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MATHEMATICS FOR ABORIGINAL STUDENTS WHO HAVE A DIFFERENT WORLDVIEW

*Barry Kepert

Language develops our thoughts and shapes our understanding of the environment. Through working in different schools I have noticed that English plays a key role in the acquisition of school mathematics. Not only is the mathematics syllabus expressed in English but those students growing up using English appear to have a view of their world that is far more compatible with this mathematics than those students who use an Aboriginal language. The worldview of students using an Aboriginal language would appear to be very different.

The mathematics in the syllabus is very much tied to a western perspective of the world. For most of us in Australia the framework for mathematics is developed as we acquire English. Where I now see plurals, dimensions and shapes many of the Aboriginal students I am working with have a language that has given them a perspective of personal relationships as well as other knowledge that I am only beginning to understand.

In two of the communities I visit the students use English to communicate with each other in the playground. This contrasts markedly with the other communities where English is rarely used outside of the classroom. Providing mathematics lessons for the English speakers is not particularly difficult. However those students who do not use English seem to experience a great deal of difficulty in understanding the mathematics that is presented to them. Remembering operations and rote learning are easily achieved as many of the students appear to be quite bright. Understanding the mathematics and being able to apply these skills is the major difficulty. To address what I saw as a cultural difference I initially conducted some sessions with the teaching (both Aboriginal and non-Aboriginal) staff. As a trial I had decided to use knowledge that was from the Aboriginal domain as a starting point in understanding the western system of mathematics. I am using knowledge that the

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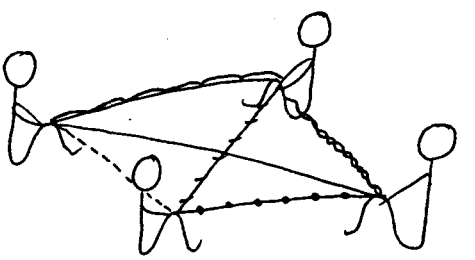
* Barry Kepert is an Education Officer in Maths E.S.L. Aboriginal-Rural with the Northern Territory Education Dept.

students already have. This would seem an appropriate way to begin any lesson.

Teacher Development Activity One - A System of Relationships:

I took personal relationships as the starting point for a maths session at Milingimbi to emphasise that just as we have a complex and abstract system of number, the Aboriginal community also functions with a complex and abstract system of relationships. The Aboriginal teachers understood *gurruṯu* (the relationship system) and could identify their relationship to others. I sat the teachers in small groups. Within each group each individual was to identify and then illustrate their relationship with every other person in the group. A different piece of coloured string was used to represent the various relationships. For the Aboriginal teachers this was something that they had no trouble with, as kin relationships are an integral part of their cultural system. For the white teachers the string enabled them to 'see' relationships that they were not aware of. I suggested that the string was a concrete aid used to illustrate this particular abstract system. Our abstract system of numbers can be similarly illustrated with objects or written with numerals. The mainstream teachers and the Aboriginal people at Milingimbi both use abstractions to create meanings of their respective worlds but these meanings are not readily understood by those coming from a different culture. The Milingimbi child faced with the abstract concept and school mathematics may learn to count and do calculations by rote, yet fail to see the world from the same mathematical perspective as the teacher.

Teachers using coloured string to illustrate abstract relationships:



I have learnt to count and can operate quite comfortably in our system that uses number as a standardised way in which we make sense of our environment. However I cannot separate the number two concept from two apples or two litres. The two is a standardised quantifier that makes sense to me but the 'twoness' is not something that can be shown on its own. I cannot show you two. I can hold up two apples or two litres of fuel but not two on its own. There is an abstract concept of number that cannot be separated from what it is quantifying. By comparing the mainstream abstraction of number and dimensions with the Aboriginal abstraction of personal relationship it can be illustrated that both cultures are using systems that we cannot see, to make sense of their respective worlds.

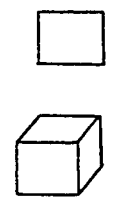
It is possible to make the analogy between the two cultures and examples of their respective abstractions by comparing the string activity with a story about dimensions. This story was passed onto me by Sue Reaburn from Yirrkala School:

> *About four thousand years ago there was an old man with a round face. His name was Plato. This man would sit and talk with the other philosophers. They knew that their world was imperfect and that the god's was perfect. There was no physical way of getting to the gods so they used metaphysics (subtle talk) to reach an understanding that would elevate them to the thinking of the gods. The concept of the abstract point was developed. This subtle concept did not exist in the physical world and so must be a part of the perfect world of the gods. The point could be stretched into a line; the line could be extended into a surface and the surface further developed into a cube. These metaphysical ideas of the Ancient Greeks are still evident in the maths that is taught at school today as the syllabus has the divisions of Number, Measurement and Space. These divisions could be thought of as a point (Number), a line (Measurement), a surface and a solid (2D & 3D Space).*

The creating of dimensions to construct a framework for our world may have helped the Ancient Greeks solve some of their concerns but it appears to be light years away from

the Aboriginal child's perceptions. The WA Mathematics Syllabus (1989) which is used in NT schools has been divided into the three strands of Number, Measurement and Space. This very neatly corresponds to Plato's story. Below is shown how all the topics in this syllabus can be fitted into an abstract framework of number and dimensions.

Plato's concepts with topics from the WA Maths Syllabus (1989):



•	0D NUMBER	Addition & Subtraction Relations & the Number System Multiplication & Division Money Statistics Chance Processes
———	1D MEASUREMENT	Length Area Volume & Capacity Mass Time
□	2D	Movement & Position in the Environment Exploring 3D Shape
⬡	SPACE	Exploring 2D Shape
	3D	Transforming Shapes

The syllabus can be viewed as a list of qualities which can be used to make sense of our environment. As a teacher I can look through the classroom window with cultural 'blinkers' and mentally establish order. This is done by counting objects, people, events etc. Alternatively I could consider the colour, length, area, volume, mass, position or shape of an object. Sequence and duration of events and time intervals are also culturally important. However, the Aboriginal student appears to be using very different qualities to define the same environment. They can see people as relations or parts of the environment which are again related to them. For example the students talk about trees almost as a quality where we would think of the species, number, height, colour or position etc. The contrasting worldviews can be illustrated by the term

balanda, which is used extensively throughout East Arnhemland to denote the quality of non-Aboriginal. It is originally from the Dutch: *Hollander*. It has been borrowed from several Aboriginal languages into English. When the teacher at Milingimbi uses it a 's' is usually added for plurals. However, when the Milingimbi child uses the same term even in an English sentence they rarely add the's' as they seem to be expressing the original non-Aboriginal quality expressed in the Aboriginal context. Number was never the main point.

Teacher Development Activity Two - Sub Sections:

Some Aboriginal students have a cultural background that will not immediately allow them to access the maths syllabus taught in school. Through my activities I am trying to give their teachers an insight into the two cultural systems - one from western culture and one from the child's world. These insights may lead to a more appropriate maths program and particularly one that begins with an understanding of the student's world. Again using the Milingimbi staff a survey was taken (adapted from *The Mathematics Curriculum and Teaching Program (MCTP) Activity Bank Vol One*, C. Lovett & D. Clarke, CDC, Canberra, 1988, pp. 143-149) of people's *mälk* (sub sections) in the room. This gave eight categories for the survey. In groups, according to the *mälk* the teachers were asked to stand, forming one large circle. By drawing a chalk circle, then segments on the carpet to make a pie graph it is possible to represent some Aboriginal knowledge in an abstract western mathematical way. This approach is using mathematics as simply a different way of expressing part of what the Aboriginal teachers already knew about *mälk*.

Fractions can be easily brought into the discussion by counting those standing in each segment against the total in the survey. In this case there were 19 teachers and the Wamuttjan (a sub section) segment for example was 2/19ths of the total survey. The Aboriginal staff already know who is there and what sub sections they are from but what I am hoping they will gain from this activity is the ability to rename their perceptions of sub sections into maths concepts such as smaller, 4/9ths etc. By adding a circle of 100 coloured beads it is possible to talk about percentages

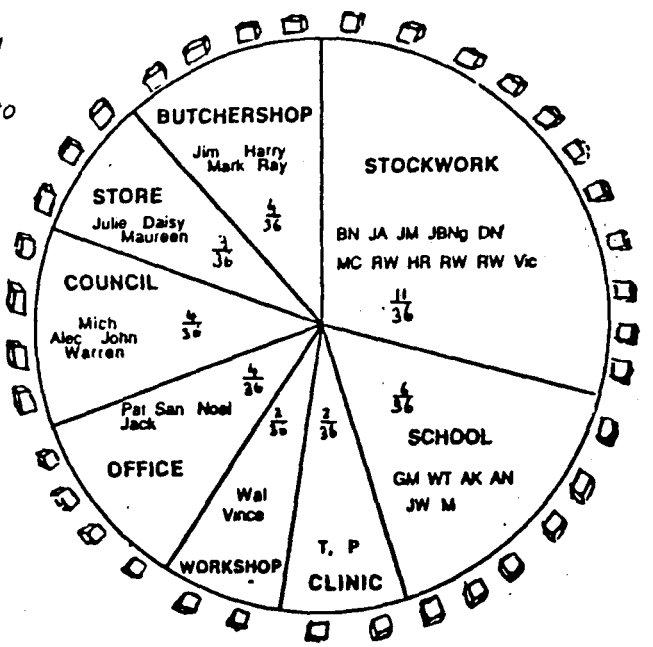
and decimals to two places for each segment (this graph is not shown here but it is described in detail in the *MCTP* book). It is difficult to teach a concept within one lesson but the reaction of the Aboriginal staff was most encouraging.

Student Activity - Workforce Survey:

I tried a similar survey with some Palumpa primary students who use very little English outside of the classroom. Greg Minogue, the teacher, had been talking with the class about jobs in the community. When questioned about who was doing what job the students easily listed the work force of the small Aboriginal run cattle station. Taking a bag of multilink cubes we wrote the initials of each worker on a cube as they went through the names a second time according to occupation. Starting with red for stockmen (as the most prestigious occupation) we were able to assemble a small pile representing these workers. They very quickly picked up the system and helped classify all workers. The initials were more helpful as a memory aid for me as the students seemed to have no difficulty in remembering which cube represented whom and where everyone worked.

All the cubes were grouped according to their colours (occupation) and then arranged into a large circle on top of a sheet of cardboard. With a texta the students were then able to construct a circle and divide it into segments according to the different occupations. They put labels on each of the segments which included such information as names, fractions and categories. Talking about the graph was very easy for the students as they were basically relaying what they knew about their relatives and the jobs they held. By looking at the relative size the students were able to give me the same information and use numbers, fractions and areas. Questions such as, "Who is represented by the largest segment?" and "How many men do stock work?" were all answered correctly and sometimes by interpreting the graph. Students were able to accurately reproduce individual graph from the class one.

Pie graph developed with the Palumpa students on the local workforce. It was constructed with multi-link cubes & drawn onto the floor:



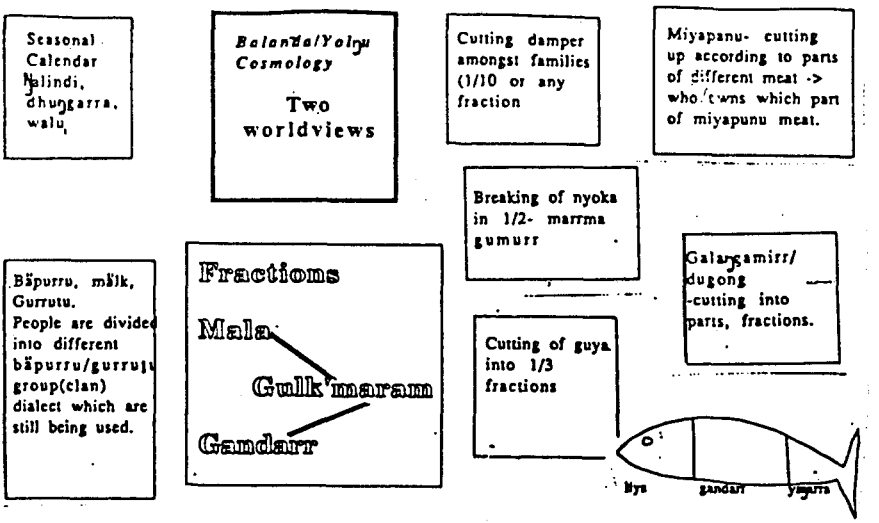
Teacher Activity Three - Fractions:

The concept of fractions was talked about in activity two above, although at this stage it is very much tied to the chalk pie graph on the floor. From a previous workshop at Wadeye I had the Aboriginal teachers investigate the concept of one quarter. Using the list of concepts from the maths syllabus the Aboriginal staff were able to give examples of where a quarter (fractions) could be found in the world of the Aboriginal child. One example concerned the passage of time. There were words for sunrise and midday in Murrinhpatha (one of the languages used at Wadeye) that the Aboriginal students understood. A day could then be described as a period of time and a quarter of this was the time interval between sunrise and midday. Similarly, an example was taken from the Aboriginal calendar. There are seven seasons used to describe the weather pattern in Murrinhpatha. Each one of these seasons could be regarded as a fraction of the whole year. Although this example may not present an equal seventh of our calendar year the Aboriginal teachers felt that the students were more likely to understand the

maths concept of equal parts (fractions) if they were first talked about in a cultural setting that made sense to the students. I certainly know from my own culture that when my youngest daughter says she will be home in half an hour she is not thinking of an hour equally divided into exact halves. However, I would see her inexact application of these two mathematical abstractions (duration of time and half) as a necessary part of her learning process. Without her relating these abstractions to her world she would be unlikely to learn them.

The Milingimbi Aboriginal staff took the Wadeye examples and added to them. *Nyoka* (mud crabs) before they are eaten are broken into two halves; the world is divided equally into moieties called *dhuwa* and *yirrtja*. The *mälk* system has eight sections; *miyapunu* and *galunggamirr* (turtle and dugong) are carefully cut into portions and distributed according to a system of personal relationships. Dampers are broken into many parts according to the number of family members present. A fish is also cut into three, *liya* (head), *gandarr* (body) and *yangara* (tail). These examples and more were illustrations of where the Aboriginal child is already familiar with fractions and parts of a whole. It is evident that they do not all conform to the text book definition of a fraction but neither did my daughter's half an hour. What they do offer is a starting point of a maths lesson that takes the Aboriginal child from where they are, which would seem like a common sense idea.

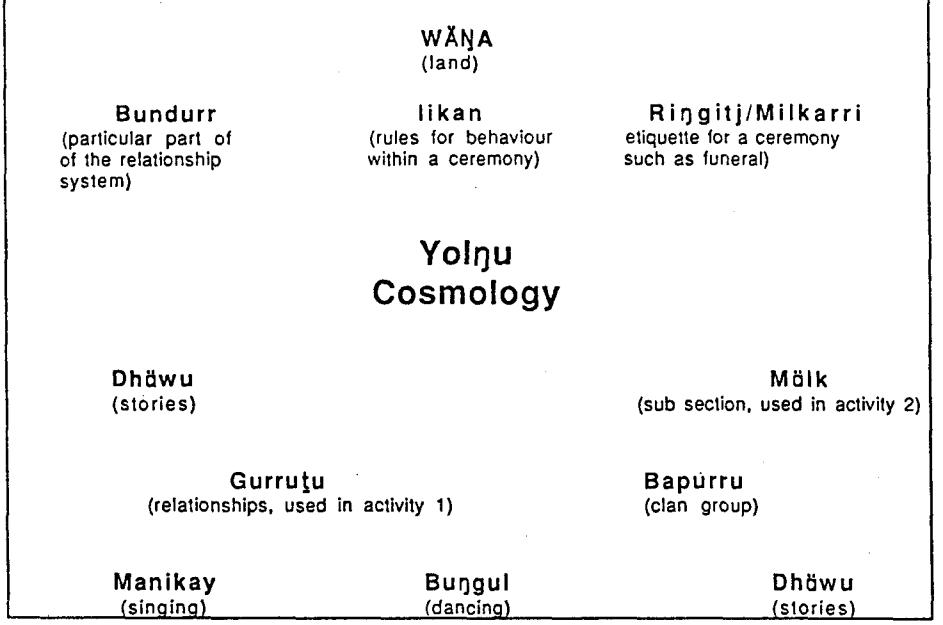
Examples of where parts of a whole (fractions) are used by the Aboriginal child at Milingimbi.



Milmilany (Milingimbi School Teacher Linguist-in-Training) led a group of the Aboriginal staff on an investigation of concepts from the western mathematics syllabus that they felt the Aboriginal students may find easy to understand from their own cultural viewpoint. Two main ideas that emerged from this workshop are firstly that from the Aboriginal point of view, there appears to be a 'big step' which prevents many of the Aboriginal students from gaining an understanding of what is being taught in school. The Aboriginal gorup made the comparison of how white students go through school and come out at the other end with knowledge. However, they stated that many of the Milingimbi students appeared to be going through school and not overcoming this initial 'big step'. The group suggested that what was happening in schools was not always clear to the students. From my experience I would also suggest that the Aboriginal teacher has sometimes not understood the purpose of a lesson in western mathematics. One suggested solution made by this group to overcome this was to first teach in the vernacular some of the mathematical concepts that are found in the Aboriginal world. This group was able to easily identify quite a lot of 'overlapping mathematics' when they were working from the list of maths topics. As many of the Aboriginal teachers have a poor understanding of what western mathematics is, the activities in these sessions are aimed at improving their maths skills as well as helping them to see the distinction in both the western and Aboriginal worlds.

As the Aboriginal group was exploring this idea they put forward quite a remarkable statement of the Aboriginal world - a cosmology of ideas. I understood this to be the main bodies of knowledge that make up the Aboriginal world for the student at Milingimbi - **a worldview.** Following is a representation of the Aboriginal world as presented by the Milingimbi Aboriginal staff. It is very much part of the Aboriginal child when s/he comes to school. Through mathematics, however, teachers are presenting a part of a very different view of the world.

Milingimbi workshop. The main elements in an Aboriginal worldview:
(the English is my approximate translation as the concepts do not necessarily have an English equivalent):



There are important aspects in describing the wider Australian society and mathematics would appear to be one of them. Mathematics is so much part of the way we communicate that if a student fails to understand western mathematics they may fail to understand much of western society. I used examples from both *gurruṯu* and *mälk* as a starting point in my mathematics activities. I think that the Aboriginal teachers and the students were able to follow the mathematics that was involved mainly because the examples came from a social context that was familiar to them. What I did was begin with the known and build this knowledge with a quality mathematics lesson.

My intuition as a teacher tells me that I am achieving some success with these trials in mathematics. The Aboriginal teaching staff are responsive and certainly willing to put forward ideas in an attempt to improve the mathematics of their school. By working closely with the Aboriginal teachers it might be possible to achieve a program that gives some Aboriginal students an understanding of mathematics beyond their current role performance.

The above activities have developed through the Mathematics Inservice Network for Teachers (MINY) program which has been a professional development package for both Aboriginal and non-Aboriginal teachers operating in the Darwin Aboriginal Schools (DAS) region. Topics addressed have included: Worldview/Language, Problem Solving/Active Learning/ Programming, Assessment & Evaluation. As this approach to mathematics seems to raise some questions that I have not answered I would welcome comments.