Responding to the Mathematics Curriculum with Language and Culture

Cris Edmonds-Wathen
University of Melbourne, Australia
c.edmonds@unimelb.edu.au

Abstract

Indigenous language speaking students in Australia’s Northern Territory are often taught mathematics in English. Australia’s mathematics curriculum is supported by a resource which provides language and cultural considerations and teaching strategies, a few specific for Indigenous students. A critically oriented textual analysis shows that a discourse of developmental imperatives and incompletely articulated expectations leads to a focus on teaching English language and concepts, rather than on how students’ prior knowledge might be used as a resource in a culturally responsive approach. Recommendations are given to improve the resource for Indigenous language speaking students and develop more culturally responsive mathematics teaching.

Introduction

This paper provides a textual analysis of a mathematics resource for teachers of students whose first language is not English. The analysis focuses on the needs of Australian Indigenous students who speak Australian languages as their first languages. The Indigenous peoples of Australia are diverse in their cultures, languages and contexts. Those areas where Indigenous peoples are more likely to still be speaking Australian languages as their first languages are generally remote, in the sense of having small populations physically distant from Australia’s large cities and a range of services such as full educational and medical services (Australian Bureau of Statistics, 2014). For the people who live permanently in these areas with ancestral connections to their land, their communities are home and remoteness as a concept applies instead to the “far away places” of Australia’s southern cities (Singer, Garidjalalug, Hewett, Mirwuma, & Ambidjambidj, 2015). As well as language, Indigenous people in these communities also often maintain other traditional practices such as land management, hunting, and ceremonies. However, Australian mainstream culture is present in
the provision of government services such as schools, medical clinics and other infrastructure such as telecommunications.

There is both a real and a perceived need to improve Indigenous education in Australia in general and in mathematics education specifically. While many Australian Indigenous students speak English as a first language, this paper is specifically directed to the educational needs of young Indigenous language speaking (ILS) students who live in the remote communities of the Northern Territory. Many of these students are taught in English by teachers who don’t have training in teaching English as an Additional Language or Dialect (EAL/D) (Silburn, Nutton, McKenzie, & Landrigan, 2011). Government policy places the responsibility for appropriate teaching of EAL/D onto school rather than requiring prior qualification for teachers (Northern Territory Department of Education, 2015a), and, due to a shortage of suitably trained teachers, inexperienced and underqualified teachers often continue to be employed, and must learn on the job. This means that ILS students, who have everyday language and life experiences different to those assumed in the national curriculum for mathematics, do not have their mathematics lessons building on the language and concepts which they use at home. While this situation continues, these teachers require additional support to teach their ILS students more effectively.

Throughout Australia, the *Australian Curriculum Mathematics* (Australian Curriculum Assessment and Reporting Authority, 2015a) describes the mathematical content that teachers are expected to teach at each school Year level. The Australian Curriculum Mathematics has little internal accommodation to the needs of students with EAL/D. The *English as an Additional Language or Dialect Teacher Resource: Annotated Content Descriptions Mathematics Foundation to Year 10* (EAL/D Mathematics Resource, Australian Curriculum Assessment and Reporting Authority, 2014a) was designed to assist teachers with adapting their teaching of the Australian Curriculum Mathematics. The *EAL/D Mathematics*
Resource addresses a gap in support material for teaching mathematics to EAL/D students, immigrant students as well as ILS students, providing language and cultural considerations and suggested teaching strategies for many of the mathematics content descriptions from the curriculum, not many of them specific for ILS students.

Close analysis of the EAL/D Mathematics Resource shows several serious flaws and much scope for improvement. Substantial prior research into mathematics education for Indigenous students seems to have been lost or forgotten (Meaney, 2011). Possible reasons for this educational amnesia can be partially understood by identifying key elements of educational policy discourses, which can then be used as a frame to guide critical analysis of the resource. Nevertheless, the EAL/D Mathematics Resource provides a start from which to recommend improvements. It is hoped that this paper helps with the reimagining of a more culturally responsive mathematics education for Australia’s Indigenous language speaking students.

Language, Colonization and Indigenous Mathematics Education

The imposition of English (or another colonial language) and the banning of Indigenous language are typical colonial practices (McKinley, 2013; Smith, 1999). As recently as 2009, the Northern Territory instituted the Compulsory teaching in English for the first four hours of each school day policy (Northern Territory Government, 2009), which practically banned bilingual education. While this policy has since been retracted, the acquisition and use of English in education continues to be positioned as being of primary importance (Northern Territory Department of Education, 2015a). The use of Indigenous languages and the knowledge they contain plays a fundamental role in the development of mathematics education for Indigenous peoples that permits them to operate within a global community and global economy, while minimizing the effects of colonization (Munroe, Lunney-Borden, Murray-Orr, Toney, & Meader, 2013).
Purpose and Terminology

The goals of this paper are to investigate how public policy discourse characterizes the mathematical learning needs of Indigenous language speaking (ILS) students from a deficit and colonial perspective; to investigate the strengths and weaknesses of the EAL/D Mathematics Resource in terms of how it offers opportunities for culturally responsive mathematics education; and to suggest how the EAL/D Mathematics Resource could be improved, based on what is known from previous research about Indigenous languages and culture.

In Australia, the term Indigenous includes both Aboriginal and Torres Strait Islander peoples. This paper favours the term Indigenous as inclusive. The languages of Indigenous Australians are known to linguists as Australian languages, but in education they are generally referred to as Indigenous languages; these terms are used interchangeably, and include Australian creole languages of recent origin. The term non-Indigenous is used along with the term mainstream to refer to the dominant Australian culture of Anglo, Western origin although it is acknowledged that many non-Indigenous people in Australia are of non-Anglo and/or non-Western origin.

English as an additional language or dialect (EAL/D) refers to the language status of students whose home language is a language or dialect other than English. EAL/D is regarded as a more inclusive term than English as a Second Language (ESL), but ESL is still used in some literature and the meaning of the acronym is more widely understood throughout Australia.

Critically Oriented Discourse Analysis

This paper engages in a critically oriented discourse analysis based on examination of strategy and policy documents that focus on Indigenous education in Australia. According to Gee (2004), a discourse is a distinctive way in which a group of people communicate and act,
and through which societal power relations operate: “Discourses recruit specific social languages (ways with words) and cultural models (taken-for-granted stories), which in turn encourage them to construct certain types of situated meanings” (Gee, 2004, p. 41). The discourse analysis identifies colonialist practices that continue to operate in the educational discourse, by identifying certain situated meanings that recur in these public documents. Public policy socializes us into what is thinkable and what is unthinkable (Woodside-Jiron, 2004). Identifying the situated meanings in education policy documents provides a frame for a textual analysis of the EAL/D Mathematics Resource.

The main documents that are referred to are Australian national documents: the National Indigenous Reform Agreement (Closing the Gap) (Council of Australian Governments, 2009), the National Aboriginal and Torres Strait Islander Education Strategy 2015 (Education Council, 2015), and documents relating to the Australian Early Development Census (Commonwealth of Australia, 2014–2015); as well as the current relevant Northern Territory strategy document A share in the future: Indigenous Education Strategy 2015–2024 (Northern Territory Department of Education, 2015a).

Public Policy: Closing the Gap

The key current government response to Indigenous disadvantage in Australia is Closing the Gap (Council of Australian Governments, 2009). One of the key Closing the Gap goals in education is to reduce the gap between the results of Indigenous and non-Indigenous students in reading, writing and numeracy, as measured in standardized tests such as Australia’s National Assessment Program – Literacy and Numeracy (NAPLAN), in Years 3, 5, 7 and 9. Smith (1999) points out that normative tests can be another tool of colonization. These standardized tests have been criticized regarding their suitability for students with EAL/D (Wigglesworth, Simpson, & Loakes, 2011), which is of particular relevance to the Northern Territory, which has by far the largest proportion of Indigenous language speakers.
in Australia. Around 40% of school children in the Northern Territory are Indigenous, and the proportion of these who speak Indigenous languages as their first language seems to be between 60–70% (Li, Silburn, Li, McKenzie, & Lynch, 2016). Although some ILS students attend bilingual schools, more attend schools where the language of instruction is English.

**Culturally Responsive Mathematics Education**

Sleeter (2012) points out several ways that culturally responsive pedagogy is often simplified, two of which are *cultural celebration*, which “tends to relegate attention to culture to the margins of instruction” (p. 568), and *essentializing culture*, which “means assuming a fairly fixed and homogeneous conception of the culture of an ethnic or racial group” (p. 570). In these documents, culture is valued as an important factor in identity and well-being, but receives little consideration as a body of knowledge valuable for schooling. These two approaches can be seen in the policy documents, which speak of culture as something that should be *recognized, acknowledged, respected and/or valued* (Council of Australian Governments, 2009; Education Council, 2015; Northern Territory Department of Education, 2015a). By not also considering Indigenous culture as relevant and active, it is positioned as other, distant, and delicate. Limiting the scope of the term culture to Indigenous peoples is also a colonialist practice:

The systematic exclusion of local knowledge has been a hallmark of colonialism. …

Culturally based curriculum is, in fact, a misnomer, since all curricula are culturally based. The key question is: Whose culture is it based on? … curriculum is typically based on the norms, values, and wisdom of the mainstream society. (Lipka, Yanez, Andrew-Ihrke, & Adam, 2009, pp. 265-266)

The desires of Indigenous Australians in remote communities for education that will “help young people maintain their connection to language, land and culture” (Guenther, Disbrey, & Osborne, 2015, p. 199) is not taken into account in these policy documents. When Indigenous
culture is only celebrated and essentialized, education remains a tool of assimilation into mainstream culture.

**Rights: individual and Collective**

The rights of Indigenous peoples to their languages is a collective right that gets positioned against the democratic right of individual citizens to the language of social and economic power, with the individual rights taking precedence (McKinley, 2013). The Northern Territory ESL Policy (Northern Territory Department of Education, 2015b) states “The department supports the right to equity of access to the curriculum within a learning environment respectful of language, culture and differentiated learning needs” (p. 1). Access to the curriculum is positioned as a right accessed through the acquisition of English. A perceived conflict between learning English and using and learning in Indigenous languages is exacerbated by Australia’s monolingual mindset (Clyne, 2008), rather than a perspective that both possibilities can be complementary and advantageous. This rhetorical positioning of learning (in) English as an individual civic right creates difficulties in proposing alternative approaches because of the risk of those approaches being interpreted as denying the rights of individuals.

**Evidence-Based Pedagogy**

The discourse of *evidence-based* pedagogies is powerful in Indigenous education policy. Educational programs should be “informed by knowledge, evidence and research” (Education Council, 2015, p. 3), and schools should deliver “clear and effective programs that are proven to make a difference for Indigenous students” (Northern Territory Department of Education, 2015a, p. 3). However, there are currently few pedagogies for Indigenous students that have been proven using large samples and controls (Lloyd, Lewthwaite, Osborne, & Boon, 2015). Previous research is ignored on several fronts. Meaney (2011) pointed out that recent mathematics education research in remote Aboriginal communities
does not seem to be drawing on earlier research, claiming that “Neglect of what is known about different Aboriginal languages and mathematical concepts has resulted in a concentration on perceived deficits in Aboriginal languages” (Abstract). The Closing the Gap objective of parity in the national standardized tests by Year 3 is contradicted by all available evidence regarding language acquisition and time to achieve academic proficiency in an additional language. This is expertly stated by a teacher in a Canadian study: The legislators say these standardized tests are research-based. Yet we all know that acquiring thinking in a second language takes 5–9 years. Whose research are they looking at when testing children after a year…? There is nothing that is evidence-based about this. (Bernhard, Diaz, & Allgood, 2005, p. 269)

The evidence-based discourse implies that there are proven methodologies, while setting educational goals that run counter to available evidence.

**Expectations**

A recurrent theme in both research and policy is that teachers and educational institutions should have high expectations of the learning capabilities of their students (Dreise et al., 2016; Council of Australian Governments, 2009; Education Council, 2015). This appears to be an anti-racist statement, positioning Indigenous students as capable learners. However, this includes the expectation that ILS students learn according to the same Year level based curriculum in English as students who have English as their first language. Learning an additional language to a level of academic proficiency takes between four and six years (Silburn et al., 2011). This learning is an additional expectation of ILS students who are positioned with unacknowledged higher expectations of them than of first language English speakers (Edmonds-Wathen, 2015). This high expectations discourse shifts responsibility onto individuals, both students and teachers, rather than curriculum and system.
Individual responsibility is also present in expectations of teachers. Hattie’s (2008) claim that teacher quality is the most significant factor in student achievement has widespread traction (e.g. Wilson, 2014). However, the relevance of Hattie’s research for teachers of ILS students is questionable: Hattie focused only on school-based variables, whereas out of school variables including culture are more important in student learning (Lloyd et al., 2015). Hattie’s (2008) meta-analysis specifically did not include contexts with English as a Second Language. By focusing attention on teacher quality and student capability, the high expectations discourse distracts attention from structural inequities placed on ILS students.

**Developmental Vulnerability**

School curricula that are organized by age-based expectations of students embody a “developmental imperative” (Flint & Peim, 2012, p. 85). According to the Australian Early Development Census, a national data collection of early childhood development in five domains when children start school, children are considered *developmentally vulnerable* if they score below a certain measure in any domain (Commonwealth of Australia, 2014–2015). In 2009, almost two thirds of Northern Territory Indigenous students were assessed as developmentally vulnerable in one or more domains, with ESL status being the strongest factor to correlate with increased vulnerability (Guthridge et al., 2016). The Australian Early Development Census “remains a measure of skills demonstrated in English within an English-speaking setting” (Goldfeld et al., 2011, p. 15) and hence for children who are not fluent in English it is “unlikely to provide a complete, holistic measure of these children’s development and home language skills” (p. 24). In this discourse, not only is the learning of English an individual right that supersedes the right of the collective to their own language, but learning an Indigenous language as a first language positions a child as developmentally vulnerable rather than as a learner with a rich linguistic and cultural foundation.
In these policy documents, Indigenous culture is *celebrated* or *essentialized*, but rarely recognized as relating to the goals of education. Learning an Indigenous language as a first language positions students as *developmentally vulnerable*. Responsibility for learning is placed on students through *high expectations*, while *evidence* is spoken of but ignored. These discourses inhibit realistically educational policy that might take account of the learning that ILS students bring to school and the expectation that they eventually become academically fluent in English. For example, if the *Closing the Gap* goal was parity of achievement in Year 9 national standardized tests, rather than Year 3, schools and students would have nine or ten years to work towards that goal, without students being meanwhile positioned as unsuccessful and their teachers being positioned as not competent.

**Method**

**Questions to Guide the Analysis**

The textual analysis of the *EAL/D Mathematics Resource* was guided by asking whether the language/cultural considerations and strategies, including those specifically for Indigenous students, are

- Factual and based on previous research, and appropriate to the anticipated language capabilities of ILS students?
- Expectationally fair or not, for example, do the teaching strategies require more teaching than if the students were not EAL/D?
- Culturally responsive, meaningfully utilizing affordances of Indigenous language and culture?
- Timely, sequential and relevant in relation to the mathematics curriculum content?

These questions were developed by thinking critically about the purported aims of the resource with respect to the goals of culturally responsive mathematics education in the context of the political discourse in Indigenous mathematics education.
The Curriculum Documents

The *Australian Curriculum Mathematics* is organized by school Year Level, from Foundation (Pre-Year 1) through to Year 10. This paper focuses primarily on the first three years (Foundation to Year 2). There are three content strands: Number and Algebra, Measurement and Geometry, and Statistics and Probability, which run across all Year levels. Within these strands there are threads, such as Number and Place Value within Number and Algebra, Shape within Measurement and Geometry, and Chance within Statistics and Probability. Within the threads there are one or more *content descriptions*, which I shall refer to as *descriptions*. These are phrased as imperative statements of what the students should be able to do, and have a unique identifying code, for example, *Compare and order the duration of events using the everyday language of time (ACMMG007)* is a Measurement and Geometry content description at Foundation level.

The *EAL/D Mathematics Resource* is presented as a table for each Year level from the *Australian Curriculum Mathematics* with three columns: (a) content descriptions (b) *language/cultural considerations*, which I shall call *considerations*, and (c) teaching *strategies*, which I shall call *strategies*. The content descriptions come directly from the *Australian Curriculum Mathematics*. This document has no references to the research on which it was based.

The English language capabilities of ILS students are assessed using the *EAL/D Learning Progression* (Australian Curriculum Assessment and Reporting Authority, 2015b), which has four learning phases (Beginning, Emerging, Developing and Consolidating).

Analysis of the EAL/D Mathematics Resource

Overall Structure and Content

The *EAL/D Mathematics Resource* is presented as a completed table with no empty cells. There is much repetition in the language/cultural considerations and the suggested
teaching strategies, and few unique considerations overall. For example, the considerations for Foundation to Year 2 can be summarized quite briefly, and are mostly considerations of features of English that EAL/D students are likely not to know:

- Students need to learn vocabulary;
- Some words have multiple meanings, some of which may be special to mathematics, and may be abstract or metaphorical;
- A morphemic breakdown of words can help students to understand word meaning (e.g. triangle), and some morphemes change a word’s class; and
- Students need to learn comparative language, modals, question forms, and prepositions and other “small words”.

Regarding the knowledge that EAL/D students bring to school:

- Children from different cultures may have different everyday experiences and routines,
- Time is different in different cultures, and
- Systems (patterns) of time and of number words vary in different languages.

Most of the teaching strategies that accompany these considerations involve teaching English. The teaching strategies are phrased in the imperative, and the most common imperative verb is *teach*. Teachers are told to teach: the meanings of words in different contexts; comparative forms; source words of abbreviations; the language structures of telling the time; the morphemes within mathematical terms; vocabulary; the patterns of number words; sounds of English; sentence structures; English question forms; the ellipsis in word problems; and common prefixes and suffixes and their meanings. In most cases there is little concrete advice of how such teaching should be done.

Many of the remaining strategies suggest providing sentence models, either verbally or written, or providing physical supports such as words banks, picture dictionaries, wall charts, and objects that reflect the students’ experience. Some strategies focus on paying
attention to students’ language and understanding, and occasionally specific language features, such as “Pay attention to the ways that small words such as prepositions are used in describing position and movement” (p. 2).

There are relatively few strategies that focus on non-verbal ways to teach mathematics, such as “use pictures, role play and gesture” (p. 2). There are various mentions of visual support, some of which refer to using pictures or symbols. Some of these strategies accompany those considerations that discuss the prior knowledge of students who are in the Beginning or Emerging phases of English language learning.

The sequence of considerations and strategies does not always seem to be clearly planned, with some very similar considerations and strategies provided for content descriptions on similar topics across various Year levels. For example, the statement “the telling of time is constructed differently in different languages, and often reflects concepts of time in different cultures” occurs in Years 1, 2, 3 and 8, but not the other Years.

Sometimes a consideration should have appeared at an earlier Year level. For example, the Year 2 Number and Algebra description Investigate number sequences ... (ACMNA026), has the consideration “Every language produces its own sounds …” with the strategy “paying particular attention to … For example, the difference between the final sounds of fif-ty and fif-teen” (p. 8). This would be relevant for the Year 1 Number and Algebra content descriptions that focus on learning numbers to 100 (ACMNA012, ACNMA013, ACMNA014), but those descriptions are not included in the EAL/D Mathematics Resource.

**Valuing Linguistic and Cultural Knowledge**

Few strategies explicitly suggest making use of the linguistic and cultural knowledge that students bring to school. There are several positive but unspecific statements about the cultural resources that EAL/D students bring to school, such as
All EAL/D students have rich cultural resources that give them alternative perspectives on issues and phenomena, as well as experiences and knowledge. (p. 5)

This consideration is for a Year 1 Number and Algebra description Recognise, describe and order Australian coins according to their value (ACMNA017); very similar considerations are provided for money related descriptions in Years 2, 3, and 4. The accompanying strategies refer to immigrant children from other countries who may have experience of different currencies. These considerations that discuss the cultural resources of “all EAL/D students” don’t seem to be relevant to Australian ILS students, whose experiences of money will be Australian money. A similar generically positive consideration is provided for a Year 2 Measurement and Geometry description regarding using calendars (ACMMG041), and for a Year 2 Number and Algebra description regarding grouping and partitioning collections up to 1000 (ACMNA028), but again the strategies are focused on immigrant students and don’t seem to be strongly relevant to Australian ILS students.

Aboriginal and Torres Strait Islander Representation

There are five mentions of Aboriginal and Torres Strait Islander languages or cultures in the EAL/D Mathematics Resource, which occur in the considerations from Foundation to Year 2. The two mentions of Aboriginal and Torres Strait Islander cultures involve time, and the three mentions of Aboriginal and Torres Strait Islander languages involve the three topics of comparatives, questions and modality.

Telling Time

The Year 1 description Tell time to the half hour (ACMMG020) has the following consideration:

The telling of time is constructed differently in different languages, and often reflects concepts of time in different cultures. … Time in many Aboriginal and Torres Strait Islander cultures is ‘measured’ in terms of quality of event rather than duration. (p. 4)
It is possible to measure the quality of events rather than their duration, but saying that this is how time is ‘measured’, the quotation marks implying that this is not really measurement, essentializes Indigenous culture, positioning Indigenous approaches to time as so foreign to school mathematics that it is hard to see how a teacher might make use of that consideration. Possibly the consideration stems from Harris’s (1991) analysis of some of the differences and similarities between Australian Indigenous and non-Indigenous concepts. For example, she discussed how the English word fortnight is “focusing on a quantity of time” (p. 70), whereas Warlpiri terms for weeks in which pay is received or not received show a focus on “the quality of the moment” (p. 70). However, there is no context in the EAL/D Mathematics Resource’s one sentence consideration. The related strategy states that teachers should:

Teach the language structures of telling the time, being aware of possible linguistic differences, to better understand if problems with time-telling are linguistic or conceptual. (p. 4)

There are suggestions on how to deal with conceptual differences or conceptual development. Harris (1991) points out that there is a difference between developing concepts of time and learning to tell the time, proposing delaying the teaching of telling the time to Indigenous students whose families who do not use clock time at home, instead focusing on developing concepts of clock time informally. Teachers should “constantly draw the children’s attention to the clock in the classroom, give them plenty of time-related activities, and ensure they gain a concept of the duration of a second, a minute and an hour” (p. 78). Harris’s (1991) approach is counter to the discourses of developmental vulnerability and high expectations, within which proposing any type of delay in the teaching of content might be interpreted as having low expectations and putting children at risk.

Concrete examples of different conceptualizations of time might be of more assistance to teachers than essentializing statements. More recent experimental research has
demonstrated that mental representations of time depend on how languages talk about time. For example, Kuuk Thaayorre speakers conceptualize time as flowing from east to west (Boroditsky & Gaby, 2010).

One consideration and strategy explicitly values Aboriginal and Torres Strait Islander cultural knowledge. A Year 2 content description which states *Name and order months and seasons* (ACMMG040) has the following consideration and strategy:

**Consideration:** Seasons are understood differently according to geographical locations, including the wet and dry seasons in the tropics, to the more complex seasonal descriptors used by some Aboriginal and Torres Strait Islander people.

**Strategy:** Relate work on seasons to the teaching and learning environment, using descriptors relevant to the geographical location. Use bilingual assistants, where available, or parents as useful sources of information about the local environment. (p. 7)

The strategy would be particularly useful for non-Indigenous teachers who come from the southern parts of Australia to teach in the tropical north.

**Comparison**

Comparison occurs in all the strands of the *Australian Curriculum Mathematics*, with one mention of Aboriginal and Torres Strait Islander languages. For the Year 2 Measurement and Geometry content description, *Compare masses of objects using balance scales* (ACMMG038), the consideration states: “Many Aboriginal and Torres Strait Islander languages don’t have words of comparison (for example ‘big mobs’, ‘big big mobs’)” (p. 7).

There are three main types of comparative structures in the world’s languages: standard, implicit (or conjoined), and exceed (Beck et al., 2009), and all three are found in Australian languages. The standard form is formed with a single clause and the standard is marked, often by a locative case marker, or with a special marker such as English ‘than’, as in...
“You are taller than her” (Beck et al., 2009). An Australian language that uses a standard construction is Wambaya, as in example (1).

(1) bulyingi nyamirniji ngarra
     little.I(NOM) you.NOM I.OBL

‘You’re littler than me.’ (Nordlinger, 1998, p. 176)

In this example, bulyingi ‘little’ is in the nominative case, but the standard ngarra ‘me’ marks the comparison by being in the oblique case – a literal translation might be “You are little to me”.

The implicit or conjoined comparative juxtaposes a positive statement about the standard with a negation, reversal, or intensification (Beck et al., 2009). An Australian language that uses an implicit comparative is Warlpiri, as in example (2).

(2) Watakiyi nyampu-ju yukanti, nyampu-ju wirijarlu
     bush.orange this-TOPIC small this-TOPIC big

‘This bush orange is bigger than that one.’ (Bowler, 2016, p. 13)

This example literally means “This bush orange is small, this one is big”. Although the bigness of the smaller bush orange is implicitly negated, this type of construction can still be used to make “crisp judgements” – the bush oranges in this case were almost the same size (Bowler, 2016).

In the exceed form the comparison is formed with a verb meaning ‘exceed’ or ‘surpass’ (Beck et al., 2009). Wilkinson and Bradbury (2013) describe a child’s use of a verb in Djambarrpuynu meaning “to overtake, pass” to express “bigger than” with numbers.

However, not all Australian languages can make comparisons with degrees, that is, they may not be able to state how much bigger one bush orange is than another, or even how big (Bowler, 2016). Rather than simply describing Indigenous languages as deficient in
comparatives, linguistic research on different types of comparatives could be used to inform mathematics education.

Questions

The Foundation level has a Statistics and Probability description that says Answer

‘yes/no’ questions to collect information (ACMSP011) which states:

English questions are formed in many ways and can be challenging for many EAL/D students. For example, questions can be formed by changing word order – ‘Are you six years old?’, or by using question words – ‘How old are you?’ ‘Do you have a brother?’ Many Aboriginal and Torres Strait Islander cultures use questioning in social context only, and not for learning. (p. 3)

This statement reflects a widespread misapprehension in educational research that Aboriginal and Torres Strait Islanders do not use display questions, where the person asking already knows the answer (Moses & Yallop, 2008). However, Moses (2009) points out that “none of the research makes use of corpus-based or quantitative language data on pre-school age Indigenous children’s language use” (p. 10). In fact, display questions are frequently used by caregivers of Kriol-speaking pre-school age Indigenous children (Moses, 2009) and by Murrinhpatha speaking caregivers (Kelly, Mansfield, & Forshaw, in prep.). It is likely that ILS children are reticent to answer display questions in the classroom because they do not understand the question, feel ‘shame’ (shy or embarrassed), or have conductive hearing loss, rather than not having experience of display questions (Moses & Yallop, 2008; Moses, 2009).

Although the consideration acknowledges that “English questions are formed in many ways and can be challenging for many EAL/D students”, the suggested teaching strategy focuses on instructing the teacher to “explicitly teach English question forms by providing models of the structure of questions required for the chosen activity” (p. 3). According to the EAL/D Learning Progression (Australian Curriculum Assessment and Reporting Authority,
learners don’t develop understanding of different question types based on word order rather than intonation until the Developing stage. The advice to “explicitly teach English question forms” at Foundation level does not acknowledge that ILS students need more years of English learning before they can respond appropriately to a range of question forms. Useful advice might also include making sure that the chosen activity does not require multiple or difficult question forms.

**Modality**

One consideration of a Year 1 Statistics and Probability content description mentions Aboriginal and Torres Strait Islander languages. The content description says that students should *Identify outcomes of familiar events involving chance and describe them using everyday language such as ‘will happen’, ‘won’t happen’ or ‘might happen’ (ACMSP024).* The consideration says:

The modal verbs in English (for example ‘will’, ‘may’, ‘might’, ‘should’, ‘could’) modify the certainty of verbs and are a feature of hypothesising. They are a feature mastered late in the language progression of EAL/D students and are not necessarily ‘everyday’ language. Words of chance do not necessarily exist in many traditional Aboriginal and Torres Strait Islander languages, and so these concepts may need to be explicitly taught, as well as the vocabulary. (p. 5)

Rather than English’s modal verbs, modality in many other languages is expressed through verbal affixes, which do not exist as independent words. While there is no separate word for ‘might’, possibility is expressed as part of the verb’s morphology. In Murrinhpatha, for example, there are verb forms to express, amongst other modalities, ‘must’, ‘should’, ‘shouldn’t’, and ‘wouldn’t’, as well as a distinction between a not undesirable possibility ‘might’ and an undesirable possibility ‘lest’ (Nordlinger & Caudal, 2012). An undesirable possibility is given in example (3), which is a single word in Murrinhpatha.
The range and scope of expressible modalities may be different in Australian languages from those in English, but rather than simply describing Indigenous languages as deficient in modality, linguistic research on different types of modality could be used to inform mathematics education.

**Alignment of Language Requirements with EAL/D Learning Progression**

Language requirements in the curriculum and the strategies do not always align with the EAL/D learning progression. There are scattered references throughout the *EAL/D Mathematics Resource* to the fact that students in the Beginning or Emerging phases of English language learning may not have prior experiences or the breadth of vocabulary that are assumed in the curriculum. In the later Years, it is mentioned that students’ cognitive development and life experiences may be more extensive than their English language proficiency. There are also a few references to mathematical content descriptions requiring language features which are “mastered late in the language progression of EAL/D students” (p. 5), in relation to modals in Years 1, 5 and 6; and in relation to connections and conjunctions in Years 2, 7, and 8. Typical strategies suggested for these considerations include “Teach the sentence structures and connectors required of the task” (p. 9), and “When teaching mathematical meanings, focus on the word meanings” (p. 20). So, where the resource says many EAL/D students will not have learnt modals, connectors and conjunctions in English, the strategies say to teach them, an extra learning expectation for students.

In Year 7, there is a strategy in response to a Number and Algebra description that says teachers should “Monitor spoken instructions and explanations to ensure that the language used is commensurate with where students are on the EAL/D language learning
progression” (p. 27). This strategy is repeated in Years 8 and 9 for similar Number and Algebra content descriptions. This is a consideration that should be at the very beginning of the resource, as advice to teachers of all levels.

**Other Opportunities for Culturally Responsive Considerations**

There are numerous other opportunities where culturally responsive considerations and strategies could be improved in this resource. This section will briefly address two, Classification and Location.

**Classification**

Classification appears in multiple strands in the Australian Curriculum Mathematics, but it first appears in the Foundation Number and Algebra content description *Sort and classify familiar objects and explain the basis for these classifications. Copy, continue and create patterns with objects and drawings* (ACMNA005). The consideration and strategy state:

*Consideration*: EAL/D students in the Beginning and Emerging phases of English language learning may not have had the experiences with objects that teachers may consider ‘familiar’.

*Strategy*: Ensure that EAL/D students have an understanding of the objects they are sorting; pre-teaching vocabulary and providing a variety of objects to sort and classify that are reflective of EAL/D students’ experiences. (p. 3)

While these are valid points, there is a Year 7 Measurement and Geometry consideration which states “Different cultures have different ways of classifying objects” (p. 26). For example, Rudder (1983) described in detail the classification systems of the Yolngu people of Northeast Arnhem Land. It is important for non-Indigenous teachers to realize that culturally relevant classification systems can be drawn on in the development of early mathematical thinking. While it is important to provide objects to sort and classify that Indigenous students are familiar with, it is also essential to be aware that their classification criteria may be
different from those of a non-Indigenous teacher. The *EAL/D overview and advice* (Australian Curriculum Assessment and Reporting Authority, 2014b) gives the example “an Aboriginal student may classify plants according to edible or inedible, rather than species” (p. 22), but somehow this important point did not make it into the *EAL/D Mathematics Resource*.

**Location**

Location is part of the Measurement and Geometry strand, appearing first in the Foundation content description *Describe position and movement* (ACMMG010). The consideration focuses on the vocabulary challenges of English prepositions, which is a valid point. However, there is a missed opportunity to discuss how different Indigenous cultures have different systems of spatial reference in their languages. Systems of spatial reference in Australian languages have been of interest to and documented by both linguists and educational researchers (Boroditsky & Gaby, 2010; Edmonds-Wathen, 2014; Harris, 1991). Spatial language is important mathematically beyond the Measurement and Geometry strand, underpinning other numerical and logical processes (Edmonds-Wathen, 2014).

**Discussion and Ways Forward**

The *EAL/D Mathematics Resource* recognizes that cultural and linguistic considerations are necessary for teachers of all EAL/D students, and ILS students more specifically, within mathematics. However, a focus on language learning can be seen throughout the document, with EAL/D learners positioned as in need of English instruction far more frequently than they are positioned as having cultural and linguistic resources for their mathematics learning.

While there is some consideration of the specific learning needs of Indigenous language speaking students, it is rare, and generally positions Aboriginal and Torres Strait Islander students and their languages from a deficit perspective. Indigenous culture is essentialized and superficially celebrated, and Indigenous Australian languages are described
as lacking mathematical capabilities. There are some surprising oversights, such as no mention of Indigenous ways of locating in space. The *EAL/D Mathematics Resource* does little to facilitate the teaching of *The Australian Curriculum Mathematics* in Indigenous languages by Indigenous language speaking teachers – much more work is required to make this a practicality.

Many beneficial considerations and strategies suffer from being distributed with some degree of randomness throughout the resource. The *EAL/D Mathematics Resource* would benefit from being restructured so first general information was provided regarding mathematics and EAL/D learners, and regarding mathematics and ILS learners. This could be followed by information relevant to each strand, and then information relevant to specific threads. Little of that would be specific to each Year level, but there might also be information for specific content descriptions.

There is much scope to improve this document with considerations and strategies that are more specific and pertinent for Aboriginal and Torres Strait Islander students. Valuable previous research could be utilized for these purposes. Although much of that research does not meet the current trend in favour of quantitative evidence-based research, the use of good illustrative examples from a range of Indigenous cultures and languages could nevertheless provide teachers with appropriate stimuli to make their teaching more culturally responsive.

Contemporary linguistic research in Australian languages also has a great deal to offer to developing culturally appropriate mathematics education. There have been many advances in typological linguistics, which focuses on describing the ways that languages around the world can vary within a particular linguistic subfield. Many fields of interest in mathematics education are similar to those in typological linguistics, as was seen with the example of comparatives in different languages, as well as research into the language of time and space. Corpus based quantitative approaches also provide more accurate information about language
practices than that gained by individual observation, as was seen in the examples of questions.

However, making use of this research knowledge, and developing mathematics programs that are more culturally and linguistically responsive, requires acting against the developmental imperative. The discursive construction of ILS students as inherently at risk because of their language background is presented as a matter of individual rights, but subtly acts against students’ human rights as members of a cultural group. It is both unfair and against the research evidence to expect Indigenous language speaking students to learn English in addition to the mathematical content in the same time as students who have English as their first language, with national assessments after only three years of school.

References


