TENSIONS, CONTENTIONS AND CONNECTIONS IN LEARNING MATHEMATICS FOR STUDENTS FROM SIGNIFICANTLY DIVERSE BACKGROUNDS

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Perhaps one of the most worrying outcomes of mathematics education specifically and education generally in Australia is the entrenched and long-standing lack of success among Indigenous Australians in education. Compounded by issues of language and cultural differences, living in very remote communities, living in poverty, and having poor health, Indigenous students confront significant obstacles in their schooling. Drawing on outcomes from a number of projects, key issues related to the mathematical success for Indigenous students are the focus of this paper.

COMING TO LEARN SCHOOL MATHEMATICS

In order to be successful in school mathematics there is a sense that the learner needs to engage with high levels of mathematics per se. The gaol for many communities is that the children will be able to access the goods and rewards in mainstream society but with the hope that they will also retain their own culture. There is increasing political and educational awareness that educators should have high expectations of Indigenous students so that they can avoid the self-fulfilling prophecy that has been integral to previous educational reforms where deficit thinking plagued educational practice. Current approaches to educational reform in Indigenous communities are premised on the notion that mathematics learning should be encouraged and well scaffolded. In taking this position, due recognition must be made of the border crossings necessary for Indigenous students in coming learn the fundamental cultural and linguistic assumptions that underpin school mathematics. Learning mathematic is as much about the mathematics as it is about cracking the code of the culture and language in which school mathematics is relayed.

THE TENSIONS OF LANGUAGE

As a monolingual country, Australia is one of the few nations in the world where the language of instruction is that which is spoken by most residents. For a country as large as Europe or the United States, the reliance on one language is remarkable. The tensions around language are considerable when working with Indigenous students. For some learners, the language spoken in the home is a dialect or Kriol so that there are aspects of English in the home language, for others the home language (or

languages) are those spoken by the 'mob'[1] or group. In remote areas of Australia, these languages have been spoken by the groups for many thousands of years. In the more urban areas, derivations of English are spoken but hold many grammatical markers that demarcate them from Standard Australian English (SAE). The degrees of separation from SAE become indicators as to the degrees of difficulty that may be encountered by learners as they come into the school context. Where the home language may not have words for comparisons or attributes, or uses different forms of language for prepositions, then the capacity to grasp the nuances of mathematical language becomes more evasive. Similarly for students who speak Kriol, the languages often use a single term (such as big) to refer to comparisons and a range of attributes. Coming to learn SAE requires considerable reshaping of not only language but concepts. For example, in northern parts of Queensland, children often refer to things as 'big' such as 'my big sister'. This may mean an older, taller, heavier, hairier, etc sister so there is little sense of the attributes or the comparisons that can be made. Meaning is derived from the context in which the utterance is made. Developing the capacities of language to enable access to the mathematical discourse becomes a serious task when these fundamental-to-mathematics concepts are not evident in the home language.

A series of tensions arise when considering access to the language of instruction and mathematical. Many of the groups are trying to maintain their languages in a context where English is needed. In a context where English is a necessary commodity for success (however defined), the maintenance of the home language becomes a challenge for both communities and educators. Negotiating mathematical meanings with limited access to the language of instruction (and mathematics) is a further challenge, particularly when many of the concepts and dominant modes of teaching have little relevance, application or embeddedness in the home cultures/contexts.

Boaler's extensive work in Railside has indicated that in this context the students were able to talk in their home language (Spanish) to negotiate meaning in mathematics. Interestingly, observations of the code switching in mathematics classrooms showed the students speaking Spanish to talk around ideas but within the conversations they used the mathematical language when discussing a mathematical idea. This would suggest that in some communities, it may be useful for the students to use their home language to negotiate meaning of mathematical concepts but that the language of the concept (e.g. length of the hypotenuse) would be in SAE. Such an approach may allow greater access to mathematical ideas and to SAE which preserving the home language of the students.

[1] Many Indigenous people refer to their family/cultural groups as 'mob'. It relates to their geographical, historical, and familial group.

CONTEXTS AND TASKS

Many of the remote communities offer little in the ways on immersion in literacy or mathematics. The homes and communities have little signage so that the young child is not immersed in the signifiers of the urban landscape. Such contexts offer little in ways of preparing students for the world of schooling. Once in school, there is a significant need for educators to provide a rich context for immersion in the language of instruction and the language of mathematics. Provision of a language-rich classroom is even more critical in the remote communities than the urban contexts.

In contrast, the life of the child in these communities is rich in other tapestries – relationships (kinship); space (location and moving around in space); and life sciences. Building links between these rich experiences that the learner brings to school requires significant learning for the teacher in coming to know about these new forms of life but also provides entrée into the secret business of schooling.

The teaching of mathematics is predominantly based on a particular view of how mathematics should be taught. This is evident in most of the schemes and resources developed for teachers. The resources used in the teaching of mathematics often include bundles of ice-cream sticks, plastic teddy bears, interlinking blocks and so on. These may be concrete items or representations of the same in workbooks or sheets. For the students, questions about the relevance of these resources in the teaching practices of school mathematics may be pertinent to the overall learning of school mathematics. Recently, in working with students in such communities, tasks were posed of students where they were asked how many sticks were in a collection where there bundles of ten ice-creams held together with a rubber band (ENRP, 200?). The child was unable to tell how many were in one bundle (of ten). He was instructed to unbundle one group and count them. The student did this and indicated that there were ten sticks. He was again asked how many sticks altogether where upon he unbundled the another groups and then counted all the sticks. Such an action could be interpreted that he was unable to group in tens, did not understand the place value system or a range of other possibilities. However, questions need to be raised about the hidden assumptions within the bundling process. The conventions of bundling in ten along with the convention of using ice-cream sticks may be unfamiliar practices in such communities. In a remote community where access to ice-cream sticks is very limited[2], the bundling process of such sticks is a novel practice. Furthermore, while it is a well rehearsed mathematical practice it potentially has limited value in terms of deep learning of mathematics. Using sticks in this

[2] In the remote communities, a general store will stock essentials. Ice creams are very difficult to transport, are very expensive and pose a considerable risk of melting in hot communities. Stores will sell iced confectionary that comes as liquid in a plastic sleeve which is subsequently frozen. Hence, sticks are not a part of the everyday lives in these communities.

context begs askance of how relevant the practice is to deep learning of mathematical ideas. The sticks may add a further distracter to the learning of place value. The fact that is commonly used may be more about the accepted practice than the actual learning of place value. Seeing the student unbundle and then count the sticks can be interpreted through current mainstream practice that will then retain the cultural hegemony of the practice. Without serious consideration of the border crossings that the student needs to undertake to gain successful access to this task, questions about the relevance and purpose the task remain unanswered. In these contexts, questions about the value and relevance of such practices need to be asked rather than imposed. More recognised icons may prove to have greater potential for learning. In this case, the tension is around the focus on ice-cream sticks as a mediating tool that may direct attention away from the potential mathematics to the artefact itself. What becomes necessary is the development of tasks that are mathematically rich but without the distractors to learning the deep mathematics embedded in such tasks. Undeniably, learning mathematics is about learning the conventions of the discourse but some conventions may need to be questioned in terms of their real value or whether they work to exclude access to the mathematics embedded in such tasks.

ASSESSMENT FOR LEARNING

In many instances, the practice of teaching mathematics is centred on the teaching of content rather than the teaching of students. The current emphasis of teacher activity in planning is around what to teach. This has been strongly endorsed by the current focus on outcomes-based education where the focus has been on particular outcomes. Most syllabus documents are framed in this way. Further, assessment is focused on whether the students have achieved these outcomes or not. The reflexivity between teaching and learning has all but disappeared from the teachers' repertoire of practice. In this context, summative assessment has become an entrenched practice. Working with teachers recently where they were implementing a curriculum innovation for Indigenous schools where teachers used a curriculum that progressively built content knowledge, it was found that there was little backward mapping. By and large, teachers would use the document to

a) map learning outcomes against existing learning resources, particularly in the case of secondary school teachers;

b) identify what should be taught at a particular grade level and teach to that, often only focusing on their particular year level content;

c) identify that students could or could not do the content that was indicated; and

d) identify where to move forward from what the students could do when they were working at the nominated level.

The main practice of teachers centred around the teaching of particular year level content. They were unlikely to consider the curriculum in terms of providing for the

diversity of learners so that, for example, the Year 6 outcomes were the primary focus of their planning and action. Of particular interest was that very few teachers used the document to identify where students were in terms of their current thinking when they did not meet the outcomes for a particular topic. There was little backward mapping in order to gain a sense of what the learner could do and then use the maps to move the student on from that point.

While learning achievements of Indigenous students have been considerably below national benchmarks, with the gap increasing between Indigenous and non-Indigenous students the longer they remain in school (MCEETYA, 2006). As such, as the students move to the upper years of primary schooling, their mathematical knowledge is increasingly behind their peers. It becomes increasingly important for the later years of schooling (primary and secondary) to identify current understandings and then to offer curriculum that will move the students' thinking forward. A reflexivity between teaching, assessment and learning is more potent in this context due to the diversity of learners and learning among the students.

CONCLUSION: THE IMPORTANCE OF TEACHER KNOWLEDGE

Teacher knowledge of students, curriculum, pedagogy and assessment, along with the cultural context within which they are work are key determinants of student success. Indeed, numerous studies now identify the teacher as the key variable in student learning and success (Hill, 1994). In contexts defined by systems as "difficult to staff" due to their remote location and/or the demands of the community itself, these schools rely heavily on early career teachers. While very enthusiastic about their new careers, fresh graduates most often struggle in their first year or two of teaching. Coming into these contexts often compounds the fragility of the first year experience. Serious scaffolding of early career teachers is essential but difficult to achieve. Building the strong pedagogic content knowledge, mathematical content knowledge and the cultural knowledge necessary for success in these communities becomes an imperative.

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