We've heard that you teach maths through kinship

Garma Maths

Helen Watson-Verran

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We've heard that you teach maths through kinship

A Garma Maths Course of Study

in the

Yirrkala and Laynhapuy Schools Community

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University of Melbourne 1992

INTRODUCTION

This curriculum document focuses on a course of study in maths developed by the group of Aboriginal schools run by the Yolngu community in the Northern Territory. Here we provide an overview of the course of study for non-Aboriginal educators.

The curriculum development work behind this document cannot be seen in isolation from other elements of the work in education at Yirrkala and the Laynhapuy Homelands, in particular community-based teacher education. During the 1980s, in beginning to meet demands by the Yolngu community for a form of education which will support self-determination, the schools embarked on an ambitious program of Aboriginalisation of all functions of the schools. the most important element in this was effective community control of the schools.

The making of curriculum documents should be carefully distinguished from the making of a curriculum. This is even more crucial when a course of study grows from a form of life which celebrates community achieved through oral communication. The rendering of knowledge into a course of study with strands and topics is, in many way the antithesis of what Yolngu hold important in education. In particular the topics laid out as the djalkiri strand are suggestive; a basis for beginning negotiation.

As a consultant to the development process since 1986, I have put this text together, however the work is in profound ways the work of a collective of Aboriginal and non-Aboriginal people. I was adopted into the Marika family at Yirrkala in 1986, and my role in the educational work at Yirrkala has continued since that time. Teachers involved in this work include: Raymattja Marika-Mununggiritj, Banbapauy Maymuru, Merrkiyawuy Ganambarr, Yalmay Yunupingu, Mandawuy Yunupingu, Ngalawurr Mununggurr, Wali Wunungmurra, Leon White, Michael Christie, Kathy McMahon, Bev Taumololo, Claire van Rooy, Sandra Bach, Dundiwuy Wunungmurra, Manhdhulpa Mununggurr, Tracey Kensey, Rarriwuy Marika and others. Elders stand behind the work of the teachers having been actively involved from the very beginning. The answer to the question contained in the title is "Yes, we do teach maths through kinship." We feel that it is not only Aboriginal children who can benefit from learning about maths as something which is based in, and shaped by, human concerns. Our course of study grows from our life as a particular group of people and reflects the concerns of our community. Developing as an expression of Yolngu life, it cannot be used as such in other places, by other communities. But we expect that the ways that we have worked to develop this course of study will be useful to other communities, both Aboriginal and non-Aboriginal.

Helen Watson-Verran
1992

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FINDING USEFUL METAPHORS

It might seem odd to begin to elaborate a maths course of study with a discussion of metaphors, however, finding useful metaphors has been an extremely important part of the work. Metaphors give us strategies, tactics and categories for our actions. While using metaphors is essential, we must not make them invisible. We can change metaphors and mix them if that suits our purposes. We need not be impaled on the structures of our metaphors.

Much of the contemporary discussion of Aboriginal education in Australia can be understood as a search for useful metaphors. Disparate and competing metaphors have been used in recent times and at times disagreement has been bitter with opinion thoroughly divided. One common metaphor used is the notion of 'two way education', implying a two-way road. On this account two way education makes it possible to go in two directions. Learning is taken as implicitly containing directionality leading to different worlds.

This metaphor draws on the powerful Western metaphor of linear directional space and time as its common analogy. Another common metaphor used in discussion of Aboriginal education is the notion of knowledge as a domain, as seen in the policy of 'domain separation'. Metaphors of knowledge worlds as distinct and separate domains imply a relativism which emphasises difference rather than commonalities. We get a picture of soap bubbles, floating free of each other, each with its own trajectory, connected perhaps by the fragile experience of two-way education. These metaphors emphasise Aboriginal Australia as 'other', as needing to maintain its separateness from contemporary Australian cultural life.

In developing our Garma Maths course of study we made use of an alternative set of metaphors deriving from Yolngu life. These emphasise the uniqueness of Aboriginal education through asserting the possibility of a careful and collective self-aware process of working things together. When this process of blending is under Aboriginal control, the process of balancing, affords continuing renewal of Aboriginal life. Metaphors of working toward a unified balance have educational work in the Yirrkala and Laynhapuy Schools community. The metaphors variously elaborate ways of achieving uniqueness through subtle and complex blending of multiple influences.

We began our educational work in the mid 1980s with one particular metaphor grounded at a particular identifiable place and owned like the place itself, by a particular group of people. Our work was thus grounded in the practical political life of the community of which the school is part. This served to bring the issues of Aboriginal education and schools to life in new ways using new sorts of terms. To a large extent this metaphor has been replaced as our work has continued. The metaphor we began with the Ganma (now called Garma) metaphor, calls up a deep pool of brackish water, the surface of which is marked by foam. This pool indicates some of the origins and impetus for work in education in the Yirrkala/Laynhapuy communities. In using this metaphor, great care is needed. Many westerners are likely to misunderstand it. While for many non-Aboriginal people the notion of a deep pool of brackish water is an object of distaste, for Yolngu it expresses a profound foundation of useful knowledge. European traditions identify essences and purity as worthwhile; pollution is to be avoided. Brackish water seems to express pollution to many westerners. In contrast, for Yolngu

people, brackish water is a source of inspiration, expressing an admirable balance of natural processes which peoples should seek to emulate in social life.

The Ganma metaphor is specifically located at Biranybirany, the homeland of the Yirritja, Gumatj clan . At Biranybirany there is a deep waterhole where the paperbarks of the land give way to the mangroves of the saltwater. Here crocodile life (a metaphor for Gumatj life) is remade, rhythmically hatching and feeding in the context of the balanced interactions of freshwater and saltwater. Freshwater streams from the escarpment flow into this pool and saltwater flows in along salty rivers with the tide. Crocodile—Gumatj—life is continually remade through the meeting of the streams which have their origin elsewhere. Their meeting has produced a vortical flow of currents of salty and freshwater. Fingers of saltwater mix with fingers of freshwater creating turbulence and foam where the surfaces of the two meet. The pool is a balance between two quite different natural recursions—the natural recursive system of tidal flow and the natural recursive system of the freshwater streams, varying cyclically in their flow across the wet and dry seasons. In each of the interacting, natural recursive systems there is ebb and flow; initiation and withdrawal. The deep pool of brackish water is a complex dynamic system constituted as a balanced entity, embedded in a particular context and embedding other balanced forms of life.

This Yolngu metaphor has been modified to carry the structure of the emerging mathematics curriculum. Streams of freshwater are taken as analogous to the two constituting strands of Yolngu formal knowledge: gurrutu and djalkiri; saltwater streams are the strands of western derived formal knowledge—number and quantification. The pool is their planned meeting. Although the notion of knowledge as linear is, in many ways disruptive of Yolngu understanding, this is a metaphor which enables a balanced curriculum to be conceived of and documented for institutional purposes.

For some years during the 1980s ganma was the name given to the curriculum which began life through this metaphor. It enabled the initiative to gain a valid life in the community. The curriculum was grounded at a particular place and identified with particular groups of people. The curriculum started life as a political act by identifiable groups of Yolngu people. This necessity marks it out from curriculum development in a western educational context where political elements in curriculum development are generally masked.

Beginning to generalise from this initiative, to blend and develop a more lasting and shareable vision led to the elaboration of other metaphors like the milngurr metaphor, a Dhuwa concept similar in some ways to the ganma metaphor. Galtha and garma are still other terms given to the teachers by the elders; the use of these are still developing. the developing maths curriculum is now known as a Garma Maths Course of Study; an element in this curriculum is the Galtha Rom Workshops.

The word Garma is also a place. It is a ceremonial area where, in contrast to other sorts of ceremonial areas, nothing is held secret. It evokes the notion of a continuous public ceremony, which continues according to an accepted formula previously agreed upon by all those whose agreement was necessary.

A VIEW OF MATHS KNOWLEDGE

Many past understandings of mathematical education have depended on the view that maths is culture-free and socially neutral. Few mathematics educators accept this today. On the contrary, most of us recognise mathematics as culturally saturated and laden with socially significant meaning. This view of mathematics has consequences for all learners of mathematics and implies many possible courses of study in mathematics education.

When we proceed mistakenly under the comfortable myth of mathematical meanings as culturally neutral, we can be happy with the idea that mathematics learning is some 'pure cognitive act' unrelated to the learner's social existence. As soon as we acknowledge mathematics as a social activity, we must be prepared to locate the making of mathematics meanings in the texts through which we communicate. Learning mathematics is learning to use it in communication. This is a fundamental principle of the alternative course of study in maths that is developing at Yirrkala.

Whether western or Yolngu in origin, mathematics seeks to systematise and hence, pattern in a particular way—through particular foci and inclusions/exclusions—all contexts of knowledge use. Learners need to recognise maths as encoding particular values. The challenge for school maths is to devise ways of inducting learners into practices which will allow them to see and to work through maths, but will also allow them to see through it. In many ways this seems to be an anathema to school curricula.

It has taken westerners a long time to recognise mathematical elements in Aboriginal life and to begin to work with Aboriginal people in devising ways that maths curricula might draw on both Aboriginal and western traditions. It is interesting to ask why. Part of the answer lies in the politics of a colonising society. For such a society it is important to see the colonised nations as both 'other' and 'lesser'. Schooling plays a role in extending practices of colonisation, domination and coercion.

This is not the whole story. A particular view of what knowledge is, with a particular set of categories and epistemology, came to dominate Western thought. However, this is now changing and we can ask with a real expectation of a helpful answer—'how can non-Aboriginal people understand something of Yolngu mathetic traditions?'

MATHETICAL FORMS IN YOLNGU LIFE

From the ancient Greek word 'mathesis' (the formal base of knowledge) we take the English word 'mathematics', implying the formal basis of Western knowledge. A more general form of this word is 'mathetic', meaning the formal basis of any knowledge system. Thus we can refer to Yolngu mathetic traditions without implying that these are the same as mathematics, while still understanding that they might have forms and processes in common with western mathematics. Hence we call our course of study A Garma Maths Course of Study. 'Maths' here is a shortened version of 'mathetics' not 'mathematics'.

The possibility of reframing Yolngu mathetics within western knowledge and vice versa requires each side to accommodate the standarised knowledge forms of the other. In this process, Yolngu look for and emphasise metaphor in western knowledge. Western mathematics looks for and emphasises codification and develops a grid in which two systems can be seen in ratio.

In the Yolngu knowledge system, the concerted use of two coherent and related, but distinguishable sets of practices or standardised knowledge forms, makes it possible for people and places to be joined in a formally related whole. Many contemporary Aboriginal people use a formalised recursive representation of kinship as their major integrative, standardised form of knowledge in much the same way that the formalised recursion of tallying (ie number) constitutes an integrative, standardised form of knowledge in western societies.

The Yolngu know their sytem as gurrutu. The gurrutu system is an infinite recursion of a base set of names of kin relations. It imposes order on the entire world, enabling coherence and differential value. Simultaneously, sets of practices collectively named Djalkiri, enact metaphors which explain a socially differentiated and focussed landscape. We understand the metaphors and practices which underlie Djalkiri as analogous to the metaphors and practices which underlie the use of quantities, like length and mass in western quantification.

The use of gurrutu and djalkiri together accomplish the same sorts of social ends that the use of number and quantification accomplish in western life.

Gurrutu is a standardised form of knowledge in Yolngu life. The Yolngu world is exhaustively divided into two sides and it is the ideal of Yolngu life to keep the two sides balanced. The two sides are named Yirritja and Dhuwa. Everything, every place, every person in the Yolngu world is either Yirritja or Dhuwa: songs, concepts individuals, clans, paintings and dances belong to one side of the world or the other.

Gurrutu is a recursive system which connects and regularises Yolngu life. Social order is ach–ieved and life is made predictable and continuing through this formal, recursive system.

Of course western society also has a formal recursive system which connects and regularises, acting as a standardised and standardising form of knowledge. Through this recursive system—the number system—social order is achieved and life is made predictable. The recursions of Yolngu and western society are strictly analogous.

Each recursion has:

- a set of basic names
- a set of rules for devising further names from any one name
- a set of rules for use of the system with the material world

Both number and gurrutu are a patterned series of names. In the gurrutu system, all the basic names exist in reciprocal pairs, as might be expected in a society existing in two complementary halves. While the number system is a recursion of points, the gurrutu system is a recursion of vectors.

Both systems have their origins in another very practical pattern implicity in everyday human life. From this practical pattern come rules for deriving names, so continuing the pattern. The number system contains within it the very practical pattern, or template, or tallying on our fingers. The gurrutu system contains within it the very practical pattern of family relations or kinship. In both recursive standard forms, the set of rules for deriving names are abstractions or generalisations of other patterns which have a material basis.

These recursive systems, number and gurrutu, at first look very different, but from a logical point of view, these differences are trivial. Both systems have logic in common and neither system were 'found'. They both developed over time. Both systems are contrived. They are the result of work by people to make something useful—standardised knowledge forms based in words and material practices.

As the product of collective work, both the number system and the gurrutu system encode particular social values. The form of gurrutu is a recursion of connections, emphasising balance and connectedness. The form of numbers is a recursion of individuation focussing on hierarchy and separatedness.

The recursions derive very strongly from the linguistic resources—the language systems and their disparate grammars within which the recursions have life. It is important not to forget the role of language in constituting these recursions and the practices through which they are useful.

The recursions or number and gurrutu are primarily linguistic. They are lists of names and their use grows out of our ordinary language use. The ways in which they grow out of our ordinary language use is of great interest to those who puzzle over the origins and workings of the logic by which human communities organise their lives.

When we approach language in this way, as a cultural product that makes and is made within a form of life, we find we have to problematise the ways the patterned practices in the languages relate to each other. Both sides must work and come to agree on ways of mapping the grammar of our languages. There are many ways that they might be mapped and each way of mapping carries with it particular assumptions and presuppositions about what knowledge is and what language is. For the work in hand we need to select one that is useful. We need an account of how the grammars relate which carries with it views of knowledge and language which are consistent with the wider understandings within which the work has life.

Our research community at Yirrkala has not baulked at this. We have derived and use an account of the grammar of the Yolngu languages which is consistent with Yolngu ontology and epistemology.

YOLNGU FORMS OF EDUCATIONAL PRACTICE

Educational practices consistent with Yolngu epistemology—unequivocally grounded in the negotiated nature of truth and meaning in Yolngu life have driven the development of distinct educational practices at Yirrkala and in the Laynhapuy schools. These practices differ fundamentally from those developing from a notion of truth as 'objective' which is associated with a strict division of teachers and knowers and pupils as learners.

The practices through which the Garma Course of Study has evolved and through which it is expressed take three identifiable forms:

- Garma Galtha Rom community based workshops
- Garma maths school-based workshops
- * Garma maths classroom work

Garma Galtha Rom workshops are, for the most part held in homeland centres and largely directed by Yolngu teachers in association with Yolngu elders.

The evocation of the particular galtha in the workshop is determined by the context and people involved in the workshop.

Garma maths school-baed workshops are related to public arenas where gurrutu and djalkiri and Yolngu numbering and qualification interact. A good example of this is the workshop held in Term 3, 1992 exploring Yolngu land rights and the contrasting contemporary practices of landownership with which Yolngu people are engaged.

Garma maths classroom work can be understood as preparation for the public expressions of accomplishment and achievement which occur in workshops. It can be in all four strands: gurrutu, djalkiri and Yolngu numbering and quantification. The content and skills practices in classroom lessons look towards the learning necessary for fruitful participation in workshops. From each of these sites of practice, written texts have been produced. These texts constitute our record of the curriculum, supplemented with individual teacher's records and student work. However Garma maths should be understood as an educational endeavour which is overwhelmingly oral in its modes of communication.

These three forms of Garma curriculum practice have common elements. As well, each can be said to have a particular distinguishing 'flavour'. The general term we have adopted to describe the Garma Course of Study is 'a workshop driven curriculum'. The central roles of language processes and 'staging' are celebrated in this course of study. The social processes of workshops as teaching/learning episodes derive from conventional Yolngu social relations This means for example that even those school-based workshops dealing with western mathematics mimic very closely the processes of Garma Galtha Rom workshops.

We have learned to tie the production of workshop records into the events. Thus, we produce texts which help drive the literacy program, simultaneously incorporating evaluation. Workshops unfold from a general topic as issues are posed around a number of focus questions and topics. Often these 'organising questions' are drawn from the outcomes of a previous workshop or the tasks which have arisen from them.

Teachers are developing techniques for integrating prerequisites which derive from notions of curriculum with direction provided by elders.

Workshops are times of intensive contact between teachers and students, often involving both day and evening sessions. We can think of workshops as moments in the course which provide the course with its primary impetus. They are usually one week in duration. In workshops a number of staff members and advisors work as a team.

REASONING BEHIND THE GARMA MATHS CURRICULUM

To understand the reasoning behind the arrangement and sequencing of the four strands of the Garma Maths Course of Study—djalkiri and gurrutu; number and quantification—is to understand that these strands are leading into an already existing social and intellectual context which is constituted by the languages, the conceptual structures and community ideals of Yolngu society. Understanding something of these we can reformulate and re-sequence the study of western mathematics so that it can be appropriated by Yolngu learners in ways that will serve to sustain and support the Yolngu struggle to retain their uniqueness and identity, rather than undermine it.

In considering the reformulation in the Western mathematics strands, it is useful to begin by briefly laying out the sequencing of mathematical ideas as they appear in orthodox courses of study in mathematics. Orthodox teaching of mathematics in the first years of schooling emphasises the notion of value right from the beginning. This is achieved through focus on one-to-one correspondence. Teachers understand themselves as teaching 'the essence' of the concept 'one'; which is the value of one. Similarly, the essence of the concept 'eight' is the value of a collection of eight similar objects. Value is taught primarily through the quality of numerosity—children re expected to 'see' the value of collections. Material objects are returned to the teaching of value through collections of similar objects and by a prior focus on classification around particular qualities. Often this latter exercise is an exercise in learning value too: big/small; long/short; thin/thick.

Having been trained to see value through the quality of numerosity in collections of similar objects, and to name it with number names, the next step is the introduction of other qualities which can be the basis of valuing the material world. Qualities are introduced as unitised; length is introduced as paddle pop sticks for example, and hence as a basis for the process of allocating value to the material world.

Exploration of space is exceptional in orthodox mathematics because it alone is not grounded in the notion of value. It may be this that leads many teachers to disregard the teaching of 'the space strand', not regarding it as 'serious' mathematics.

Equivalence builds on notions of value and also enters the orthodox mathematics course of study early. Equivalence is emphasised in the early training to understand the essence of numbers as value through focus on one-to-one correspondence and graphic numerals. Quite early on, the arithmetic processes (addition, subtraction, multiplication and division) extend the notion of value and equivalence through emphasis on ratio.

Recursion can be understood as the key to the inner logic of the number system, whereas value, equivalence and ratio are particular applications of that system. Nevertheless, recursivity enters orthodox mathematics only peripherally. It is used in the teaching of place value in the graphic numeral symbolic system and as the basis for improving the learner's facility in reckoning ratios of value.

Children who experience most success in their study of orthodox mathematics are generally native English speaking children.

English emphasises individuation of the world into spatially separated

bodies by using 'the' and 'a' and the suffix '-s'. In contemporary culture of most English speaking communities 'objective value' is a dominant social ideal. Yolngu children come to school with a different set of accomplishments and a different set of ideals.

Yolngu languages work with an inner logic quite different to English. Speakers do not emphasise individuation or the spatial separateness of bodies. Yolngu language speakers emphasise connection. Constituting the world as a named matrix (with many levels of names) Yolngu languages predicate through pointing to changed relations in the matrix. In contrast, English predicates by pointing to the movement of a foreground body against an undifferentiated background.

Yolngu children have grown up in a community where 'knowing the value' and comparisons of 'objective value' are de-emphasised. Instead, the manifold types of relatedness between humans and between humans and non-humans are emphasised.

To plunge such children into an orthodox course of study in mathematics not only sets them up for failure, worse, it sets up those who succeed for alienation from their language and the conceptual structures and ideals of their community's life. It makes much better sense to identify in the children's repetoire of skills, and in the life and language of their communities, a basis on which a sequential course of study which leads to the appropriation of western mathematics.

RECURSION AND GENERALISATION: THE CENTRAL PROCESSES OF THE GARMA MATHS COURSE OF STUDY

Recursion and generalisation have central roles in our alternative course of study. Starting with gurrutu, Yolngu children can begin to appreciate western mathematics through recursive pattern, the shared characteristic of gurrutu and number. Accordingly the symbol for our new curriculum contains a graphic representation of a dual recursion.

The triangle within which these recursions are drawn is one symbol for knowledge in Yolngu life. It indicates knowledge achieved by working up towards a point of balance from two disparate starting points. This can be understood as a process of generalisation or abstraction. We can also understand this as a process of metaphor—carrying (-phor from ancient Greek) to a meta level.

The processes of generalisation with which westerners are most familiar is the process by which we say that things have attributes or qualities. To identify the quality of length in things is a process of generalisation. To identify attributes held in common by several entities, is to work at a higher level of generalisation. It is a process which is implicit in quantification.

Similarly when Yolngu people take the landscape as inherently having particular foci that stand in particular relation to each other, they are working at a level of generalisation or abstraction. Generalisation is inherent in djalkiri. The particular forms of generalisation (the methodological practices which allow us to understand ourselves as working at different levels of generality) in quantification and djalkiri differ, just as the particular forms of recursion in number and gurrutu differ.

The Garma course of study begins with work in the two recursive patterns as expressed in language and in material organisation: the system of names and pattern of number, and the system of names and pattern of gurrutu. From understanding the recursions, children progressively take on the elements of generalisation which are worked through recursion in both the western and Yolngu traditions. We might summarise the conceptual sequencing of the Garma course of study as, in one aspect, proceeding from pattern to value through number and quantification, and in another aspect, as proceeding from pattern to relatedness through gurrutu and djalkiri.

Learning of names is accompanied by material displays of the patterning. On the one hand, people who stand in particular relations and on the other, displays of collections of objects (usually straws). The emphasis here is not on the concept which the names conjures

up, but on the pattern within which the name has a place. The global concepts of relatedness (through gurrutu and djalkiri) and value (through number and quantification) come later after children have learned to work the patterns through their naming and displaying.

In general, work in the quantification and djalkiri strands follows from work in the number and gurrutu strands.

Learning the concepts which are implicit in any application of the recursive patterns involves understanding something of the metaphorical underpinning. This in turn implies that children have attained quite a high level of language facility, on one hand in Yolngu languages, and on the other, in English. Learning the concepts implies an ability to use the language in which the concept has primary life in complex ways. Learning the concepts is also facilitated by a profound understanding of the pattern inherent in the system of codified logic. Particularly on the number side where the learner's facility in English is likely to be limited, the understanding and facility with pattern which has been built up over a number of years carries the learner towards conceptual understanding implied in correct use of numbers. A profound facility with the pattern inherent in the number system can support learning to use the number system when English is a second language.

In the tables which follow we summarise the topics treated in the four strands of curriculum at the junior and senior primary levels.

JUNIOR PRIMARY

Gurruṯu	Mälk	Rom	Wäŋa	Manikay
	Extending mälk names to each other. Understanding that people can have the same guruṯu relationship but different mälk	Beginning to understand that particular Rom is associated with gurruṯu	Introduce the concept of mother wäŋa and father wäŋa	Begin to learn their father's manikay and buŋgul

Djalkiri	Minyh'tji	Manikay	Language	Dhukarr
	Learn the skills in making patterns and animal outlines. Learning the relationship between colours. Listening to stories being told by older people. Seeing them in relation to *dhulaŋ*	Learning to sing simple songs, eg campfire songs. Listening to traditional stories/songs	Introduce the concept of different clan languages. Begin to understand own relationship with different clan languages	Introducing the concept of a starting point

SENIOR PRIMARY

Gurruṯu	Mälk	Rom	Signs	Wäŋa	Manikay
	Extending understanding of mälk names to bäpurru. Learning about the different gurruṯu terms that older people use.	Learning about the history of gurruṯu and its Rom	Learning the sign language of gurruṯu. (Outside meanings only)	Märi / Yothu / Vandi wäŋa	Know father's and mother's manikay and buŋgul

Djalkiri	Miny'tji	Manikay	Language	Dhukarr
	Looking at different symbols from miny'tji from different clans and learn to identify and not mix them. The Rom about miny'tji and their meanings.	Learning to sing selected lyrics and tunes. Outside or simple meanings	Being aware of own clan language and its history. Learning how particular languages are distinguished.	Following correct directions. Obeying rules

SECONDARY

Gurruṯu	Mälk	Rom	Signs	Wäŋa	Manikay
	Understanding the pattern of gurruṯu Relationships and the Yarrata.	Learning the deep meanings of words. Learning the deep meanings of gurruṯu. Respecting the Rom and knowing how to make it work.	Inside buŋgul. Nature's signs, symbols, feelings and beliefs. Connecting the inside and outside meanings as a whole	All the connections about wäŋa, eg Yapa, etc.	Knowing relations between manikay and buŋ gul and they must be balanced. Boys and girls separate to learn men's and women's business.

Djalkiri	Miny'tji	Manikay	Language	Dhukarr
	Men's business dhulay and design story and manikay behind painting and meaning. Colour usage. Using cross-hatching, clan designs, body painting and ceremonies	Tune and lyrics. Keening. Beginning to understand inside meanings	Developing use of own clan language.	Concepts: yäti, latji, ŋal, yuwalk, dhunapa, djarrpi

JUNIOR PRIMARY

Yolŋu numbering	Spoken number names	Material patterns	Written number names	Graphic numerals
	Say names up to millions Patterns of counting by ones, twos, fives, tens, hundreds and thousands	Make displays of arrangements and match to names	Match written names with names and material displays	Beginning introduction of graphic numeral digits. Match material displays to graphic numerals. Say names of graphic numerals and match to written names.

Yolŋu quantifying	Time	Space
	Names of units: days, months. Beginning to understand and use calendar grid	English language associated with space. Names of common shapes (English). Beginning to use English in naming spatial qualities. Beginning appreciation of spatial scale.

Emphasis is on children internalising the structure of the number pattern through knowing the number names.

SENIOR PRIMARY

Yolŋu numbering	Spoken number names	Material patterns	Written number names	Graphic numerals	Value and equivalence
	Continuing work with patterns of whole numbers. Names of decimal fractions. Names of common fractions.	Displays using decimal fractions. Model addition, sub-traction, multiplication, division	Read and write number names	Decimal fractions notation. Common fractions notation. Use of calculators	Estimation and approximation. Money Ratios of numbers

Yolŋu quantifying	Time	Space	Length	Area	Volume	Mass
	Discuss the concept. Read analogue and digital time. Hours, min-utes, seconds	Discuss the concept. Shape, structure, trans-formations. Notion of space having dimensions, location and arrangement. Terms of geometry—coordinates, degrees and angles	Discuss the concept. Understand the pat-tern and relations of units millimetres to kilometres. Make measurements	Discuss the concept. Understand the pattern and relations of units: square, centime-tre to hectare.	Discuss the concept. Understand the pattern and relations of units: cubic centimetre, litre, cubic metre	Discuss the concept. Understand the pattern and relations of units: gram to tonne.

CONNECTING WITH OTHER AUSTRALIAN MATHEMATICS CURRICULUM DOCUMENTS

This course of study stands as one expression of the sentiments contained in the National Statement on Mathematics for Australian Schools. As such, it stands as one member of a cluster of documented courses for the study of mathematics which have been developed by various Australian school communities. For the most part these are State Departments and Ministries of Education.

In demonstrating how our course of study is an expression of this statement we take various sections from Part II of that statement showing how the scope of the generalised Australian mathematics curriculum is realised through our course of study.

We understand our course of study is organised through focus on two processes: recursivity and generalisation. Each of these is expressed in two disparate forms. What might be identified as a strand in the National Statement can appear as a topic within a strand of the Garma course of study. In particular, space appears to receive less attention here, being included as a topic within the quantification strand. Our defence of this placement would point to the involvement of space in many of the topics treated in the djalkiri strand, and to the element of generalisation associated with boundary making in the subsidiary elements of the space strand in the National Statement.

Similarly, we have treated strands which deal with the practices of mathematics education, like 'Attitudes and appreciations', 'Mathematical inquiry', and 'Choosing and using mathematics' in the section 'Yolngu Forms of Educational Practice'.

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