



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
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Mathematics Pedagogy

Brewarrina Central School

Brewarrina is a town located on the banks of the Barwon River, 787km NW of Sydney. The name of the town comes from the Wayilwan word, 'burru waranha' which means 'Acacia clumps', 'a native standing' or 'place where wild gooseberry grows'. The population of Brewarrina is around 1500 with a further 700 living on properties surrounding the town. The town is located in the traditional lands of the Ngemba peoples and was once the tribal meeting grounds for over 5000 indigenous people. Evidence of this remains with camp sites, scar trees and fish traps still in the area.

The Brewarrina Fish traps (Ngunnhu) are a very important part of the local history and are heritage listed. They are estimated to be more than 40,000 years old (they may be the oldest surviving manmade structure in the world) and lie downstream from the weir on the bed of the Barwon River. The traps are made up of a collection of stone weirs and ponds, organised to create channels which lead to a complex 'net'. Many years before European

settlement, the Aboriginal communities who created these fish traps were applying innovative knowledge of fish migration, water ecology, physics and engineering. Once the fish were trapped within the 'net', the Indigenous fishermen were free to pluck the fish from the traps as they pleased. The Ngunnhu continues to be an important meeting place for the local Aboriginal people to this day. Brewarrina is now a very popular area for fishing enthusiasts with fish such as Bream, Yellow Belly, Catfish and Murray Cod (the largest officially recorded Murray Cod was caught in the Barwon River and weighed a staggering 113kg).

The first settlers arrived in the region in the late 1830s and in 1859 the town was developed as a port for paddle steamers and was soon recognised as the furthest navigable point on the Barwon River. Wool was shipped from Brewarrina to Adelaide on the Darling and Murray Rivers for many years. Cobb and Co. had a number of coaches that regularly passed through the town which resulted in the

town thriving during the 1870s. This led to a large number of hotels and stores being built in the town. The NSW heritage listed Barwon Bridge was opened in 1888 so that the river could be crossed without a punt or pontoon, and this opened up the opportunity for transporting wool to Sydney by road, rather than just by paddle steamer to Melbourne and Adelaide. This bridge is unusual because it is only one of two surviving examples of the first lift bridges in NSW.

The Brewarrina Ngemba Billabong has a strong Indigenous history. This was the Brewarrina Aboriginal Mission for the local Indigenous people from 1876-1967 and was the very first institution to be established by the Aborigines Protection Board as part of its policy to segregate Aboriginal people. Local Aboriginal people were sent to this location when their land was taken for grazing and this mission was responsible for the removal of many Aboriginal people from their homes against their will. In recognition of this history, the 261 ha property is now listed on the NSW State Heritage Register. The billabong wetlands and woodlands are home to four endangered bird species, the brolga, blue-billed duck, freckled duck and the red-tailed, black cockatoo. They also contain

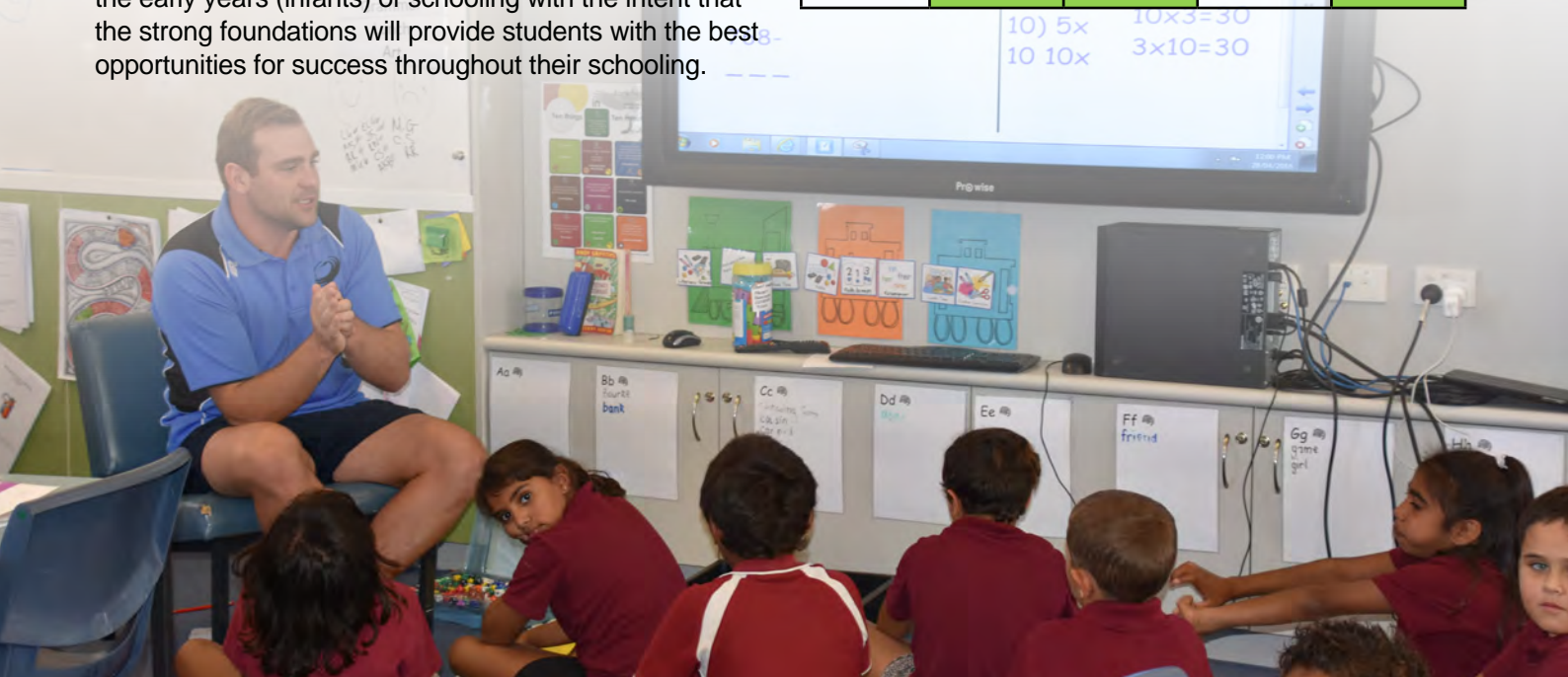
many native plants such as water lilies, river redgums and coolibah. Land management is very important to the traditional owners and this helps to provide job opportunities as well as continuing the important traditions of culture and custodianship.

The Brewarrina Central School is a K-12 school that draws its enrolment from the Brewarrina township and surrounding settlements. A number of children travel 100 to 200km by bus each day from Gongolgon and Weilmoringle. In 2015 there were 160 enrolments at the school with 97% of the student population being Aboriginal. The school has very strong community support and works closely with the local Aboriginal Education Consultative Group. The school has a strong focus on Aboriginal education and cultural awareness. The school is part of the NSW DET Connected Schools strategy. The school enjoys a relatively stable staffing profile with both teaching and support staff having been involved with the school for extended periods of time. Some staff members and executive staff have been at the school for a number of years. The school is well resourced and has an outstanding mathematics resource centre to support the approach taken at the school.

Defining Growth

Brewarrina has shown growth in numeracy results in NAPLAN when compared against like schools. The school is aiming to continue the improvement and move students into a higher band in NAPLAN. The growth described in this case study apply to the primary sector of the school. There has been a very strong emphasis in the early years (infants) of schooling with the intent that the strong foundations will provide students with the best opportunities for success throughout their schooling.

	2012	2013	2014	2015
Year 3				
Year 5				
Year 7				
Year 9			No score	





Practices at the School

Brewarrina has adopted a number of key practices that are implemented across the primary years of school (K-6). These practices are built into all mathematics lessons in a whole-school approach. Like many schools in this study, Brewarrina has adopted a timetable where literacy occupies the first block of school, numeracy the second, and the final block for all other curriculum areas. An emphasis on literacy and numeracy is seen to be a priority for students, as this forms the basis for a functional learner. The structure of the program is consistent throughout the whole year so that students are familiar with the timetable and expectations. Lessons involve group work, rotations, use of technology, games and hands-on activities to ensure students remain engaged and allows for differentiation to meet the needs of each child.

Aboriginal Educators

The school has many long serving staff members, both Aboriginal and non-Aboriginal, making for a very stable teaching and support staff. Aboriginal Educators are a key part of the school program, with some classes operating with up to 2 Aboriginal Educators. Most Aboriginal Educators have been working at the school for many years and have been involved in professional development. They know how processes work and have much experience in working with the students. They bring considerable knowledge - school, home, cultural and community - to the classroom.

Aboriginal educators are provided with release time each week to work with the teacher around planning and preparation. This fosters collaboration and promotes the sharing of local knowledge to better meet the needs of the students. Aboriginal educators play a number of roles in the classroom including facilitator of small group activities.

Lesson Format

The school has developed a broad lesson format for mathematics that all teachers in the infants/primary sector follow. The staff place great emphasis on hands-on, practical learning experiences with text books and worksheets only used on occasion. This approach follows current research and pedagogies, with staff being trained in Targeted Early Numeracy (TEN) and Taking off with Numeracy (TOWN).

Consistency

Consistency within the lessons across the timetable, are seen to be a vital part of the planning in mathematics (and literacy) across the school. Ensuring that lessons follow the same format and expectations enables the students to know what to anticipate when they commence their lessons, and hence be ready to engage in the lessons.

Lesson Structure

Teachers have flexibility within their own classrooms to organise lessons that meet the learning needs and styles of their students. Lessons are structured around a number of key organisers, with teachers able to move emphasis within a lesson to any one or more of the lesson elements depending on students' needs.

Some teachers use timers (on the interactive white boards) as a visual aid for students to see how much time is left for a given activity. The lessons are designed to keep a fast pace to maximise engagement. The use of digital tools is a feature of the lesson as well, to engage learners and promote participation.



1. Number consolidation

In this phase of the lesson, teachers use various strategies to build fluency and automaticity with number facts. The students enjoy competition and speed with various games played and an emphasis placed on personal best rather than competing against peers. Number activities are targeted for the individual students so their number knowledge is commensurate with need and growth.

2. Interactive white boards

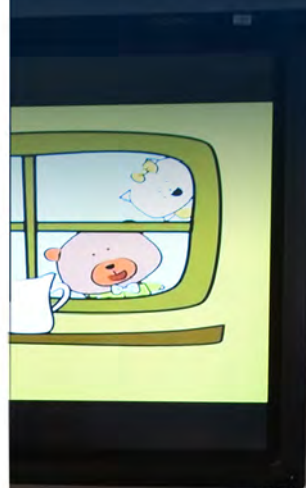
All classrooms have, and use, interactive white boards. These are used in a range of ways to stimulate, engage and motivate students.

3. Hands-on, games group work rotations

All lessons involve focussed activities in small groups. The majority of activities are hands-on and practical. In some classes, group rotations last 15 minutes and are supported by a teacher, Aboriginal educator or student's work independently. The pacing is quick and some teachers use a timer (usually on the interactive white board) so students can see time left in an activity. This keeps the pace brisk and students on task. Groups vary from mixed ability to specific targeted groupings and have intensive specialised support.

4. Word problems

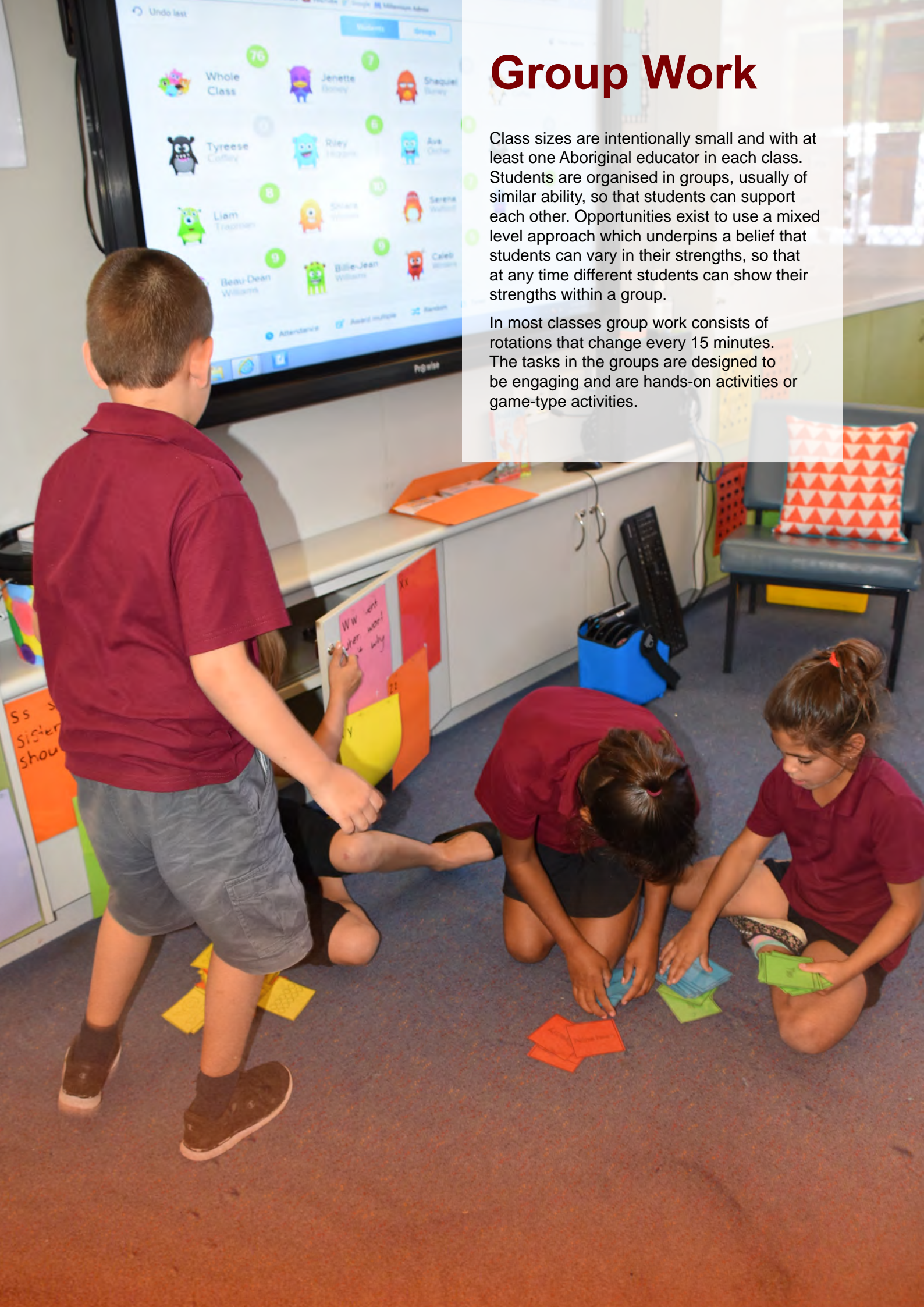
Contextualisation of mathematics into words problems is the final phase of a lesson. Word problems are posed, often in the group context to allow the students to work through a problem, using Newman's Analysis, as a collective group. This promotes peer tutoring and fosters a deeper understanding of concepts taught.



Group Work

Class sizes are intentionally small and with at least one Aboriginal educator in each class. Students are organised in groups, usually of similar ability, so that students can support each other. Opportunities exist to use a mixed level approach which underpins a belief that students can vary in their strengths, so that at any time different students can show their strengths within a group.

In most classes group work consists of rotations that change every 15 minutes. The tasks in the groups are designed to be engaging and are hands-on activities or game-type activities.



The background image shows a two-story school building with a prominent external staircase. The building has a light-colored facade and a dark roof. A tree with green leaves is visible in the upper left corner. The overall scene is captured in a slightly desaturated, warm-toned photograph.

Using Digital Media

Most lessons involve the use of some sort of digital media, usually interactive white boards, where the tool can be used for whole class or small group activities. It is seen to engage the learners and promote positive learning opportunities. Teachers use a wide range of interactive media to enhance understanding of new concepts and support reluctant learners.

Small Classes

Brewarrina CS has intentionally implemented smaller class sizes to lay foundations for success, not only in Primary School but throughout their schooling. A smaller class size allows teachers and Aboriginal educators to know the needs of their learners and provide experiences to cater for varying abilities of individuals within a class. Smaller class sizes also provide an opportunity for positive relationships to form and often result in a more productive and supportive learning environment, where individual strengths are recognised and difficulties are addressed. Smaller classes are possible due to the additional funding that Brewarrina Central School receives. Classes are smaller in the early years and progressively increase in size as the age of the students increase. This process is seen to support the needs of students in the infant (early) years of schooling as they transition into school, learn school behaviours, and come to understand many important concepts in mathematics (and literacy).

Hands-on

All classes actively promote the use of hands-on learning experiences. This is made possible through the small group activities. Within any group, the students will work on similar activities that are tailored for individual learners. Activities range in diversity whilst using similar materials such as cards and dice. The degree of difficulty for the learning opportunity is dependent on the specific learning intention for each group and previous experiences and concepts taught.

To enable the whole school approach with hands on learning, the school has developed a substantial resource room. The room is located in the library and staff are able to collect and use the resources through the borrowing system. There are multiple copies of most resources so that staff are able to cater for all students within the class.

Deconstructing Word Problems

With the move towards more problem-based mathematics questions, there is a greater need for students to be able to decode word problems and decipher the meaning and mathematical processes needed to be able to correctly

answer questions. Based on Newman's model, teachers use a five step process to specifically teach students how to solve word problems. This includes both the literacy and numeracy demand of the question.

Steps	Example
1. Read the problem Students read the problem as a group or whole class. Words are discussed as to how they are said, or what they mean.	Can the students read the words? Mary went to the supermarket and bought 5 apples and 6 pears. How many pieces of fruit were in her basket?
2. Decipher the meaning of the question Collectively (small groups or whole class), the class discusses what the question is actually asking of them	What is the question asking you to do? Can the students make sense of what the question is asking them to do? We have to work out many pieces of fruit are in the basket.
3. Identifying what the mathematical processes involve in order to solve the question/problem As a group, there is discussion with regard to what the mathematical demands are in relation to the question and how the question could be solved. E.g. Identification that this is the addition of the two numbers in the word problem.	So, what do we need to do to find out the answer? Can the students identify the mathematical process required? We need to add how many apples and how many pears there are altogether.
4. Undertaking the mathematics Doing the mathematics that is needed to calculate the response that is required. Here the students actually do the mathematics that is required. (Adding the two numbers to find the result).	So, how do we do that? $5 + 6$ Various strategies could be used – such as counters, fruit, counting on, etc depending on what the students have been doing or how they prefer to work.
5. Constructing the correct response for the answer What was the question asking about - finding out how many apples were in the basket? , So the answer needs to be 'x' apples.	So what do we have? 11, but 11 what? Need the students to be able to interpret what the 11 means – in this case, 11 pieces of fruit.

Consolidation and Fluency with Number

There are many differences between the home, community and school in terms of numeracy practices, and the impact that this can have on the retention and automaticity with number (facts, place value, operations, etc), mathematics lessons place a priority on developing strength in number study.

Lessons begin with number facts and are targeted for each stage and students. Many strategies are used as much for diversity in experiences as for catering for student needs. Drawing on assessments of students, the activities will appear to have a sameness to them for the class but each activity will be different based on student assessments. This approach keeps the class together as a whole so that students do not feel singled out and also meets individual students' needs. For example, students might be making the largest number using a deck of cards. Differentiation occurs when one student might be doing two digit numbers,

another 4 digit numbers, while another might be using decimals. Similarly, students may be using dominoes with some students counting the dots, some recording the dominoes on paper and counting how many and making an addition sentence using numbers (not dots) while another student/group might be doing multiplication. From a class perspective, it appears that they are all using dominoes and unaware of the differentiation that has occurred.

Teachers employ many resources to teach number including games using cards and dice, which are particularly popular given their familiarity with the resources. Resource packs containing dice, cards and counters are sent home during the year to encourage learning at home. Many other number activities are available through the vast array of resources in the library.



Monitoring (and Celebrating) Mathematical Learning

Teachers assess students every 5 weeks and then plot data against the PLAN framework as required for all EAfS schools and governed by Department of Education. The teachers record student performance against the growth points on the continua and then use this data to monitor growth as well as to provide insights into where to take learners from their current levels of achievement. The framework provides teachers with a solid means by which to show growth in learning. If a student is not progressing in a manner that would be expected, as shown through the mapping process, then further support is provided. This support can be for the teacher, to help him/her devise other activities that will scaffold learning, or it may be additional support for the student.

Depending on the ages of the students, the assessment tools will vary. In the early years of schooling, teachers use observational methods and document these into their records, as well as formal individual testing. Older students are assessed using a wider array of tools including observations through to mini, focused assessments.

Teachers meet weekly with the Instructional Leader (K-2) or Deputy Principal (3-6) to discuss student progress and strategies to move the students forward in their mathematics learning.

IN most rooms, student data is displayed on walls so that students can see where they are on the learning continuum and know where they are expected to grow in terms of mathematics. Students are provided with an “I can” book in which their learning is mapped against the continua. The books contain learning growth points from the continua expressed in language accessible to students and families. Students mark off what they have learned during conferences and teachers will then confirm success in that learning cluster. Once all learning outcomes have been achieved within a band or level of learning, students can be marked off as having achieved that level of learning. This process makes the learning intent and success transparent to students and families whilst providing teachers with a record of learning progress.





Extra Support for Infant Learners

The program for mathematics is relatively consistent across the K-6 school. However, it is recognised that by stronger intervention in the early years (infant), the gap in learning between the students' current levels and benchmarks could be narrowed with more time spent on numeracy. To this end, the school has developed a program for the late afternoon (2pm) for 20 mins where the students are grouped by the levels of achievement and focussed teaching occurs commensurate with the levels of students' mathematics. This occurs in Terms 2, 3 and 4. Like other lessons across the school, the focus is on the use of hands-on activities but with very targeted learning activities for the whole group.

Instructional Leaders

As part of the Connected Community strategy and as an Early Action for Success school, an Instructional Leader was appointed in 2014. This role entails working with the teachers to develop quality programs for the students. The role also includes building teacher capacity by working with teachers on planning and assessment, particularly in relation to diagnosis and then moving students into the next phase of learning, as well as training staff in TEN. There is a K-2 Instructional Leader who works with Infants classes and staff, as well as Primary staff in after school team meetings. This role has enabled the whole school approach to be adopted and a move away from text books to the hands-on approach that was evident across the school. Teachers meet fortnightly in their stage teams (K-2 and 3-6) for planning and professional learning. These meetings are guided by the Instructional Leader and Deputy Principal and allow for a collaborative approach to teaching and learning.



Benefits for Learning and Learners

Aboriginal Educators are integral to the success of teaching and learning in the classroom. They provide a conduit between school and community, and actively encourage students to do their best, all the time.

The hands-on, activity-based approach used in mathematics lessons engage the learners and provide students with opportunities to participate in their learning. Students enjoy learning through play and discussion.

With the increasing numbers of language-based problems being posed in mathematics classrooms, often under the guise of being more practical or grounded in the world beyond schools, there is a greater need for students to be able to read and correctly interpret and respond to these questions. This is increasingly the case in NAPLAN testing as well. The use of Newman's Analysis within classes enables students to have ways of working that empower them and increase confidence needed to tackle and solve word problems.

Regular assessment-for-learning provides teachers with data upon which to see success and growth, while simultaneously providing teachers with a benchmark from which to develop students' future learning.



Advice for Teachers

It is imperative to create learning situations that meet the needs of the learners. This can be pedagogical as well as mathematical. Learning styles - as well as areas of concern (such as the literacy demand of numeracy) should be built into the mathematics program. Families and community members can provide advice on the ways in which their children's learning can be catered.

Having a consistent approach across the school builds consistency and transparency for students (and community members) so that they know what to expect when they commence mathematics lessons. This minimises lost time as students can be prepared upon entry into the mathematics lesson and ready to engage with learning.

Model for Quality Learning

Principle	Implications for mathematics	Focused strategies
A whole school approach to mathematics	<ul style="list-style-type: none"> Students all take mathematics in the second session of the day, and the approach is similar across all classrooms. 	<ul style="list-style-type: none"> Use of hands-on, practical, games approach in the classroom Use digital tools to engage learners Use of group work Quick pacing of lessons
Aboriginal educators are an integral part of the school	<ul style="list-style-type: none"> Aboriginal educators are seen as 'teachers' and are provided with professional learning and support to be a valuable part of the classroom. 	<p>Aboriginal educators:</p> <ul style="list-style-type: none"> work as a teaching partner supervise a small group in each rotation are provided time to work with the teacher in the planning of mathematics lessons and their role in the activities are provided with professional learning activities to help their development as teaching partners.
Instructional leader	<ul style="list-style-type: none"> Instructional leader appointed to support the infants (K-2). 	<p>Instructional leader:</p> <ul style="list-style-type: none"> provide professional learning to teachers and aides for mathematics assist in the design, interpretation and follow on from student assessments provide teachers with feedback on lessons.

Key Messages – Summary

Brewarrina families support pedagogies that suit their children's preferred learning styles. Group work and hands-on activities were high on the list and these are featured strongly in the teaching of mathematics.

A high percentage of the staff are local people (ie Indigenous) who work as qualified teachers, (including the assistant principal and one teacher), teacher support staff, liaison staff and general employees in the school. Teachers and support staff are provided with at least 30 minutes preparation time each week in which the class teacher can prepare for lessons and ensure that the support staff feels supported and confident in the activities that they will be working with the students.

Over the past few years, support staff have been provided with professional development opportunities.

Being consistent and transparent with teaching mathematics is a priority. Students need to know what to expect when they enter a mathematics lesson. Knowing what is going to happen allows them to go into a lesson ready to learn rather than wondering what will happen.

Literacy demands of numeracy need to be explicitly taught. Providing students with a framework through which they can breakdown a word problem enables better access to the demands implicit in the task. This may be important for NAPLAN, but it is a valuable skill for mathematics in general.

School Demographics (Brewarrina Central School)

Year range	U, K-12	FTE teaching staff	17.6
Total enrolments	160	Non-teaching staff	9
Location	Remote	FTE non-teaching staff	8
ICSEA (school)	655	Indigenous students %	97%
ICSEA (distribution of students) (bottom quarter to top quarter)	86% 10% 4% 0%	Enrolments: Girls/Boys	85/75
Teaching staff	16	Language background other than English	2%
		Student attendance rate %	86%