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# Mathematical Success in Culturally Diverse Mathematics Classrooms

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*This paper discusses the initial thematic analysis of practices used in remote classrooms where there are high percentages of Australia's First People. The case studies from which the data are drawn are from a large project that explores successful teaching of numeracy/mathematics in remote and very remote contexts of Australia. There is considerable diversity in the case studies due to the variety within the contexts and the needs of those contexts. However, there are also similarities emerging across cases. This paper discusses the emerging similarities that are evident in many of the sites. The project uses grounded theory to explore the similarities. There appear to be three levels of practice that need to be taken into account when building a successful numeracy program for Australia's First People learners.*

## **Success in Remote Indigenous Communities**

Overall, First Australians represent about 3% of the national population. This measure is somewhat crude as it is based on the self-identification of First People. Contrary to popular belief where there is often an exoticism that First People live in remote outback lands, First Australians live predominantly in well-populated areas with approximately 60% living in major cities or major regional areas, and just over 20% living in remote and very remote areas (Australian Bureau of Statistics, 2013). This figure however, must be explained as there are quite nuanced statistics for various regions. For example in the Northern Territory where the overall population is just over 200,000, First Australians are 30% of the population and that there is a much younger demographic of First Australians than there are older First Australians (Australian Bureau of Statistics, 2014). The Northern Territory has the highest proportion of First Australians of all states, while Victoria has only 1% of their population as identified First Australians. The age structure of First Australians is

also different from the non-Indigenous Australian population. The median age for First Australians is 22 years while for the non-Indigenous population it is 38 years. Such differences have impact on education provision. In many remote and very remote communities, the proportion of the population is close to 100% First Australians with the non-Indigenous people being in community in service roles and only in transitional roles. The project discussed herein draws on communities in remote and very remote settings. Aboriginal communities in the Australian context are suffering from a wide mix of social, economic, infrastructural, health and criminal issues. The issues, identified in numerous reports to government through to the general media, are widespread. The issues are complex and are contextually bounded by the communities themselves. Many remote communities serve a number of different family groups, and this also creates particular challenges in some communities. Many remote communities are built to cater for the familial/tribal differences within a given community; and often with the non-Indigenous people being separate from the main community.

The roles of non-Indigenous people in remote communities generally involve service roles such as teachers, police, health workers, social security providers and the like. Teachers are often early career teachers, young and remain in community for the length of their contract of employment – usually 2-3 years – and use the position to levy for a ‘better’ position in an urban setting. As neophyte teachers, usually in their first teaching position (Goos, Dole, & Geiger, 2011), the teachers are not only confronting the first year of teaching but also in a remote, isolated context working with families whose language and culture are very different from their own (Howard, Cooke, Lowe, & Perry, 2011). Increasingly, systems and employers are building programs to help support teachers in this critical period of their teaching career and in their cultural induction into remote community life. But as the majority of the teachers are very early career teachers the possibilities for mentoring are limited in situ. Furthermore, the tyranny of distance means that the provision of professional development and support is limited. This creates quite unique circumstances for the induction and on-going development of early career teachers in remote settings. The high turnover of teachers and leaders in remote communities also means that there is often a loss of knowledge as staff continually moves through communities (Helmer, Harper, Lea, Wolgemuth, & Chalkiti, 2013).

What is well known and documented is the lack of success (as measured on traditional assessment and reporting measures) for remote students whose culture is different from that of the Western education system. In the Australian context culture and geographical location compound the (limiting) possibilities for success in mathematics. There is a substantial literature that demonstrates the issues that are central to this paper are common in other countries such as Canada (Ezeife, 2002). Some of the key issue within current education policy and thinking are issues of attendance (Purdie & Buckley, 2010), language and assessment (Mushin, Gardner, & Munro, 2013), and the upskilling of teachers who commence work in remote areas (Auld, Charles, Dyer, Levy, & Marshall, 2013).

Within the Australian context, there are a range of approaches that have sought to address the poor educational outcomes for Australia's First People. Some of these have included approaches that build bridges between the two cultures (Robinson & Nichol, 1998) where others have sought to use artefacts (such as witchetty grubs) (Treacy, Frid, & Jacob, 2014) to provide a meaningful context for learning mathematical concepts. More recently, there has been a strong push for more explicit teaching approaches such as that undertaken by the Cape York Academy (Cape York Aboriginal Australian Academy, 2014) where students have been exposed to a curriculum and pedagogy that seeks to remove areas where there is potential for misunderstanding in the instructional process and students are grouped by "ability". There are also approaches that have sought to transpose successful approaches in other contexts into the Australian remote context (Sullivan, Jorgensen, Boaler, & Lerman, 2013) to identify salient features of such programs that offer potential success for Indigenous learners.

What is clear, however, that despite considerable funding being allocated to interventionist programs to bring about success in mathematics learning for the most at-risk learners in Australia, there has been very little success in terms of measurable learning gains. In contrast, this project has taken as foundational, the possibility of those working in remote contexts to bring about success. To achieve this, a large national study is in process that is seeking to identify elements that may be contributing to the success of Australia's First People who are most likely to perform poorly on standard measures of success in mathematics.

## Defining “Remote” and “Very Remote”

Schools selected for this study are either ‘remote’ or ‘very remote’ as defined by the Australian Curriculum and Assessment Reporting Authority. The concept of remote is very Australian-centric and refers to geographical isolation. For example, remote education is defined by The Queensland Department of Education Training and Employment (2014) being over “3 hours from a regional/provincial or larger town” (np). With this isolation, many other influences are felt such as access to resources (hospitals, shops); the psychological effect of remoteness; the communication possibilities (often no mobile or internet connections), mode of transport to the site (often on unsealed roads); being cut off in the wet season due to floods (can be for 3 months).

## Defining “Success in Numeracy”

While it is recognised from the outset that there are considerable limitations with a National Testing program, the first round of selections of schools has been through the National Assessment Plan for Literacy and Numeracy (NAPLAN). This is the only “objective” measure in Australia where schools can be compared. All schools sit the same tests so there is some comparability across the country. The tests are “designed to show a snapshot of typical achievement and do not describe the full range of what students are taught” (Australia Curriculum Assessment and Reporting Authority, 2014, np). Initially schools were selected on the basis of their performance on numeracy where they performed better or significantly better than similar schools. The MySchool site provides information publicly on school performance so data were used to identify schools who were performing better than similar schools usually across at least 2-3 years so that the data for one year was not aberrant data, that the school was listed as remote or very remote, and had at least 80% Indigenous population.

The project has also incorporated a process of personal recommendation on the basis of inclusion. Many schools, for various reasons, do not produce data that shows performance on NAPLAN testing. As such, regional directors and state authorities have recommended the inclusion of some schools. In all cases, schools are asked to provide

evidence of their success. School-based data is more reliable and robust than relying solely on NAPLAN scores. There have been two cases where the school was unable to provide data when the ethnographic case studies were undertaken and these have not been included in the study.

## **Success in Remote Numeracy: The Project**

The study is funded by the Australian Research Council through its Discover grants scheme. The project is funded for three years and seeks to document at least thirty-two case studies of remote and very remote schools that have been identified as being successful in the teaching of numeracy. Across the Australian research community there have been numerous funded studies that have sought to bring about change and success. In contrast, this project has been founded on a number of premises – first that there are numerous teachers/schools who are succeeding, who know the communities and know what is working. This project seeks to document their practices and understanding of what works in that community. Many interventionist studies have met with minimal success for a range of reasons. This project is about documenting and developing richer understandings of what works in these contexts while recognising that each context is highly nuanced.

Field trips are undertaken to each site. Depending on the size of the school and the focus of the work at the school, the visits can be up to one week for larger schools. The data collection consists of interviews with key staff, lesson observations, and collection of school artefacts. A story is developed for each site post the visit and is then negotiated with the relevant personnel at the school. Once the story is approved by the school it is uploaded to a website for public sharing.

Now that the project has a substantial database of data, it is now moving into the formal and on-going analysis stage for the overall project. This has included the design of the nodes for the coding of data via NVivo10 - (QSR International, 2014). This is a qualitative data analysis program using grounded theory (Strauss & Corbin, 1997) that enables a theory to be developed from the themes in the data. Prior to the coding, a system of categories (for the nodes) was developed. This is based on the emerging themes that the research

team has noted in the data. These nodes provide the initial starting point for the coding of the data but the program allows for more nodes to be added. The coding process allows for initial ‘hunches’ to be confirmed or invalidated, as well as for new nodes to be developed as the data are coded. Collectively this process enables the research team to develop themes across the thirty-two or so cases that will be developed once the project has been completed.

At this halfway point, there are now themes emerging from across the sites, where it is clear that there are some commonalities across some sites. It is not the case that there are common themes in across all schools, and this is to be expected given the diversity of schools, contexts and systems within which the schools operate. It is not the intent of the project to derive a common set of themes from all the schools.

## **Findings**

What is emerging from the data is a series of themes that can be found in some schools, while other schools may have common themes with and across other sites. It is emerging that the practices of effective mathematics teaching are multileveled and it is important that this layering of practices is taken into considerations.

### **Multiple Levels of Practice**

What is emerging from the case studies is the recognition that quality practice in mathematics education for remote and very remote communities is multi-levelled. The schools in the project may have stories that are focused on particular level/s but there is reference to other levels in their stories.

#### **Envisioned Practices—School-level Practices**

This level refers to those practices that build a strong culture at the school. These practices focus on the building of cultures around learning and cultures of support. This level of practice highlights the

importance of quality leadership at the school to build an environment where learning is the focus and where practices are informed by ‘big ideas’ in education—such as a coherent philosophy which is used to inform the work across the school. There are also practices at this level that create a strong sense of the core business of the school and how this business can be enacted and realised.

## **Enabling Practices**

This level of practice is operationalised as a mediator between the vision of the school and the grass-roots classroom practice. While leaders may have a vision of what they see as the key business of the school, there are practices that need to be enabled for the vision to filter through to the level of classroom practice.

## **Enacted Practices—Classroom Practices**

The final level of practice is at the level of classroom. At this level, the classroom teachers and support staff work to build quality practices to enable students access to, and success in, mathematics. These practices are those around pedagogy, curriculum, and assessment. They are informed by, and facilitated by, the other levels of practices across the school.

The levels are interactive rather than hierarchical since the practices at any level are informed by and shaped by the practices at other levels.

To further expand the model, Figure 1 highlights the various attributes that can be seen within the different levels. For example, the school may have challenges with attendance so there are practices envisioned at the macro level. The school may decide that one of the issues around attendance is that students have not felt welcomed at the school or that if there have been behaviour issues during the day that a student may not feel keen to return to school. At one school, the administration team stand at the school gate and welcome every student who comes to school and wishes them (in a very genuine manner) a great, successful and happy day at the school. At the end of the day, every child is farewelled and congratulated for being at

school, for successes and encouraged to return the following day. This has created significant changes in attendance. The envisioned practice is that school should be a place where students are welcomed and wanted and this must be made genuinely apparent to students (for whom school is quite a different culture from that of their homes). At the level of the classroom, teachers adopt similar practices to ensure students feel welcome in their classrooms. To ensure synergy between the practices of the administration team and the vision of the school and that which is enacted at the level of the classroom, a culture has been built at the school through considerable professional development and the allocation of resources to build a very transparent culture at the school (the enabling practices).

Consider the classrooms practices at a school where there are groups for learning. At this school, the teachers have been working towards having targeted learning for the students. Recognising that attendance is a significant factor in achievement, students who attend regular are generally achieving significantly better than those whose attendance is poor, sporadic and/or irregular. To help support the learning of teachers, there have been many approaches being undertaken at schools and across systems to help build teachers' knowledge of assessment and recording as well as their knowledge of how to scaffold from identified starting points. Collectively these skill sets are achieved through various processes adopted by schools. In some sites, the schools recognise that professional learning of teachers (often early career) is needed so funds are re-allocated within schools to have devolved models of leadership where there are 'coaches' to work with the teachers in their curriculum learning and planning. A number of schools have models of leadership in place in order to build communities of learners (and learning) – for teachers and Aboriginal support workers. In this scenario, teachers and leaders at various schools have adopted a range of practices to enable such interventions to occur (and succeed). It is by undertaking range of case studies, that the themes are beginning to emerge. They are not in all schools but there are synergies across sites that are becoming apparent.

For example, in many schools, there is a strong vision for recognition of the culture and languages of the communities in which the schools are located. Having high expectations of learners—students, teachers and Aboriginal Education Workers (AEW)—is foundational to the goal of the schools. Various strategies are implemented on how



to achieve this goal. In some schools, there is considerable investment of resources in the AEWs, and in the teachers to work alongside AEWs. In one site, for example, the school recognised the difference between the two languages spoken by the students—their home language and the need to be fluent in Standard Australian English. The vision of the school was to establish a strong early years program in home language and then scaffold the students into SAE. The early years sector of the school relied heavily on the AEWs to develop resources in home language that focused on mathematics concepts—such as spatial language, prepositions, etc. so that students could be scaffolded into learning SAE while also valuing the home language of the students. Teachers developed many classroom-based practices to enable the learning in two languages in mathematics, aided by the AEWs. Across other sites different scenarios were developed that also employed the skills of the AEWs at classroom level practice, but also at the level of the enabling practices in terms of the upskilling of the AEWs in order that they were empowered to work alongside the classroom teachers. Collectively these stories highlight various features of the practices employed by the schools to enable students to have greater access to mathematics and mathematics learning.

Furthermore, at most sites, there was a strong recognition that teaching needed to be targeted at the learners. This targeted teaching was premised on a number of issues, depending on the context. Most commonly the issues were related to attendance (or lack of); the language of the students, the culture of the students, and the resources that were available in community. For many communities, there are very different experiences for the students upon which they can draw in terms of understanding mathematics. The taken-for-granted experiences of urban students are worlds apart for remote students. For example, the language of money is one that can be problematic. A task in which coins are differentiated by gold and silver colourings (dollars and cents) may be obvious for urban students, but in remote contexts where the home language may be a Creole, then a term such as “silver” is used to refer to “coins” as opposed to notes. Posing a question where students may be required to identify silver coins to make up a dollar value may be nonsensical for some Aboriginal students. Knowing, recognising and celebrating the culture and language of remote students were also built into programs, particularly when targeting learning. Knowing why students perform mathematically as identified on

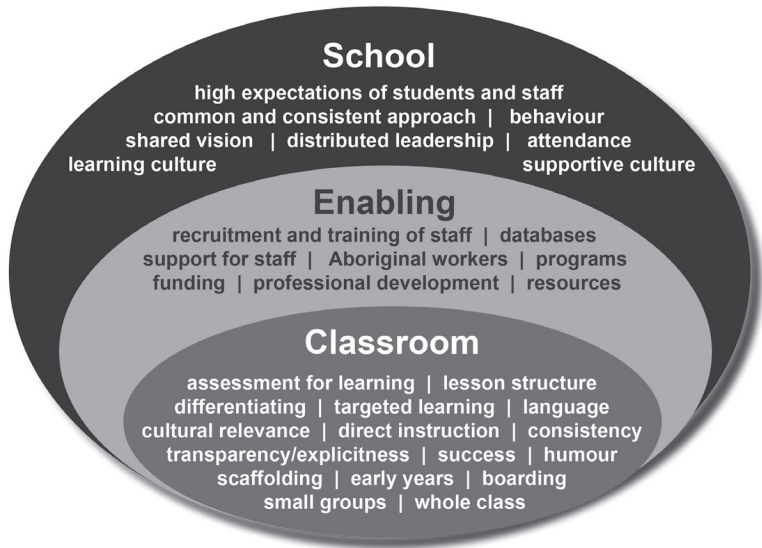


Figure 1: Levels of practices

various assessments helped teachers target learning. But communities varied in how they might take such targeted teaching. In some cases, strategies included grouping students by attendance so that teaching could be targeted for the diversity within/across achievement/age levels. In some sites, the teaching was targeted by drawing on cultural knowledges and how these impacted on achievement—in these cases, the knowledge of AEWs was critical.

Collectively, what we can see emerging across the study are the intersections and differences across sites. A model is needed in which points of intersections across sites can be mapped. This will be an on-going refinement in the project. More sites will be needed before this can be achieved. But what is emerging is that there are significant—as in both importance and frequency—of common themes. NVivo is a rigorous tool that will help in the development of this model. At this point, it is beginning to show the frequency of some constructs, and hence their relative importance in terms of thematic analysis. Other tools for analysis of these themes will be explored in 2015 as more case studies are completed and the data set is increased. It is anticipated that both confirmatory and contradictory cases are likely to emerge in the 2015 round of site visits.

## Conclusion

At this stage, it is only possible to draw on emerging themes, as per a grounded theory approach. What is becoming clear from the study is that there are differences and synergies across sites. More exploration of these themes is necessary to better understand what is working in successful sites. There have been a number of contradictory cases—such as one school that relied heavily on direct instruction and worksheets while other cases involved small group work that was less orientated to the recording of results. In the initial stages of the research, this contradiction was stark, but as more cases are undertaken, what is becoming more obvious is that even with such a stark difference in pedagogy, the school using worksheets was also relying heavily on targeted learning. In the case of the worksheets, the macro practices at the school were centred on ensuring that the learning experiences were commensurate with the student’s level of understanding. This is a theme that is emerging in nearly every school. What is different is the classroom level practice (such as worksheets, or group work, or language-based activities) where teachers carefully plan teaching activities to meet the learner’s needs. The differences in the classroom (enacted) practice are how the envisioned practice (targeted learning) is being realised.

It is not the intent for the overall project to develop a common model for all remote schools. Across all case studies, the context in which the practices are developed are acknowledged from the outset. The conditions of that context help to shape the possibilities for various practices and this is critical for what can be developed. A “one-size-fits-all” model is not a desired outcome, as has been argued in other national contexts (Meaney, Trinick, & Fairhall-Uenuku, 2010). However, there is likely to be a set of principles that can inform practice in remote schools, some of which are likely to be more relevant to one context than another.

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