ABORIGINAL INDEPENDENT COMMUNITY SCHOOLS (AICS) NUMERACY STRATEGY & PORTAL

Introduction

The Aboriginal Independent Community Schools (AICS) of Western Australia are a cluster of independent community-run schools scattered around the vast state of Western Australia. The schools are part of the Association of Independent Schools of Western Australia. The governing bodies of the AIC schools initiated the strategy, asking for a program to help their students learn the mathematics they need in order for them to participate fully in community and work-related life when they leave school. A DEEWR funded numeracy project started within these schools in 2010 with two years of funding and is now continuing through financial support from the schools.

The AIC schools cater for students from Kindergarten through to Year 12, have 100% Aboriginal student population and are mainly staffed by recent graduate teachers. These teachers have the in-class support of Aboriginal Education Workers (AEW’s).

Recognising and Accommodating Students Starting Points

The AICS Numeracy Strategy is designed to support teachers to recognise and accommodate student starting points and hence to improve the outcomes of the students within the schools. Recognising and accommodating students starting points can be quite difficult for teachers who are still learning their craft of teaching. Indeed, students starting points cannot be accommodated unless they are first recognised. So the question is, what are the students’ starting points, what aspects need to be considered? This project focussed on students’ starting points in two main areas: Mathematics, and Culture.

Mathematics:

It is really helpful for teachers and AEW’s to have a deep understanding of the mathematics content that they are teaching and to have an idea where students are at in their learning of the content. Teachers in particular need to know how to work out what mathematics their students already know; from this they can work out what they may need to learn next. This helps them to create focussed plans of work to accommodate the learning needs of their students.

Culture:

It is very difficult for recent graduate teachers, who are still learning their craft of teaching, or indeed any teacher new to community life, to quickly learn all the aspects of culture that may impact on students’ learning of maths. Therefore the project has focussed on the essential elements that they need to accommodate in order to ensure that a lack of cultural knowledge does not impact adversely on students’ learning. The project focused on: language, preferred learning styles and contexts.
Language: Many different languages are spoken within the AIC schools. Students need support to connect their home language with the language used within the mathematics classroom. Research being undertaken within the project compares students’ understanding of English and Kimberley Kriol; to identify the English words and word clusters that student in lower primary find problematic. This research is focusing on the everyday words that are commonly used in maths lessons; not the technical mathematics words. Although students need to learn these, the other, everyday words seem to be posing more of a barrier. Within this research we have identified many English words and word clusters that students have difficulty with. For example, in Kimberley Kriol there are no word clusters, such as, ‘more than’ and ‘less than’, and yet these words are used often in mathematics. By working with the AEW’s we have found that within the home languages, directional words can be used and connected to these phrases, thus accommodating students starting points in language. The project is helping teachers and AEW’s to identify difficult English words and to connect home language with them.

Preferred learning style: Aboriginal students’ preferred learning styles is a focus of further research for us. Based on the work on Hughes, More & Williams, (2004) Aboriginal students recurrent learning strengths are being considered in relation to the mathematics classroom. For example, the idea of learning through observation and trial and error with feedback is one of the areas being investigated. (See Braid and Sullivan this proceedings). This research is helping to inform the project and hence teachers and AEW’s in the AIC schools how to best accommodate students pedagogical needs.

Contexts: The project is supporting teachers to situate the mathematics they are presenting to students within context that are relevant to them. Students are mostly located in remote communities, which means that teachers are encouraged and supported to use everyday contexts such as how much petrol is needed to drive into town, or stories about hunting kangaroos or fishing. However, this does not mean that contexts should only include kangaroos and hunting. The students are global citizens, who have access to books, internet, television, and have a wide range of interests, which include things like hunting, but are not limited to it. Like all students, when engaged in learning about dinosaurs or zoo animals through literature, these contexts can stimulate mathematical thinking. Context can also include games and activities that have an element of intellectual challenge, as this in itself provides a context for learning.
Focus of the Strategy

A focus of the strategy is to support teachers and AEW’s to learn their craft of teaching. As part of the strategy, a number of resources have been developed to support teachers and AEW’s in their work. The elements of culture mentioned above are woven through the mathematics, the activities and the assessment tasks within these resources, and within the professional learning provided.

The strategy focussed on the Number section of the mathematics curriculum as an understanding of numbers is the basis for learning in most other areas of mathematics. The focus is on the critical building blocks of number that students need to learn at each of the year levels from Kindergarten through to –Year 6. Without these critical understandings students can struggle to make progress, and later, can be limited in their life opportunities when they leave school. The project focussed on improving students’ understanding of the way the numeration system worked, and their ability to do mental and written calculations, use a calculator effectively and to judge the reasonableness of their results.

Understanding the Numeration System

Early on in the project, work within the schools revealed that many students needed a better understanding of the way the number system worked, and in particular, an understanding of the magnitude of numbers. For example, how big is the number 150 and how is this different from $1.50 or 1 500? Building students’ ability to read and write numbers, including large numbers and decimals, and to say number sequences, forwards and backwards, by ones, tens and hundreds, helps them to build an understanding of the magnitude of numbers. Further to this, subitising, partitioning, counting collections and place value also help to build this understanding. -This is a two-way process as an understanding of the magnitude of numbers can help build an understanding of these aspects. Many of the activities provided within the strategy helped teachers to see the links between these aspects of number and hence helped students to better understand the size of numbers.
While observing lessons, it became evident that many teachers where not helping students to link the written and oral versions of numbers with the quantity that they represent. They might, for example, do a counting activity without writing down a number, or a bingo game to help students to learn to read numbers, but not connect the written numbers in the game with any materials or diagrams. The same was evident in later grades in lessons involving place value for example, or decimals. The following diagram became a focus of work at all levels to help students to make connections between the written version of numbers and the quantity that they represent. For example: in the lower grades, connecting smaller numbers with materials while learning to count; in middle grades, using bundled materials and diagrams while learning about the place value of two digit numbers; and in later grades using grid paper to understand decimal numbers involving money and measurements.

**Quantity**

Materials, visualized
materials & diagrams

**Oral**

**Written**

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**Calculations**

In the area of Calculations, the AICS Numeracy Strategy supports teachers and AEW's to build connections between the critical aspects of Numeration, and Calculations. As shown in the diagram below, many aspects of number understanding need to come together if students are to understand and be able to use mental calculation strategies rather than inefficient counting-on by ones, to solve addition and subtraction problems. For example, fluency in saying number sequences forwards and backwards by tens helps students to learn to mentally solve addition by counting forward by tens, 54 + 32 => 54... 64, 74, 84, 85,86, and to solve subtraction problems by counting backwards by tens. This beginning mental calculation strategy is much more efficient than counting by ones.
On-Line Portal

The AICS Numeracy Strategy includes the following components:

- Development of On-Line Portal - resources to support teachers and Aboriginal Education Workers
- Professional Learning for Teachers, Principals and Aboriginal Education Workers
- In-school and remote support.

The first layer of the on-line portal resources focussed on the area of *Understanding the Numeration system*, including counting collections, reading, writing and saying number sequences, subitising, partitioning and place value. These components make up the building blocks for all other areas of number work.

The AICS Numeracy On-Line Portal includes:

**A Scope and Sequence:** This section of the portal outlines the critical aspects of mathematics that students need to learn at each year level from Kindergarten through to Year 6. This is directly linked to the Australian Curriculum and structured year by year, so that teachers have a view of how their students’ mathematics learning should progress. It provides the big picture of the mathematics, so that teachers know where students have come from and what they should focus on teaching next.

The other resources, the Assessment Tasks, Mathematics content and Activities are all accessed through the Scope and Sequence. This is to encourage teachers to continuously consider the critical aspects of mathematics that students need to learn at each of the year levels.

![AICS Scope & Sequence](image)

**Diagnostic Assessment Tasks:** A collection of Diagnostic Assessment tasks have
been written for each aspect of the Scope and Sequence. The tasks get progressively harder to help identify what students know and what they need to learn. The assessment tasks include a page of instructions, a recording proforma, examples to help teachers identify students' current level of knowledge and common misconceptions.

**The Mathematics Content:** This section of the portal resources explains the mathematics content students need to learn. It helps teachers to:
- understand the mathematics to be taught at each of the year levels
- know how their students learn the mathematics
- identify common student misconceptions
- understand the pedagogy and resources that help students to learn

Recent research in the area of Indigenous mathematics and learning mathematics in a second language environment has been incorporated into this section of the resource.

The mathematics is summarised into dot points which can be added to a planning document by clicking the option on this page.

**The Activities:** Are high quality, effective, targeted activities that can be easily applied to classrooms. Research in the area of Indigenous mathematics has also been incorporated into this section of the resource. The contexts within the activities have been written specifically for the Aboriginal students in the AIC Schools. The English language words that students need to understand in order to undertake each activity are listed.

The activities can be easily added to teachers' planning documents.

**The Planning Tool:** Can be used to create a range of planning documents, which can be saved for later use. The tool includes links to the Australian Curriculum, the AICS Scope and Sequence, the mathematics focus and activities. The documents can be downloaded into WORD so that teachers may personalise them.
The AICS Numeracy Tracking Tool (ANTT): Allows teachers to track individual student’s progress against each of the critical areas of number as outlined within the Scope and Sequence. Teachers can create a range of reports and graphs by filtering the data to show student progress against each of the components of the Scope and Sequence. These can be created for individual students or entire cohorts.
Each of the AIC schools have access to their own students’ data. However, the AICS Numeracy Portal allows student data to be easily moved from one school to another and lessens the impact of the transient nature of the school communities. This means that teachers do not have to start their assessments from scratch when a new student arrives within their school. The portal stores each school’s data as individual data sets. Teachers can go onto the portal, search for the student and transfer all the accumulated data by simply clicking a tab. The teacher knows straight away what that student needs to learn next. Accessing student data in this way allows teachers to start working immediately on targeted activities which meet the needs of each student. This is particularly helpful for the residential schools in the south of the state, where many of the students go for high school. These schools are able access all their students’ achievement data gathered through the primary school years in any of the AIC schools.

Evidence of Improvement:

**NAPLAN**

Using NAPLAN data in schools that have very small student numbers can be problematic as often they do not have enough students to register. However, results from the two larger schools are showing measureable improvement:

- School 1, 2011, shows progress at the Year 5 level. Students were ‘substantially above’ similar schools whereas in 2009 they were ‘below’. They did not have enough students to register results at the Year 3 and 7 levels.

- School 2, 2011, all year levels are ‘close to’ similar schools instead of ‘substantially below’ as in 2009.

**Classroom-based Diagnostic Assessment**

The Numeracy Strategy is data driven, which means that teachers are encouraged to use assessment before they start teaching a concept. This helps them to work out what mathematics students know already and hence what they need to learn. Teachers and AEW’s are supported to use this information as the basis for their planning. In this way teachers are encouraged to become more efficient and effective in their teaching, more targeted in their daily lessons.

Classroom- based Diagnostic Assessment Tasks were used to gather baseline data in February 2010. This can be compared to the data from November 2011. Data was gathered from 741 students in 2010 and 608 students in 2011. The students ranged from Kindergarten through to Year 12. Teachers selected tasks to suit the needs of the students, so they did not assess every student on every task.

The amalgamated ANTT baseline data from February 2010, when compared with the data from the end of 2011, showed considerable progress, despite the fact that some of the tasks became harder (decimals were added in response to community requests) This progress was reported against each of the critical areas of Understanding the Numeration System, as outlined in the Scope and Sequence: reading numbers, writing numbers, saying number sequences, subitising, partitioning, counting collections and place value. Data was amalgamated into table form and graphs generated. This allowed comparisons to be made between the two
sets of data by comparing the percentage of students achieving each of the year level. The data showed that students had improved understanding in each of the listed areas of the Numeration System. Space will not allow the discussion of all of these areas, so the next section will report on the progress within the area of Reading Numbers, which is indicative of the progress made in the other areas.

The amalgamated Reading Numbers data showed an improvement across all of the year levels, with many students working at higher levels in November 2011. For example, in 2010, 24% of the students from K – Year 12 were working at or above Year 3 level, whereas in 2011, 42% were working at or above Year 3 level. This is significant as the assessment tasks becoming more difficult with the inclusion of decimals. In 2011, 18% of Year 8, 22% of Year 9, 31% of Year 10, 15% of Year 11 and 21% of Year 12 could read decimal numbers to three decimal places (Year 6 standard within the Australian Curriculum). This shows a very significant improvement as no students were at this level in February 2010.

Individual year groups also showed very significant improvement; for example, the students at pre-primary level. In February 2010:

- 81% of pre-primary students were not able to recognise numbers in their environment (F1.1)
- 19% of students could recognise numbers in their environment
- 4% could read numbers symbols up to ten (F1.2, the Australian Curriculum standard for pre-primary)

In 2011,

- 78% of pre-primary students could recognise numbers in their environment (F1.1)
- 47% of students could read number symbols up to 10 (F1.2, the Australian Curriculum standard for pre-primary)
- 16% could read numbers up to 50 (Y1.1)
- 9% could read numbers up to 109 (Y1.2, the Australian Curriculum standard for Year 1)
This means that by the end of 2011, 47% of pre-primary students were working at or above the Australian Curriculum standard for pre-primary compared to 4% at the beginning of 2010.

At the Year 3 level, in February 2010, 33% of students were achieving the Year 1 level, and 13% were achieving the Year 2 level and 0 were achieving the Year 3 level. In November 2011, 89% of Year 3 students were achieving the Year 1 level, 42% were achieving the Year 2 level and 24% were achieving the Year 3 level.

At the upper end, progress was much more difficult. In Year 11 for example, students made progress, but not as much as in the lower year levels. This was for three main reasons. Firstly, the tasks became harder in November 2011 with the inclusion of decimal examples, which were not included in the original tasks. Secondly, the students needed to develop an understanding of whole numbers first before engaging with decimals. Thirdly, older students tend to be more disengaged in mathematics classrooms after years of struggling with maths concepts.
In February 2010, 69% of Year 11 students were achieving the Year 3 level, 31% were achieving at the Year 4 level and 6% were at the Year 5 level. In November 2011, 90% of Year 11 students were achieving the Year 3 level, 33% were achieving at the Year 4 level and 23% were at the Year 5 level and 15% were achieving at the Year 6 level. Although this shows progress, this data indicates that students are still below their age appropriate level and need continued support and focussed teaching if they are to make further progress.

**Conclusions**

The AICS Numeracy Strategy resources and the professional learning have focussed on the critical building blocks of number - Understandings the Numeration System, and Calculations. These two sections of the portal will be complete by the end of 2012, and available for other schools should they wish to use it. The AICS Numeracy Strategy is continuing into 2013, which will allow further development of the portal, and further support for teachers and AEW’s within this unique cluster of schools.

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