indigenous people to become fully qualified teachers.

Despite a wealth of research (Christie and Verran 2006; Harris 1987; P. Harris 1991) highlighting the sophisticated mathematical ideas of space, time and relationships among Indigenous¹ peoples, myths about the capacity of Indigenous students to learn mathematics abound (Matthews et al. 2005). These often play out in school classrooms where expectations of Indigenous students are limited. For example, the teacher of a Kindergarten class in one school in which we worked had only one stated outcome for mathematics for an entire year—to enable the children to count to twenty. The emphasis on counting was clearly a response to a belief that the local Aboriginal² number system is simplistic; the Murrinhpatha³ language spoken at the school by the children has words for *one* (Numi), *two* (Perrkenku), *three* (Perrkenku neme), *four* (perkenkha perkenkha), *one hand* (mange numi), *two hands* (mange mange), and beyond that *lots* (terert) and *lots and lots* (wurnangart).

However, as J. Harris (1987) points out multilingual Indigenous people code-switch between languages using number labelling, rather than having a different conception of number. Harris suggests that the Indigenous people among whom he worked used words that represented body parts such as two hands flexibly as meaning either an approximation to an amount, or where necessary, as an exact number. He recounts the incident of the people of Groote Eylandt who, when asked by Norman Tindale to bring 150 spears, produced seven bundles of twenty spears each, with a further ten. He suggests that although the language of larger numbers may not be common, it can, in fact, be constructed from the linguistic resources of the Indigenous language. It is not hard to see how numbers at least to 20 could be constructed from the Murrinhpatha words above.

Even very young Aboriginal children in the communities in which we worked were able to understand number concepts, without necessarily having the counting facility in Standard Australian English that non-Indigenous children bring to school. This was shown by their facility with card games, in which they fluently counted on

¹ We use the term Indigenous in a general sense as referring to people of Aboriginal and Torres Strait Island descent.

² We use the term Aboriginal when discussing the people and community in which this paper is located; in this case the teacher held beliefs about the people in the community, not necessarily about Indigenous people in general.

³ Murrinhpatha is the official language of the community that allows different groups from the area to communicate with each other. For many children it is their second or third language, with English only spoken at school.

from ten, but starting again from one for numbers greater than ten. In our experience this facility with number is seldom recognised by non-Indigenous teachers.

There is at least 30 years of research showing that Indigenous people have sophisticated ways of thinking mathematically in algebra, space and measurement. For example, the complex kinship systems and naming conventions in Yolŋu cultures can be represented using algebraic relationships with periodic properties (Yirrkala Community School 1991). While the language of such relationships is clearly not Western mathematical language, and the relationships are seldom expressed symbolically through diagrams, it is clear that young children understand the concepts underpinning the relationships as they seldom call others *sister* instead of *mother*⁴ and are able to extrapolate their understanding of relationships to new situations. P. Harris (1991) suggests that the Warlpiri people of the Western desert have a built-in dynamic map of the environment, being able to navigate easily and accurately after several changes of direction and in the absence of obvious environmental landmarks. Children whom she met in the Northern Territory found the concept of being “lost” foreign as there was no suggestion that they would ever be in a situation where they could not simply go home. Other examples of complex mathematical ideas in Aboriginal cultures include a sophisticated sense of North-South directionality (Edmonds-Wathen 2010; P. Harris 1991), and non-linear cycles of time (P. Harris 1991).

Yet there remains an implicit belief in curriculum documents, and perhaps even more powerfully among teachers, that Indigenous mathematics is inferior to Western mathematics. A recent document in the Northern Territory (Northern Territory Government Department of Education and Training 2011b) provides advice to teachers about incorporating Indigenous perspectives into literacy and numeracy. While it is at pains to point out that Indigenous children are able to think mathematically, it uses the metaphor of a bridge whereby Indigenous knowledge can be used to enable children to learn Western mathematics. Such a metaphor reifies and validates teachers’ beliefs in the inherent superiority of Western mathematics over Indigenous mathematics.

It is not our expectation that non-Indigenous teachers in remote schools will understand the ethnomathematics of Indigenous societies. Rather, valuing this knowledge enables teachers to cast Indigenous children as knowledgeable and able to learn (Dickinson-Jones 2008). Programs such as *Growing Our Own*, which enable Indigenous people to adopt full teaching responsibilities, have the potential to dispel myths about Indigenous children’s lack of capacity to learn mathematics.

More importantly *Growing Our Own* empowers Aboriginal people to take their place as equals within the school community. As S. Harris (1995) suggests in his review of bilingual education in the NT, valuing Indigenous knowledge is as much about power as knowledge. The *both-ways* approach of Garma educators (Bat and Ober 2007; Yirrkala Community School 1991) builds on compatible aspects of Western and Aboriginal ways of knowing, such as the Yolŋu kinship system (Gurrutu) and algebra, or between people’s connections with place (Djalkiri) and concepts of pattern and space in Western mathematics. In the *Mathematics in*

⁴ The labels sister and mother are not birth labels. A person may have several mothers, grandmothers and sisters from different birth families. The labels represent complex, cyclic kinship relationships.

Aboriginal Communities (Christie 2007) elders from Arnhemland discussed, as equals with academics, the richness of Yolŋu mathematics and the mathematics education they desired in their schools. The Yolŋu people recommended that school mathematics should be systematically located within aspects of contemporary Yolŋu life. Clearly such a recommendation can best be enacted through the education and employment of Yolŋu people as teachers.

While the *both-ways* approach to knowledge is a key to improving outcomes for Aboriginal children in remote locations, pedagogic approaches also need to be addressed. Rather than learning from a formal teacher-student relationship that embodies the teacher as expert imparting knowledge through telling, children in remote communities learn from a very early age through stories, examples, metaphors and modelling. The imagery embodied in activities such as digging for yams or turtle eggs or navigating in the bush provides an ideal pathway for learning mathematics as it enables children to embed mathematical concepts in language and activities with which they are familiar (Christie 2007). In learning about these activities children are seldom told how to do things; rather they watch the activity being modelled, and they copy. Indeed in Yolŋu cultures students who are gifted are not those who can question and debate, but those who can listen quietly and imitate well. Again, we suggest that this mismatch between Western school-based pedagogy and that of Indigenous societies can best be addressed through the employment of Indigenous people as teachers.

The lack of value attributed to Aboriginal ways of knowing and learning discussed above has obvious implications for how Indigenous children feel about mathematics. It creates a clash of cultures in which, “in the world where mathematics matters, Aboriginal values are neither recognised nor respected, but discarded as worthless” (Watson 1988, p. 271). It has long been recognised that affect is a key determinant of achievement in mathematics (Leder et al. 2003) and developing the confidence and disposition to learn among Aboriginal children is critical to bridging the gap. Of particular importance is the lack of purpose and motivation apparent in many classrooms in remote Aboriginal communities (Kitchen 2003). Copying tasks appear to be the norm in Indigenous schools (Rose et al. 1999), with little flow of sustained, productive mathematical activity. In our own work we have frequently heard teachers suggest that “these students won’t attend for that long,” or “we have to keep their attention by changing tasks frequently”. The response is often to use a plethora of low-level tasks that have limited expectations rather than attempting to surprise, intrigue or disturb learners to promote and sustain learning.

This purposeful, sustained activity appears to be a key factor in the success of effective literacy and numeracy programs such as *Quicksmart* (Pegg et al. 2005), *Count Me In Too Indigenous* (Howard and Perry 2002) and *Accelerated Literacy* (Rose et al. 1999). In each of these programs children engage in sustained activity built around a key concept or text, and are asked to extend and reorganise knowledge and explain their thinking in appropriate language. While all of these programs were present in the schools in which we worked, their adoption appeared patchy and in some cases formulaic rather than dynamic and generative, at least partly due to the rapid turnover of non-Indigenous teachers. As a result we observed both disengaged children and teachers, where dependency rather than resilience was the norm. For children this dependency meant a lack of confidence in their capacity to learn; for teachers it meant

a sense of despondency about their situation and a reliance on low-level tasks. Of course, this is an over-generalisation and we observed notable exceptions where teachers were thinking deeply about how they might better engage children in more meaningful and challenging tasks. However, situations characterised by dependency and low-level learning are not uncommon in remote schools (Hughes and Warin 2005). Again, we suggest that rediscovering a sense of purpose in mathematical activity and the consequent development of confidence and resilience among learners is much more likely in a situation where teachers deeply understand the cultural context in which they are working. Programs such as *Growing Our Own* thus have the potential to address the affective needs of students by developing such teachers.

In fact, the teachers in the *Growing Our Own* program recognised the issues associated with knowledge, pedagogy and affect discussed above, and expressed the need to address these areas in their own learning. All *Growing Our Own* students expressed a need to upgrade their mathematics skills and conceptual understanding, particularly the foundational knowledge and big ideas (Siemon et al. 2006) that underpin number and algebra and enable students to make connections.

The *Growing Our Own* project

In 2008, Charles Darwin University and the Northern Territory Catholic Education Office gained funding through the Commonwealth Department of Education, Employment and Workplace Relations as part of the Northern Territory Emergency Response. The resulting program, *Growing Our Own*, aims to attract, develop and retain teachers, and embed, at the local level, good teaching practice to strengthen the existing education workforce, especially local Indigenous staff. It operates in Catholic Community Schools in six remote communities in the NT, each of which is geographically isolated.

The overarching goals of the program are:

- To empower Indigenous educators to join culturally relevant ways of being, knowing and doing with contemporary curriculum and pedagogical knowledge; and
- To empower non-Indigenous teacher mentors to understand culturally relevant Indigenous ways of being, knowing and doing and infuse these with contemporary curriculum and pedagogical knowledge to strengthen opportunities for children's learning.

Whereas mainstream teacher education students access courses externally via the Internet and/or internally by attending lectures and tutorials, the *Growing Our Own* program enables students to access the course by the lecturer coming to them, in situ. If this option were not available, it would be highly unlikely that students would be able to move to Darwin to attend classes because of their complex commitments to their families and community. Internet access is patchy and not available in most of their homes; so online learning outside of the school is also impossible. Therefore, the *Growing Our Own* project seeks to overcome some significant barriers for students who would otherwise have little or no chance of becoming qualified teachers.

There are five key components in the *Growing Our Own* project: the community, the Teacher Assistants (TAs) who have become the preservice teachers, school-based mentor teachers, a school-based coordinator, and a CDU lecturer. These components work in concert to achieve the goals of the program.

Initially, intensive consultation was undertaken with the six remote Indigenous communities involved in the program. Each community was visited twice, and consultation took place with the key stakeholders. The program was outlined, and support requested from the community. Then, the community nominated potential students. Ongoing support from the community was required through the establishment of a dedicated learning space and time for the preservice teachers. In all schools two or more TAs worked together in the program for at least one full day per week, thus creating a mutually supportive community of learners.

The TAs nominated for the program attended a full day workshop during which the expectations and requirements were discussed. Each student was given the opportunity to make the necessary commitment, or to withdraw his or her nomination. Those who wished to join the program were then enrolled in the Bachelor of Teaching and Learning, a four-year education degree leading to teacher registration in the NT.

The delivery of this program is distinctive in that it harnesses and blends assistant teachers' extensive classroom experience and expertise with new knowledge about teaching and learning to meet course learning outcomes in practical ways relevant for each school and community context. Many of the TAs have worked in the schools for a long time—more than twenty years in some cases. These people are deeply embedded in the community, many having significant responsibilities and all having extensive knowledge of the local culture, language(s), families and environment (Maher *in press*). In the bilingual schools, where school instruction initially takes place in an Indigenous language, and then English is gradually introduced over the years, they are an integral part of the classroom when the teacher speaks only English. They are also the main link between families, the community, and the school.

The TA role provides an ideal opportunity for the integration of the learning required as part of an undergraduate teacher education qualification with day-to-day classroom activity. It allows the use of authentic, culturally appropriate learning to be used to progressively achieve the learning outcomes required by CDU course and teacher registration requirements. These outcomes are achieved across subject boundaries within the school context, rather than as part of isolated, university-based units. As the program has progressed it has become apparent that the participants are gradually repositioning themselves in the classroom and the school as teachers rather than teacher assistants.

Each *Growing Our Own* student is supported by a mentor teacher, with whom he or she discusses the implications of their learning, and plans and implements lessons. This relationship is a mutually supportive one, as the student works as a TA in the mentor teacher's class during those four days when they are not involved in academic work. As is common in remote schools, many of these mentor teachers are relatively inexperienced and few have specialised knowledge of teaching in a remote Indigenous community, however those who are open to new ideas and have positive beliefs about the capacity of the *Growing Our Own*

student to develop as a teacher, are able to make an enormous contribution to this growth.

The students are also supported within each school by a full-time school-based coordinator. The coordinator works with the group when the lecturer is on site, and then supervises the students' study and practical work for the rest of the week. The school-based coordinator also plays a crucial role in being the link between the coursework and the classroom practice, working closely with the mentor teachers to ensure that the preservice teacher completes thorough planning and receives feedback on lessons.

A designated CDU lecturer visits each site once a week (by plane, four wheel drive or boat) for the whole school year (typically 40 weeks) to deliver the academic course content. For three of the authors this has been a new and challenging experience, as we have not previously worked in a remote community. However we have been quickly accepted by the community, and by the preservice teachers in particular, and, through weekly visits, have been able to form respectful and supportive relationships. The lecturers work closely with each other to ensure that the program is coherent across the six school sites, and each works with the school coordinator and mentor teachers to help oversee the preservice teacher's planning and liaise with the school staff.

The course content consists of the standard 24 units taught as part of CDU's Bachelor of Teaching and Learning Preservice (BTLP), of which two focus on mathematics content knowledge and pedagogy. However they are not taught as stand-alone or isolated units, but rather are integrated and customised to suit the context. The school classroom is a particularly important site for learning, with strong links being made between theory and practice. The program enacts a *both ways* approach (Bat and Ober 2007; Verran and Christie 2007), with the mentor teacher, the school coordinator, the CDU lecturer and the *Growing Our Own* student learning culturally relevant knowledge and practices from each other, embedding them in the academic learning of the BTLP and enacting them in the pedagogy and curriculum of the classroom. Indeed, as lecturers in the program, we are continually confronted with how little we know of the context and of how much we can learn from the *Growing Our Own* students, both about their culture and about the knowledge that is embedded within it. The relationships between the *Growing Our Own* students, their mentor teachers, the school-based coordinator and the CDU lecturer, and the mutual learning that takes place as a result, are thus the key to the successful implementation of the program.

The *Growing Our Own* model is clearly resource-intensive. However it responds to a need to restructure teacher education for students in remote Indigenous communities. By locating learning within the context in which the students live, and activity within the day-to-day tasks of teaching in which they are involved, the *Growing Our Own* program creates an authentic situation in which to embed learning. By creating a partnership between participants at all levels it seeks to break down barriers that inhibit the participation of Indigenous people in traditional teacher education programs. By valuing the knowledge that the Indigenous students bring it seeks to instil the confidence required for them to become effective teachers in the community, who are then able to use culturally appropriate knowledge and pedagogy in teaching their own children.

Methodology

The cultural background of the TAs involved in the *Growing Our Own*, and the context in which the program was enacted, make formal and conventional methods for collecting data problematic. In particular it would have been inappropriate to view the participants as units of analysis in a research project, as they are part of a complex web of activity in a particular cultural space. Thus conducting interviews would have positioned the participants as objects of study, and been particularly threatening early in the course. Similarly administering tests of mathematical knowledge would have privileged a Western way of knowing that is measurable by results on a test. Rather, the research discussed below arises from an emerging agenda, focused on teaching and learning, in which the CDU lecturers, school coordinators, mentor teachers and *Growing Our Own* students are co-participants. As the program has progressed it has become apparent that the *Growing Our Own* students have grown in confidence and taken more control of their learning.

The data arises from our day-to-day work with the *Growing Our Own* students, their mentor teachers and the school coordinators. We use informal comments, casual remarks made by mentor teachers, reflections of the *Growing Our Own* students following particular events in the program and our own observations of the knowledge, pedagogical practices and confidence of the students throughout the program. In addition we use video recordings of lessons taught by the *Growing Our Own* students to examine how the knowledge and confidence gained by the students as part of their formal study was enacted in the classroom. We suggest that this holistic view of data is more authentic in the cultural context of a remote Indigenous school than something more structured, formal and atomistic. It is true to an ethnographic tradition (Hammersley and Atkinson 1995) that values complexity and accepts the premise that there are multiple perspectives within any given community.

We present the data in the form of a narrative, Philomena's Story. It should not be read as a story of a single individual; rather it is an evocative narrative that illustrates of the journey of a *Growing Our Own* student, and represents similar journeys of the other students in the program. Just as Indigenous ways of learning employ story-telling, watching and modelling, we present this as a story from which lessons may be learned. To present the data otherwise would rob it of its power and cultural relevance.

Philomena's Story attempts to describe how, within the *Growing Our Own* program, the complexities of working in a remote Aboriginal community were addressed. As Zevenbergen and Flavel (2007) have pointed out, learning in Indigenous communities is inextricably linked to the community, its rules and values and the expectations of who does what. In the *Growing Our Own* program the synergies and tensions between the various subjects and their goals, the changing aspects of the division of labour that emerged as the program evolved, the availability and use of cultural tools including language, and the complex nature of the community in which the program was conducted, all had a huge impact on the students' development of mathematical knowledge, effective pedagogy and self-efficacy. We highlight these as we describe the mathematics lesson taught by Philomena.

Philomena's story

Philomena⁵ is a 52-year-old woman from Wadeye (or Port Keats, as it is also known from its days as a Roman Catholic mission), the largest remote Indigenous community in the NT. It is located on the edge of the Daly Reserve, approximately 350 km southwest of Darwin. Wadeye came to the attention of the wider Australian community through a series of newspaper reports leading up to and during the Federal Government Intervention. Whittaker's (2007) article *A Town Like Wadeye*, in *The Australian* newspaper, highlighted some of the social and economic problems experienced by the community. The negative aspects of Wadeye were the focus of subsequent media attention, highlighting issues of gang violence, rioting, poor living conditions, low levels of primary health care, educational disadvantage, domestic violence and high levels of incarceration of young people from the community. While this reporting served to highlight decades of government neglect and fiscal mismanagement, much of the media attention has ignored the more positive aspects of community life in Wadeye. There are a number of families in the community, of which Philomena's is just one, that are thoroughly committed to ensuring a positive future for the young people of the town.

Philomena is a wife, a mother, and a grandmother, and is the sole breadwinner in her extended family. She is an active member of the school's Indigenous Leadership Committee and of the local parish Church. She is a caring, compassionate and extremely humble woman, with a mischievous sense of humour and an intense pride in her heritage and her community. She cares (in all senses of the word) for her sick husband, her two children, and her grandchildren. Philomena's compassion extends to her intricate family and community network. Philomena can see beyond the troubles that disrupt her community, which is so often represented in the media as the archetypal failed Indigenous community. She speaks proudly of Wadeye, of its people and especially of the children that live there.

Philomena's education took place mostly in Wadeye, where she was taught by nuns, and boarded at a convent. With many giggles, she will tell of how she frequently 'escaped' and headed off country to be with her parents, only to subsequently be brought back to the convent. Her education was punctuated by a short stay in a Darwin Catholic boarding school, only to 'escape' again and return to Wadeye. While English is not her first language, Philomena has a relatively good grasp of both written and spoken English. In all she speaks about five local Aboriginal languages fluently.

Within the cohort of *Growing Our Own* students at Wadeye, Philomena emerged very quickly as the leader and spokesperson for the group. Her community standing and English skills have been assets in her development as a teacher throughout the program. She worked with two different mentor teachers over the course of the *Growing Our Own* program, each of whom had very different teaching styles and personality types. With the second mentor, Melinda, Philomena developed an excellent professional relationship that was a truly *both-ways* learning experience. Melinda was able to assist Philomena to develop her English and numeracy skills, in addition to her classroom management skills and general pedagogical knowledge. Philomena was able to share with Melinda something of her own culture and the knowledge that the Aboriginal children brought to school.

⁵ The name Philomena and all names used in the story are pseudonyms.

Philomena has worked at the school as a TA for nearly three decades. Indeed, she taught the two other students in the *Growing Our Own* program when they attended Wadeye school. One of the great challenges for TAs such as Philomena has been overcoming the low expectations of the ‘whitefella’ teachers whom she has worked alongside. The expectation of TAs is for them to manage behaviour in the classroom in Murrinhpatha, which most teachers from outside Wadeye cannot speak (there are few who learn it during their time in Wadeye). The big leap for teachers such as Philomena, in the *Growing Our Own* program, has been to recognise that their knowledge is important in the formal school curriculum.

The following lesson is but one example of the culmination of all of the factors in the program: the intensive yet sensitive mode of delivery, the commitment of all involved, the *both-ways* learning which occurred and the wonderful relationships which developed. It tells the story of one lesson as recorded in a video. We observed lessons taught by each of the twenty-one *Growing Our Own* students, and videoed five lessons near the end of the program for analysis. While we could have discussed other lessons, we selected Philomena’s as it tells a powerful story from which others can learn.

Philomena’s lesson

Philomena’s lesson focuses on developing knowledge of ordinal numbers with her Year 2 class. It is important to note that in Murrinhpatha, the language spoken at school by the children, and in their own first home languages, there are no words for first, second, third etc., and furthermore there are no words for specific numbers beyond five (although they could be constructed if needed). As all the children in the class speak Murrinhpatha as a common language (not necessarily their home language, but always as a preferred lingua franca to English), counting in Standard Australian English is not part of their everyday language. For Philomena this language was also uncertain, and she spent considerable time before the lesson with the CDU lecturer ensuring that her knowledge was secure. She also spent considerable time discussing appropriate activities that would engage children and connect with their existing knowledge. Taking responsibility for these details of planning was not part of the regular practice of the *Growing Our Own* students during their time as TAs, when they adopted a subservient role. Philomena was, in effect, challenging the division of labour to which she had become accustomed over a long period of time.

Due to some unrest in the community only five children, all boys, were present for the lesson. These children came from at least two different classes, so Philomena did not know all the children as well as those from the class with which she normally worked. She was initially concerned about teaching the lesson as planned, as the children were potentially at different stages in their learning. However, after reassurance from her mentor teacher, Melinda, and the CDU lecturer, she decided to teach the lesson as planned, accommodating the difficulties arising from the community context at the time.

The video of the lesson commenced with Philomena and the five children sitting on a mat in front of a whiteboard at the front of the classroom. An Indigenous Teacher Assistant sat to the side of the room, Melinda sat at the back of the room,

and Veronica, the school-based coordinator of the *Growing Our Own* program, filmed the lesson. Philomena showed the children cards labelled *1st*, *2nd*, *3rd*, ..., *10th*. She chose a card at random and held it up to show the children, and modelled the correct use of language by reading the card aloud along with the children. The pedagogy of modelling is consistent with how children learn in the community, and the use of cards draws upon the resources with which they are familiar.

Philomena then placed the cards in a random arrangement face up and asked each child in turn to find a particular card. It was clear from the video that the children had little difficulty in identifying cards where the number matched the word, such as *7th*. However they had trouble with cards such as *1st* or *2nd*, where the English word apparently has little connection with the numeral on the card. This is clearly an issue for children whose first language is not English.

Philomena addressed this issue by connecting the idea of first with winning. She used the idea of a race to identify people finishing first, second, third, fourth and fifth, showing this initially with four drawings of people she named Peter, Mary, Ann and John. She staggered the cards so that Peter was further away from her than Mary, then in turn Ann and John. Giving the people in the pictures names helped the children in the class to identify with them in a situation with which they were very familiar. Philomena asked in English, "Who came first?" and the children pointed to cards at random, at this stage identifying with the drawing that appealed most rather than the positions of the cards relative to Philomena. She emphasised that Peter won or came first, then the children correctly identified that Mary came second, Ann third and John last. It was interesting that Philomena used the term *last* rather than *fourth*, and the terms *won* and *first* interchangeably, again making a connection with children's familiar knowledge and language.

Philomena then explained to the children in Murrinhpatha that they would go outside, have their own race and find out who came first, second, third and so on. She took the five boys outside, and explained to them in Murrinhpatha with accompanying gestures that they were to race around the building and back to her. Near the finish of the race, as the boys approached her, Philomena could be heard quietly saying the words, "first", "second", "third", "fourth", "fifth", which the boys repeated as they arrived. Again, she was modelling the language that she wanted the children to develop in a way that valued how they learned at home. She then gave cards labelled *first*, *second*, *third*, *fourth* and *fifth* to the boys finishing in those positions, and the class moved back to the classroom.

A conversation between Philomena and the boys ensued in Murrinhpatha, during which time the boys took their place on the mat in front of the whiteboard. Melinda and the Teacher Assistant watched at the side, but did not take part in the conversation. It was clear that Philomena was adopting a position of authority in the classroom. She asked in English, "Who came first?" and carefully wrote *Thembing—came 1st* near the top of the whiteboard. She pointed to each word in turn and spoke them aloud, again modelling the language. She asked, "Who came second", and Ngarpirr told her. The boys could then be heard saying in English, "Number two" or "Number three". Philomena wrote *Ngarpirr—" 2nd* on the next line of the whiteboard, using the ditto symbol underneath the word *came*. She asked who came third in Murrinhpatha, using the English word *third* at the end of the question, as there is no Murrinhpatha term for *third*. The use of local language resources

seemed to be very important in the children's learning of the concept of third. She wrote on the board that *Mungunpiye*—"3rd" and repeated the process for Tharrwagal who came 4th. She then asked in Murrinhpatha and English who came last, and added *Jack*—"5th" on the whiteboard.

Philomena then read aloud with the children all the sentences she had written on the whiteboard, reinforcing the connection between the terms and symbols. It was evident that the boys self-corrected when they confused numerals and ordinal terms, and that they slowly learned the difficult terms *first* and *second* that did not correspond in sound to the symbols.

The final part of the lesson involved the boys drawing a picture on blank paper of them finishing first, second, third, fourth and fifth in the race. This was common practice in the classrooms in the school, and children appeared to enjoy consolidating their learning through drawing. Ngarpirr drew five figures on his paper. At Philomena's prompting he put the first letter of each child's name above the figures in their correct positions. Philomena pointed to the whiteboard and again read out "first", "second", "third", "fourth", "fifth" and prompted him to write the symbols below each child he had drawn. When Ngarpirr had finished he moved to a desk and coloured in his drawing. Through Philomena's interaction with Ngarpirr she was able to scaffold his learning of the mathematical concepts. This was significant as in her thirty years at the school Philomena's previous interactions with individual children had been limited to behaviour management and translation.

For an experienced teacher in a Western school the lesson described above may seem relatively normal, and could even be expected of most white preservice teachers. However for Philomena this was anything but an everyday occurrence and it challenged many of the assumptions and expectations from her role as a Teacher Assistant. Throughout the lesson Melinda remained invisible. The Teacher Assistant sat passively to the side of the class and did not interact with the children. Veronica filmed the lesson, but did not interact with the children in any instructional way. Philomena adopted the role of teacher, a position of responsibility that she was unable, and indeed not allowed, to adopt prior to *Growing Our Own*. As in any preservice teacher education, developing this confidence takes a long time, but in the context of a remote Indigenous community, challenging the division of labour and unwritten rules about who can do what in the classroom is particularly difficult, and in this case was only possible due to the high level of support from the lecturer, the mentor teacher, the school-based coordinator and the other two *Growing Our Own* students at the school. In sites or classrooms where one or more of these support mechanisms was not as evident, the *Growing Our Own* students developed less confidence.

The children appeared to be generally engaged in the lesson, enthusiastically matching cards, joining in the race, calling out answers and willingly drawing their representation of the race. By using the resources with which children were familiar, Philomena was able to help children to make connections with their lived experiences. This was unusual in the broader school context. In our weekly visits over a period of two years to the school we saw very few examples of classes learning outside and almost no instances of children learning from cards in the classroom.

Philomena also used the language resources of the children by conducting the lesson in both Murrinhpatha and English, using hybrid sentences where necessary. She modelled the use of language extensively as she read words and symbols on the board and asked the children to read with her. Although the children's answers to questions were generally single word answers, this is consistent with the pedagogy of watching, listening and copying that is the norm in the community. It was clear that at the end of the lesson the children could correctly identify and say the terms "first" through "fifth" and could identify ordinal numbers as corresponding to a particular order. Philomena's use of modelling and scaffolding using the resources of the community was a key factor in this learning.

Philomena's confidence in her mathematical knowledge and capacity to conduct a lesson was clear throughout. During her thirty years as a Teacher Assistant she had had very few opportunities to discuss concepts associated with content areas of the curriculum, and, as she told us, her knowledge at the commencement of the *Growing Our Own* program was restricted to things she remembered from school. In earlier experiences teaching small groups, she would frequently stop and ask the mentor teacher for help with relatively simple mathematical ideas. In this lesson Philomena did not do this, and confidently made links between words, symbols and positions.

Conclusions

We repeat that Philomena's Story is not a story about one individual. In varying degrees it has been repeated across the six sites of *Growing Our Own* and among the thirteen successful students. Philomena is now a fully qualified and registered teacher at Wadeye, with responsibility for a grade 2 class. When we spoke to her about what she had learned during the *Growing Our Own* program she emphasised that she had much greater confidence in her knowledge of arithmetic knowledge and skills. She was confident to teach the grade 2 children to count to 100, and used everyday materials such as cards to assist children to learn addition and subtraction. When asked what she needed to teach mathematics more confidently she replied "Materials, like those blocks". Clearly Philomena had recognised the need to make connections between the mathematics children were learning and the world that was familiar to them.

However, significant challenges remain. Philomena is the first to admit that her mathematical knowledge remains limited, that she would feel uncomfortable working in a school outside her own community and that she requires the ongoing support of her fellow *Growing Our Own* students and non-Indigenous people such as Melinda. She told us that she would like to have "more maths workshops."

There are significant challenges at a school and system level that may also need to be addressed before the benefits of programs such as *Growing Our Own* can be fully realized. When asked what the most difficult idea in teaching mathematics was, a group of the program's graduates said "English". The gap between Indigenous languages and the formal register of mathematics (Meaney 2002) is as much of a challenge for the *Growing Our Own* teachers as for Indigenous children, and is an issue requiring much attention. Simplistic measures such as mandating that the first

four hours of instruction in NT schools each day be in Standard Australian English do not deal with such challenges (Devlin 2010).

We suggest that the expectation that these schools prepare children for system-wide tests such as NAPLAN presents further challenges, in that it limits the capacity of teachers to contextualise the learning for the situation. There is a clear emphasis on developing skills in basic arithmetic at all levels of the primary schools we visited, rather than building on the extensive knowledge of areas such as space and measurement that, as discussed above, these children bring from their home communities.

As discussed above there is an oft-unstated belief that the extensive knowledge that Indigenous children bring to school mathematics serves as little more than a bridge to Western mathematics. While we would not deny the importance of Indigenous children learning Western mathematics, we suggest that Indigenous knowledge also needs to be valued for its own sake. It is not clear that the *Growing Our Own* program has begun to achieve this goal, as mathematics curriculum and pedagogy within the schools in which the program was located have remained largely unchanged. Even in Philomena's lesson there was little overt recognition of children's home knowledge. Such changes are as much about developing equal power relationships between Indigenous and non-Indigenous teachers as they are about teaching and learning.

At a deeper level, the potential for a clash of cultures between Western mathematics and Indigenous values (Watson 1988) also remains unaddressed. The demand for quantification as an objective measure of value lies at the heart of Western ways of thinking, yet may well be in conflict with a system of valuing that begins with relationships and moves to the material world that is characteristic of Indigenous culture. As Watson says "The two systems of valuing and relating are profoundly different, and mathematics is embedded in the profound difference" (p. 272). The potential for programs such as *Growing Our Own* to address this cultural clash is an obvious area for further investigation.

Notwithstanding these limitations, the growth in confidence that has been evident through the program, and encapsulated in Philomena's Story, has been remarkable. The features of the *Growing Our Own* program that promoted this growth include:

- The strength and mutual respect of relationships between the CDU lecturer, the school coordinator, the mentor teacher and the Growing Our Own students themselves;
- The contextual and *both-ways* nature of the learning;
- The affordances offered by learning in situ, where students do not have to abandon the day-to-day responsibilities of life in a remote community, and can work with children they know well;
- The collaborative, small group learning;
- The ongoing critical feedback of a supportive mentor and school coordinator

We suggest that this model of workplace-integrated learning has resulted in a paradigm shift for the *Growing Our Own* students in their perceptions of their status in the school and classroom. Like Philomena, they see themselves as teachers now, rather than Teacher Assistants, and are more confident that their cultural knowledge has a real and meaningful part to play in the education of the children in the community.

Closing the gap between outcomes for Indigenous and non-Indigenous children is a generational challenge. There are no quick fixes or magic bullets. *Growing Our Own* has made a small impact on a few communities. Yet the importance of this impact cannot be overlooked. Philomena and her fellow students will stay in Wadeye, just as the other successful graduates will stay in their respective communities. In time, they will teach the children of Wadeye in ways that are culturally appropriate and they will gradually instill in the children and their community beliefs about the value of schooling. The future of education in the community is in their hands, but can only be fully realised when, in the words of Tobias Nganbe, co-principal and community leader at Wadeye, we are prepared to “meet half way”.

References

- Bat, M., & Ober, R. (2007). Paper 1: both-ways: the philosophy defining both-ways and translating it into bachelor institute practice. *Ngoonjook: a Journal of Australian Indigenous Issues*, 31, 64–86.
- Christie, M. (2007). Maths as a cultural practice in a remote aboriginal community: notes for a presentation at the SiMERR national summit, Canberra, 13th Nov 2007. Retrieved 28 April, 2011 from http://www.cdu.edu.au/centres/macp/docs/MACP_Michaels_reflections.pdf
- Christie, M., & Verran, H. (2006). *Using digital technologies in doing indigenous places in Australia*. Paper presented at the conference ICTs, Development and Indigenous Knowledge, European Association for the Studies of Science and Technology, Lausanne.
- Devlin, B. (2010). The decision to curtail Northern Territory bilingual-biliteracy programs in 2008 and to introduce a new policy in 2009: A brief synopsis. Retrieved 29 April, 2011 from <http://languageseducation.com/devlin101104.pdf>
- Dickinson-Jones, A. (2008). Transforming ethnomathematical ideas in Western mathematics curriculum texts. *Mathematics Education Research Journal*, 20(3), 32–53.
- Edmonds-Wathen, C. (2010). The everyday language of mathematics: investigating spatial frames of reference in Iwaidja. In M. Pinto & T. Kawasaki (Eds.) Proceedings of the 34th Conference of the International Group for the Psychology of Mathematics Education, Vol 2, pp. 321–328. Belo Horizonte, Brazil: PME
- Fordham, A. M. & Schwab, R. G. (2007). Education, training and Indigenous futures CAEPR policy research: 1990–2007. Centre for Aboriginal Economic Policy Research, ANU: MCEETYA.
- Giles, W. (2010). Teacher education in a remote community: learning on the job. *Asia-Pacific Journal of Cooperative Education*, 11(3), 57–65.
- Hammersley, M., & Atkinson, P. (1995). *Ethnography: Principles in practice*. London: Routledge.
- Harris, J. (1987). Australian aboriginal and Islander mathematics. *Australian Aboriginal Studies*, 2, 29–37.
- Harris, P. (1991). *Mathematics in a cultural context: Aboriginal perspectives on space, time and money*. Geelong: Deakin University.
- Harris, S. (1995). Evolution of bilingual education theory in Northern Territory Aboriginal Schools. *International Journal of Society and Language*, 113, 7–21.
- Howard, P., & Perry, B. (2002). *Progress report on the effectiveness of the count me in too indigenous project*. Sydney: NSW Department of Education and Training.
- Hughes, H. & Warin, J. (2005). A New Deal for Aborigines and Torres Strait Islanders in Remote Communities, Issue Analysis No. 54. St Leonards, NSW: The Centre for Independent Studies
- Jorgensen (Zevenbergen), R. (2010). Structured Failing: Reshaping a mathematical future for marginalised learners. In L. Sparrow, B. Kissane, & C. Hurst (Eds.). Shaping the future of mathematics education (Proceedings of the 33rd annual conference of the Mathematics Education Research Group of Australasia). Vol. 1, pp. 26–35. Fremantle, WA: MERGA.
- Kitchen, R. (2003). Getting real about mathematics education reform in high-poverty communities. *For the Learning of Mathematics*, 23(3), 16–22.
- Leder, G., Pehkonen, E., & Törner, G. (Eds.). (2003). *Beliefs: A hidden variable in mathematics education?* New York: Springer.

- Lewthwaite, B., McMillan, B., Renaud, R., Hainnu, R., & MacDonald, C. (2010). Combining the views of 'both worlds': science education in Nunuvut. *Canadian Journal of Educational Administration and Policy*, 98, 1–72.
- Lyons, T., Cooksey, R., Panizzon, D., Parnell, A., & Pegg, J. (2006). Science, ICT and Mathematics Education in Rural and Regional Australia: The SiMERR National Survey. DEST: Canberra.
- Maher, M. (in press). Making Inclusive Education Happen: The impact of initial teacher education in remote Aboriginal communities. *International Journal of Inclusive Education*.
- Martin, A., Marsh, H., McInerney, D., & Green, J. (2009). Young people's interpersonal relationships and academic and non-academic outcomes: Scoping the relative salience of teachers, parents, same-sex peers, and opposite-sex peers. *Teachers College Record*, March 2009.
- Matthews, C., Watego, L., Cooper, T., & Baturu, A. (2005). Does mathematics education in Australia devalue Indigenous culture? Indigenous perspectives and non-Indigenous reflections. In P. Clarkson, A. Downton, D. Gronn, M. Home, A. McDonough, R. Pierce, & A. Roche (Eds.) *Building connections: Theory, research and practice* (Proceedings of the 28th conference of the Mathematics Education Research Group of Australasia) Vol. 2, pp. 513–520. Sydney: MERGA.
- Meaney, T. (2002). Symbiosis or cultural clash? Indigenous students learning mathematics. *Journal of Intercultural Studies*, 23(2), 167–187.
- Ministerial Council on Employment, Education, Training and Youth Affairs (MCEETYA). (2006). *Australian Directions in Indigenous Education 2005–2008*. Carlton South: MCEETYA.
- Ministerial Council for Education, Early Childhood Development and Youth Affairs (MCEECDYA). (2009). *National Report: Achievement in Reading, Writing, Language Conventions and Numeracy 2009*. Canberra: MCEECDYA.
- Northern Territory Board of Studies (2008). *NT Board of Studies Annual Report*, Darwin: NT Government.
- Northern Territory Government Department of Education and Training (2011a). *Enrolment and attendance statistics 2010*. Retrieved 28 April, 2011 from <http://www.det.nt.gov.au/students/at-school/enrolment-attendance>
- Northern Territory Government Department of Education and Training (2011b). *Prioritising Literacy and Numeracy: Embedding Aboriginal and Torres Strait Islander perspectives in schools*. Retrieved 28 April, 2011 from <http://www.det.nt.gov.au/teachers-educators/literacy-numeracy/literacy-and-numeracy-strategy>
- Pegg, J., Graham, L., & Bellert, A. (2005). The effect of improved automaticity of basic number skills on persistently low-achieving pupils. In H. Chick & J. Vincent (Eds). *Proceedings of the 29th conference of the International Group for the Psychology of Mathematics Education*, Vol 4, pp. 49–56. Melbourne: PME
- Rose, D., Gray, B., & Cowey, W. (1999). Scaffolding Reading and Writing for Indigenous Children in School. In P. Wignell (Ed.) *Double Power: English Literacy and Indigenous Education*. Melbourne: Language Australia.
- Siemon, D., Izard, J., Breed, M., & Virgona, J. (2006). The derivation of a learning assessment framework for multiplicative thinking. In J. Novotna, H. Moraova, M. Kratika, & N. Stehlikova (Eds.), *Proceedings of the 30th Conference of the International Group for the Psychology of Mathematics Education* Vol 5. pp.113-120. Prague: PME.
- Taylor, J. (2004). *Social Indicators for Aboriginal Governance: Insights from the Thamarurr region, Northern Territory*. Centre for Aboriginal Economic Policy Research Monograph No. 24. Canberra: ANU E Press.
- Taylor, J. (2010). *Demography as destiny: Schooling, Work and Aboriginal population change at Wadeye*. Centre for Aboriginal Economic Policy Research Working Paper No 64. Canberra: ANU E Press.
- Verran, H., & Christie, M. (2007). Using/designing digital technologies of representation in Aboriginal Australian knowledge practices. *Human Technology: An Interdisciplinary Journal of Humans in ICT Environments*, 3(2), 214–227.
- Watson, H. (1988). Language and mathematics education for Aboriginal-Australian children. *Language and Education*, 2(4), 255–273.
- Whittaker, M. (2007). A town like Wadeye. *The weekend Australian* Nov 3–4, 2007.
- Yirkala Community School. (1991). *Garma maths: Gurrutu Yolngu kinship system*. Nhulunbuy, Northern Territory: Yirkala Literature Production Centre.
- Zevenbergen, R., & Flavel, S. (2007). Undertaking an archaeological dig in search of pedagogical relay. *The Montana Mathematics Enthusiast Monograph*, 1, 63–74.