



UNIVERSITY OF
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Celebrating success:

Numeracy in remote Indigenous contexts



What makes
for successful
numeracy
education in
remote Indigenous
contexts: An
ethnographic case
study approach

Stories on remote
indigenous
mathematics
successes
compiled by
Professor
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Learning in the Early Years

Nyikina Mangala Community School

Nyikina Mangala Community School is located at Jarlmadangah Burru Community on Mt Anderson Station. Jarlmadangah Community is a small, relatively new community. Two brothers established the community in 1987. It is, in remote terms, relatively close to two major centres – Derby (110kms) and Broome (240kms). There are two main activities in the community – education. The tourism business runs 2- and 3-day guided tours, including camel trekking, in the local area. Surrounded by the beautiful Grant Ranges, the area offers much to tourism.

Being close to major centres, most members of the community have a strong grasp of English. Many students' first language is a variety of Kriol different from that spoken in other parts of the Kimberley region. The school is proactively seeking to maintain the local Nyikina language through a language program in which locals teach the students.

Nyikina Mangala Community School, established in 2000, is part of the Aboriginal Independent Community Schools (AICS) network. Consequently, teachers have the support of a network of teachers and support mechanisms. The school offers a comprehensive program from Kindergarten to Year 10 with approximately 23 students. The school also has a preschool (day care) program and is building a seamless web between the day care centre and the school. In addition to keeping a strong focus on literacy and numeracy outcomes, the school and community work tirelessly to educate future leaders in traditional methods, culture, and language, to ensure the success of the next generation in many different contexts.

There is great support between the school and the community and a great sense of belonging among community members. Many community members

A photograph of a dirt road in a desert environment. A series of numbers 1 through 10 are painted in a diamond pattern down the center of the road, with the number 10 at the bottom. The road is flanked by dry vegetation and shrubs. A small white object, possibly a piece of paper, lies on the road surface near the number 8.

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A young girl with dark, curly hair is seen from behind, sitting on a light-colored floor. She is wearing a colorful, horizontally striped dress with shades of blue, yellow, and pink, and a small pink bow in her hair. She is holding a green marker and writing the number '40' repeatedly on a white piece of paper. The paper is placed on a dark surface, and the background is a plain, light-colored wall.

Initiatives Undertaken – Descriptions of the Practice/s

The Nyikina Mangala story is based in the early years of schooling. The school is unique among other schools profiled in this research, because numeracy is taught in the last period of the day, that is, in the period after lunch and before going home. The teacher has adopted an investigation approach where the investigation is carefully designed to act as a prompt for learning. Students can interact with a range of activity centres (n=8), including a literacy-specific area and a numeracy-specific area. Students' interactions with the items in the activity centres form the basis of the learning. For example, the teacher will draw attention to the fact that the children were playing with a specific item in the numeracy area, and will initiate discussion about the item. This discussion leads into the lesson. The investigation approach draws on the Kath Walker approach to teaching Aboriginal students. However, because not all components of the approach are used, the curriculum is not an accredited Kath Walker curriculum.

Numeracy as the Last Session of the Day

Much of the educational literature argues that the last session of the day is not the peak time for learning. However, to combat this belief, the teacher has developed a number of strategies to build the learning stamina of the students. First, the children begin the lesson relaxing and eating fruit. This gives students time to calm down after lunch and to orientate to maths time, and the fruit provides extra energy for learning. Previously, fruit time was followed by 15 minutes of rest. Rest time has gradually decreased as the year has progressed and students have become accustomed to the program. Students no longer have a rest time, and lessons start immediately after fruit time.

Play-based Learning

The teacher uses a play-based approach. The classroom is full of activity centres that cover the Key Learning Areas (KLAs) and act as stimuli for the lesson. Children are able to move around these play stations in the investigation session of the day. These apparently free-choice activities have been carefully chosen by the teacher based on assessments of student learning.

Planning the activity centres is an important component of the model used by the teacher. For example, one of the activity centres was related to measurement, which was the teacher's current focus. The teacher had included a range of measuring tools in this activity centre. The children played with the ruler, so a subsequent lesson addressed rulers. In the lesson, children created rulers (long strips of paper) that used informal measuring units. They then used their paper rulers to measure things – trees (around the circumference), play areas, objects etc. – and they recorded what they had measured. The students' recording showed that some children understood the principles of measurement (e.g., start at a starting point, no gaps, and cardinality of length). These children were ready to move to formal units of measurement. Consequently, a new activity table – a shoe and accessory shop – was introduced, and children could measure the items in the shop with a ruler. The shop would now become the source of investigations so that those who were ready to move to formal units of measure could be scaffolded into their use, while those who were still developing measuring principles could use this activity to build those skills.



Typical Lesson Format

The typical lesson starts with “crunch and sip” (fruit time) for 5 minutes to calm the students after lunch, and orientate them to the forthcoming maths lesson. The formal lesson begins with the number of the day which is used to build place value skills; students learn that when they have 10 items they need to bundle them into a collection, and when they get 100, they swap the bundles for a bundle of 100. This bundling process can be done with items of their choice, such as icypole sticks. The bundling of 10 and trading is key to the activity. The students then move into writing numbers. The number given to a student depends on his or her level of knowledge. Students are instructed to collect that number of a certain item from the other side of the room. This helps them focus on the task and build their skills around remembering and carrying out instructions.

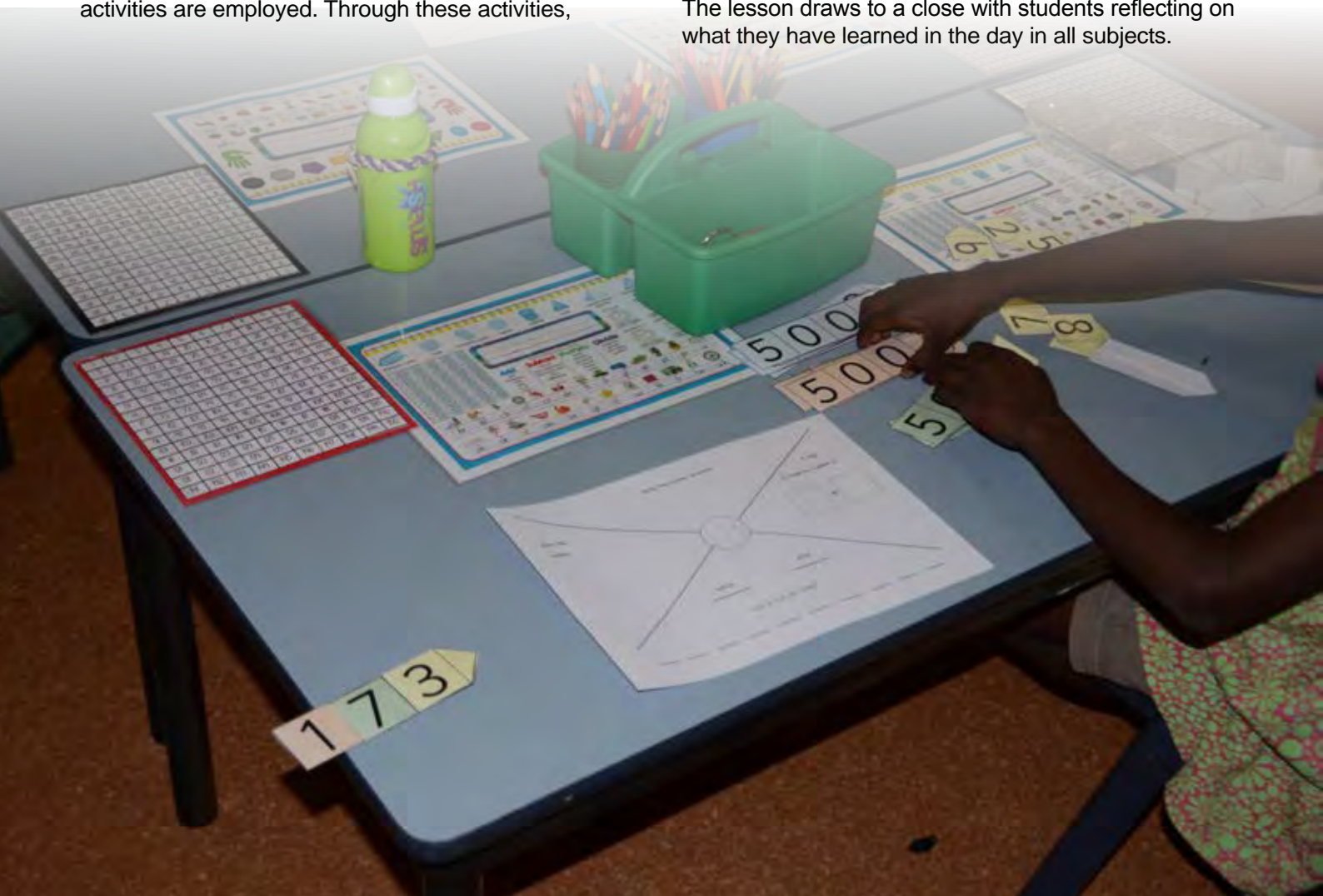
From this activity there is a transition into partitioning activities. Assessment undertaken through AICS numeracy strategy (see AISWA story in this collection) showed that the students’ partitioning knowledge was quite poor. Consequently, partitioning has become a focus of lessons, and a wide range of partitioning activities are employed. Through these activities,

the students are also seeing a relationship between addition and subtraction.

After completing the partitioning work that is targeted for the number knowledge of the individual students, students are provided with a “cross sheet” containing a number that is targeted to the needs of the learner. The cross sheet (discussed later in this report) creates opportunities for the students to work with the number in different ways – place value, partitioning, and using words. Language is seen to be very important – in maths, and for the students in general – so language is incorporated into numeracy activities. Some of the students are writing numbers in the 300s.

The class then returns to whole-group instruction time, the focus of which changes every two days and is determined by the investigations being undertaken (this is discussed in greater detail later in the report). The teacher puts items on display, and students’ interaction with the equipment is used to start discussion in the whole-group instruction. Using the students’ interaction with the equipment as a basis for discussion means that children have ownership of the discussion.

The lesson draws to a close with students reflecting on what they have learned in the day in all subjects.



Investigations as the Catalyst for Numeracy

As described earlier, the classroom contains activity stations that correspond to knowledge domains (e.g., literacy, numeracy, and music). The activity stations and the overall classroom are seen as the learning environment, which is considered to act as another teacher, so the selection of activities is a critical element in the planning for learning. Very careful thought needs to be put into the maths activities as these become the provocations for learning mathematics. There is a danger that literacy may dominate the activities and numeracy learning potential may be lost, so careful planning must be undertaken to ensure a focus on quality learning activities for mathematics. It is possible that some activity tables may also serve dual purposes, and this is an advantage of the overall approach.

The investigation is a 45-minute session at the start of the day. It includes 15 minutes of tuning in where students get cued into the things they will learn about, so they hear the language that will be used. During this time, three children have authentic conversation with the teacher to share what they have learnt. This can be anything

that the student would like to share. For example, the student might want to show that they have learnt to count backwards by 10. Throughout the investigation, the teacher keeps records of individual students' actions, talk, and learning. The teacher uses these records as a starting point for planning extension and scaffolding. For example, when recording students' measurement activities in the investigation, the teacher noted that the students needed a practical context to which they could apply their learnings. To this end, in the next day's investigations, the teacher had created a shoe shop so that the students could apply measuring skills in a pseudo-real context.

Recording Learning

Many tools are used to record student learning. Focusing on patterns in number through number work on partitioning is a daily activity. Recording the numbers to see the patterns is an essential skill that is used daily. The students record their work on small whiteboards so they are able to see emerging patterns and the teacher is able to assess their work. Using the whiteboards enables children to easily correct errors, and provides the teacher with an indication of the students' thinking (knowledge) and working (process). Because this activity is conducted on the mat in front of the teacher, she is readily able to scaffold students through the use of questions and provide them with prompts for their thinking.

Students then move to their desks where they undertake a further exploration of number work related to counting on and counting back. These activities are undertaken on a large A3 print out that is standard format. This task is divided into quadrants with a central number (which the teacher writes, and which depends on each student's level of mathematical skills). The students then use manipulatives to work through the various elements of the activities, which include:

- Writing the number in words
- Writing a way to make the number (represented by $\square + \square =$)
- Drawing the number
- Writing the number before and the number after
- Counting forward and backward from their number on a number line.

In the observed lesson, the numbers ranged from 11 to 371 depending on the learning needs of the individual student. The teacher provided scaffolds for the students that included counting frames, place value cards, counters, and number lines.



Students also have journals in which they record their learning in mathematics (and other curriculum areas). Students are allowed to represent their learning in ways that are comfortable for them. These can include diagrams, drawing, and writing in Kriol. However, there are also venues where students must respond in appropriate school language. One of these is the class book.

A large book, referred to as class book, is also used as a recording tool for the learning of the students. The teacher had placed photos of the students doing particular activities related to the measurement investigation. In the observed lesson, she prompted the students to talk about their learning about measurement and some of the things they had done. Initially she recorded some of their comments and conversation in the book. Then she reminded the students that this was their record of learning and they could also write in the book. Students took this challenge and wrote comments about their learning. As they talked about what they had been doing, the teacher brought in the language they had been using (e.g. “units”), and children used terms such as “trapeziums” to talk about the units which with they chose to measure. The class book is a highly interactive forum in which students were actively involved, and which the teacher could use to assess students’ learning. In the observed lesson, the teacher used the students’ conversations to determine who was ready to move to formal units, who needed more activities around the principles of measurement, and so on. The conversations indicated that some students were ready to work with formal units, so the teacher would add a formal device, such as a ruler or trundle wheel, to the measurement activity area. Consequently, the students would be in control of their learning through the (guided) choices that would be made available to them.

Recording Student Learning

The teacher kept a daily record of student learning. The detailed account took about 5 minutes to complete for each child and documented various aspects of their learning for that day. These records were useful for reports and for planning the on-going activities for each day. Knowing the students’ needs enabled the teacher to create learning opportunities that would be provided through the investigations. As the class was a small one, the task was not onerous but proved to be a valuable teaching tool and critical for planning.

The Role of the AEW

It is important to have a very good working relationship with the AEW. While there is little time (and money) available to support co-planning with the AEW, it is hoped that co-planning may occur in the future. Currently, the tuning session for the students helps the AEW to tune in to what the lesson will be about. A strong and respectful working relationship has enabled the AEW to listen to the ways in which the teacher is posing questions and she has adopted the same technique with the students. The role of the AEW in this classroom is not about behaviour management, but about teaching. The teacher has deliberately ensured that the AEW has the role of an educator rather than a disciplinarian. As a result of the collaboration between the teacher and AEW, the students see a common message being represented through the teaching team, which is invaluable for learning.





Modelling Standard Australian English (SAE)

Teachers and AEWs model SAE consistently to the students. In some classes, children from non-Aboriginal families also model SAE. As a result, students realise that SAE is used not only by the teacher, but also by their own community. This helps to build proficiency in SAE, which is seen to be a valuable tool in learning and life outside school.

Encouraging students to talk about their mathematical learning has required the teacher to work with the students in how to talk mathematically. The teacher models mathematical language, ways to articulate thinking and behaviour (e.g., “I think,” “I saw,” “I did”), and complete sentences. For example, if a student responds to a question with “big mob,” the teacher articulates the response as a full sentence using appropriate mathematical language – “It was a large crowd at the football.”

Attendance

Unlike many remote schools, Nyikina Mangala Community School does not have issues of poor attendance. The school has an alarm system that wakes families and then calls children to school. A sports session prior to school involves the children running around the community. Next, children eat breakfast, during which the staff determine whether any students are absent. Someone from the school will then seek out those students. The school formally recognises (through certificates) students who have missed only 1-3 days in a term. Students are offered small incentives that are linked to curriculum areas, such as a trip to Broome to visit the weather bureau.

Benefits for Learning and Learners

The teacher has documented student learning through the numeracy portal and recorded learning outcomes in the scope and sequence charts. Scoping the students' learning reveals that they are improving in their mathematical skills. The teacher is confident that the students are improving at a rate greater than they had been when using a more traditional approach. The teacher believes that the students' success is due partly to the fact that the approach takes what the students know and integrates it into a play-based learning environment. This approach validates, solidifies, and extends students' knowledge. In contrast, the previous approaches had taught maths as disjointed skills that made little sense or connection for the learners. A further benefit of the play-based approach is the focus on language and the integration of language across literacy and numeracy.

Linking the Pre-school with the School Years

This approach has been very useful for building bridges with the pre-school. The physical barriers have been removed from between the two sites (pre-school and school) so that the children can move between the two contexts. This not only helps parents and young children become familiar with school, but also helps to orientate them to school structure and activity. The resulting familiarity with the context of learning they will encounter upon entering Kindergarten year will help with the transition of the young children into the formal school context.



Advice to Teachers

AEW as a Teaching Partner

At Nykina Mangala, the role of local people is an integral part of the school culture. Many of the local people have a strong connection with the school and have strong backgrounds in literacy and numeracy. In the early-years classroom, the AEW is a teaching partner. The teaching time for AEWs is constrained by the CDP payment scheme –they are paid for only 5 hours face-to-face involvement at the school – so they are not involved in planning time. The early-years AEW has worked with the teacher for 8 months and has been learning through an apprenticeship model. Thus, she has taken cues from the teacher in terms of how to interact academically, how to lead discussions, how to organise groups, and the key learning from those groups and work stations.

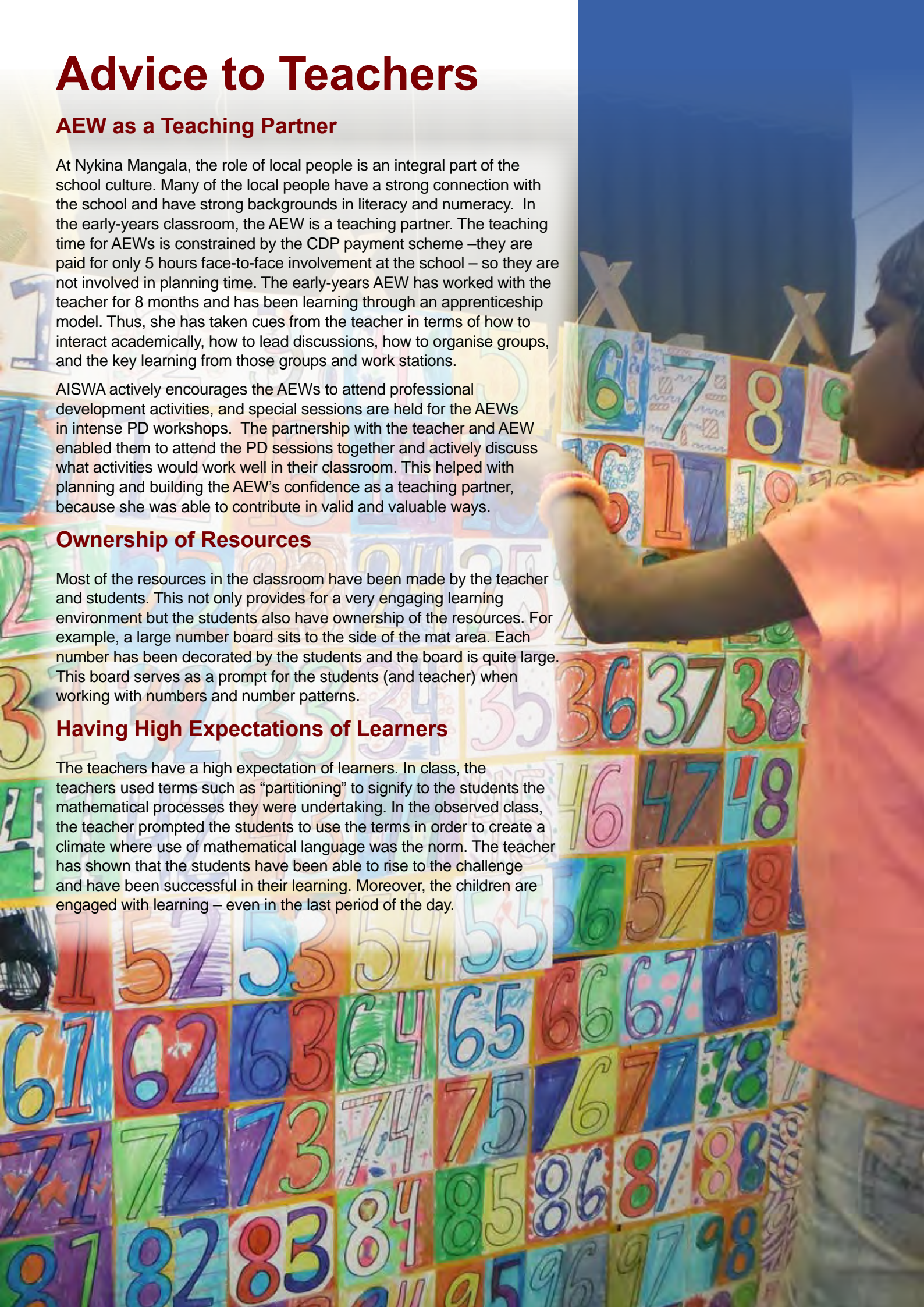
AISWA actively encourages the AEWs to attend professional development activities, and special sessions are held for the AEWs in intense PD workshops. The partnership with the teacher and AEW enabled them to attend the PD sessions together and actively discuss what activities would work well in their classroom. This helped with planning and building the AEW's confidence as a teaching partner, because she was able to contribute in valid and valuable ways.

Ownership of Resources

Most of the resources in the classroom have been made by the teacher and students. This not only provides for a very engaging learning environment but the students also have ownership of the resources. For example, a large number board sits to the side of the mat area. Each number has been decorated by the students and the board is quite large. This board serves as a prompt for the students (and teacher) when working with numbers and number patterns.

Having High Expectations of Learners

The teachers have a high expectation of learners. In class, the teachers used terms such as “partitioning” to signify to the students the mathematical processes they were undertaking. In the observed class, the teacher prompted the students to use the terms in order to create a climate where use of mathematical language was the norm. The teacher has shown that the students have been able to rise to the challenge and have been successful in their learning. Moreover, the children are engaged with learning – even in the last period of the day.



Persevering with Change

The play-based approach was challenging to implement, because it was quite different from what had been done in the past – by the students and by the teacher. The change had to be put before the Board of Directors for approval. Once the approach commenced, the teacher experienced considerable challenges from the students because the approach was so different. At many points she questioned whether or not the program would be successful, but she persevered with it. Other schools that had implemented the program had evidence that it worked, and with this research basis to the program, the teacher persevered with the roll out of the program. It has taken more than 8 months to see success and to see the embedding of the new approach as a normal part of the daily routine in the early-years setting.

There were many elements of the program that needed to be established and each of these required input and development over time. Different skills – sitting on the mat, eating fruit to calm students, working independently on activities, choosing activities, working through the various phases of the lesson format – all required explicit teaching. Embedding them into the daily routine was often challenging and met with resistance from the students. However, as they gained familiarity with the routines, they engaged more with the activities. The learning that was emerging from the approach encouraged the teacher to keep persevering with the change process.

Support from Peers

One important element of the change process was being part of a team of collaborators. In the remote school context, the teacher was able to link in with her peers at other schools in the AICS network through social media such as Facebook, where they have established an online community for school in general and for innovations in teaching. The teacher also sought out her peers, and will be undertaking further professional development in the play-based approach. The teacher also visits her peers to see how they are working in their respective schools. Having this network of peers has been an important part of her growth and knowledge about what works, what she can do, and what should be avoided. The peer network has been an important part of her feeling confident in managing and continuing with the change.





Model for Quality Learning

Key Idea	Principle	Mathematics
Using investigations as a catalyst for learning	The room is set up with investigations/task centres that cover curriculum areas. Students can select the various tasks they undertake in the nominated investigation time. The activities chosen become the focus for literacy and numeracy lessons (as well as covering other KLAs).	Carefully planned investigations in mathematics are located in the activities. An activity with which a child interacts becomes the focus of the lesson. Thus, the focus appears to have been determined by the students, so they have ownership of the learning. This helps to motivate learners and helps them to retain learning.
	Recording activities provides teachers with evidence of student learning. This evidence becomes the basis for the next teaching episodes.	Evidence is provided through various aspects of the mathematics lessons. These become teaching points within a lesson and/or an organiser for following lessons.
	Carefully structured activities that are designed to target learning needs are pivotal to planning.	The teacher designs mathematics investigations that align with student learning. They are designed to provoke, elicit, and extend students' mathematical learning.
	Students have ownership of learning	Students interact with investigations and the teacher observes these interactions. What happens at the mathematics investigation becomes the focus of learning, so the students see that they have "chosen" the learning. Resources are made by the students and are used in mathematics. These resources are displayed in the classroom.



Key Messages for Numeracy Learning

High-quality numeracy can be taught at any period of the day. However, considerable scaffolding is required to implement a change of schedule. Teaching numeracy in the afternoon requires strategies to combat students' cognitive fatigue that can hinder learning in the later parts of the day.

Play-based learning needs to be carefully structured with clear learning intent for activities.

Carefully planned investigations can serve as a catalyst for literacy and numeracy. The teacher uses students' engagement with the investigation as a starting point for lessons. Consequently, the students have ownership of the topic, and this ownership enhances the possibilities for learning.

AEWs can serve a strong role in the classroom when employed as teaching assistants rather than for discipline and office tasks. AEWs need to be part of the professional learning community to help build their understandings of pedagogy, curriculum, and assessment. Attending PD with the teaching partner helps to build a collaborative teaching approach in the classroom.

Having high expectations of learners enables high-quality and deep learning to occur in numeracy. Students can learn deep content if they are scaffolded well in their learning experiences.

Change can be difficult to implement. All aspects of the change need to be considered and well scaffolded so that learners have an opportunity to engage with the new learning expectations. Throughout the change process there will be times when the effort required to implement the change may be called into question. However, it is better to persevere with the program. If practices of the past have had little effect, new ways of working (with high expectations of students) are needed, and management of the change process is important. Having peers who are also implementing change can help the teacher to maintain strength, enthusiasm, and commitment.

It is important for teachers to share with their peers and community what they doing in their classrooms. This can help other teachers understand the work that is happening in that classroom, so acts as a form of PD. Sharing with peers and the community also means that teachers and community know what is happening. In Nyikina Mangala Community School, the teacher takes every opportunity to have community visit her classroom so that they know what their children will experience in that classroom. Community members are pleased with the changes and support her work as they see the benefits for their children.

School demographics

Year range	U,PP-10	FTE teaching staff	5.2
Total enrolments	21	Non-teaching staff	7
Location	Very Remote	FTE non-teaching staff	5
ICSEA (school)	653	Indigenous students %	100%
ICSEA (distribution of students) (bottom quarter to top quarter)	82% 16% 2% 0%	Enrolments: Girls/Boys	13/8
Teaching staff	6	Language background other than English	50%
		Student attendance rate %	—