

## Use it or Lose it: Mathematics for Language Maintenance

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The aims of a study to teach mathematics in Mawng, an Australian Indigenous language, shifted from providing a foundation to enhance transferral to English to involving a language maintenance aspect. The study took place in a multilingual community. The roles of multiple Indigenous languages in a mathematics lesson are reported on. It is argued that the use of the multiple languages as resources in the mathematics class contribute to the reinforcing the political status of Mawng in the community, including as a language of formal education.

This paper explores how different uses of Australian Indigenous languages in a mathematics lesson can be seen to impact the statuses of the languages. Status is a significant factor in language maintenance (Crystal, 2000). As in many parts of the world, most Indigenous language speaking students in Australia do not generally have access to mathematics education in their first languages. In a multilingual community, introducing a local Indigenous language into the mathematics program proved more complex than simply providing access to mathematics in first language for a group of students. Although arguably a similar study could have been undertaken in a discipline area other than mathematics, the specific status of mathematics in school and Western society is taken as a key factor. This paper contends that it is the use of one language, Mawng, in mathematics lessons where not all students are speakers of that language that serves to raise the status of that language.

### Language and Learning at Warruwi Community School

Warruwi Community School is located in Warruwi on South Goulbourn Island in northwest Arnhem Land. Warruwi has a population of around 400 people, the majority being Indigenous, although the population can vary with seasonal movements. Warruwi is on the traditional land of the Mawng people and the Mawng language continues to be used throughout the community and learnt by children. Arnhem Land is one of the world's hot spots of linguistic diversity. There are many languages spoken in close proximity to each other, each language associated with country and with a clan. Some of these languages are related, as with Mawng and Iwaidja, but there are also many different language families. Most adults in Arnhem Land are multilingual, aided by an ideology of language diversity, and by practices, such as marriage across clan boundaries, that make it likely that husbands and wives will speak different languages (Evans, 2010). At Warruwi most adults speak 3-8 languages, such as Yolngu-matha, Ndjebbana, Burarra, Kunbarlang, Iwaidja, Tiwi and Anindilyakwa as well as English (Singer & Harris, 2016).

Since colonisation, quite a few languages of Arnhem Land have died, or are today spoken only by older people, with children no longer speaking them. Language shift has been to English but also to other local Indigenous languages. Mawng is still being learnt and spoken by young children; it has been surprisingly strong and has shown grammatical stability despite being spoken by a relatively small number of speakers, and spoken alongside other languages with larger speakers bases (Singer & Harris, 2016). However, some adults have begun to express concern that language shift might be occurring and that children might not be learning Mawng in the way that previous generations have.

Warruwi Community School had a bilingual English and Mawng teaching program in the 1970s but became English-only as systemic support for the bilingual school was reduced

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(Devlin, Disbray, & Devlin, 2017; Nicholls, 2005). The low point of support for Indigenous languages in the Northern Territory was a policy which mandated that all teaching in Northern Territory schools in the first four hours of each day be in English (Northern Territory Government, 2009), effectively banning bilingual education. The policy had the stated aim of improving literacy and numeracy outcomes, and was explicitly directed towards Indigenous students. This policy was an outcome of a pervasive belief that monolingualism is the norm, positioning Indigenous languages and English as in competition in schools (McConvell, 2008). Such a belief contrasts with the multilingual ideology of the Arnhem Land region, which positions people as lifelong language learners, valuing the specificity of languages with which one has a personal connection, while also valuing the acquisition of new languages in appropriate places or contexts (Evans, 2010).

More recently, the Waruwi Community School has re-introduced a Mawng language component into its literacy program, taught by one of the senior Mawng assistant teachers, and using materials developed for the former bilingual program that are stored in the Waruwi Language Centre. The recent introduction of a new Indigenous Languages and Culture curriculum meant that, at the time of the study, support for Indigenous language instruction was greater than in the past couple of decades, and it was therefore a good time to increase structured use of Mawng language in the school.

I approached Waruwi Community School directly with an introduction from Ruth Singer, a linguist who has worked with Mawng speakers at Waruwi for over 15 years. The school agreed to collaborate in a research project to introduce mathematics lessons focussing on Mawng terminology for spatial sequencing. This was a fortuitous coincidence of my interest in extending previous research on spatial language in Iwaidja, Mawng's closest linguistic relative, including implications for mathematics education (Edmonds-Wathen, 2014), and the interest in the Mawng teaching staff in being able to use sequencing words for number. Spatial language and thinking are important for spatial areas of mathematics (e.g., geometry and mapping), but also for mathematics more generally (Sinclair et al., 2016). While initial discussions focussed on providing these lessons for the Mawng speaking students, it was decided that all students in the class should participate in the lessons. Key theoretical elements of the project were the roles of language of instruction of Indigenous paraprofessionals in Indigenous mathematics education.

The Waruwi Community School was using the DISTAR program of Direct Instruction for their literacy and numeracy program. The use of this program in remote Indigenous education is contentious; while it has been promoted by some adherents, there have been many others who oppose its use (Ewing, 2011). At the time of this study, few Northern Territory schools were continuing with DISTAR, but it was still in use at Waruwi. Some of the practical benefits included consistency of delivery across the school, and the behavioural script format of the teacher-led part of the lessons, meaning that it was relatively simple for teachers and assistant teachers to take up a lesson sequence with a new group.

## Literature Review

### *Language of Instruction in Indigenous Mathematics Education*

Learning mathematics in an additional language in which the learner is not fluent is recognised to be more challenging than learning in a first language (Silburn, Nutton, McKenzie & Landrigan, 2011). Over the past 50 years, education in Indigenous languages in Australia has been fitted into a model of bilingual education, since successive governments have regarded it as essential that a substantial proportion of teaching and learning occur in English (Devlin, et al., 2017). Rather than being viewed as an intrinsic

good *per se*, the use of Indigenous language has been justified in terms of providing a cognitive and linguistic foundation to enhance transferral to English achievement (Thornton, Giles, Prescott, & Rhodes, 2011). Mathematical instruction in Australian Indigenous languages has often been motivated by the idea that children should gain a solid conceptual base in their first language, and then transfer that knowledge to being able to express and extend it in English. This potential transferal is based on the Common Underlying Proficiency or Interdependence Hypothesis (Cummins, 1991).

One educational response to language shift in remote Indigenous contexts, with English displacing or altering traditional languages, has been an emphasis on separating languages in instruction (Murray, 2017). However, a situated sociocultural perspective that focusses on the communicative resources of multilingual mathematics learners (Moschkovich, 2002), could encourage recognition that where learning mathematics is the goal, the focus should be on learning and communication capabilities of these students regardless of the language. Planas and Civil's (2013) discussion of language-as-a-resource and language-as-political captures some of the tensions that are present in mathematics classrooms with Indigenous language speaking learners. The concept of domain separation for language use and instruction appears to be linked to the conception of the learning environment as bilingual, but may have a different applicability in a highly multilingual learning environment.

While language shift and reversing language endangerment are very complicated issues, a couple of key factors are domains of use and status. The use of a language in a high-status domain, such as school, can increase the language's status and hence assist in its maintenance (Crystal, 2000). Nevertheless, care needs to be taken however to make sure that terms appropriated for mathematics are not stripped of their cultural meanings:

... every activity is embedded within the language of the culture in which it arose. This language will highlight those features of the activity which the culture values. Changing the way an activity is discussed either by using the mathematics register or by changing the language will have implications for how the activity is perceived by the students. It may also change the actual practice itself by focussing on other ideas. (Meaney, Fairhall, & Trinick, 2008, p. 63)

Using Mawng in school mathematics therefore addressed the expressed concern of some adults that some children might not be learning Mawng to the desired extent.

Developing the language to teach mathematics is not a trivial task. All languages have the capacity for development for formal mathematics instruction if this is something desired by the speakers, but it requires a great deal of time and effort (Trinick & May, 2013). Where a Western mathematical concept does not have a clear analogy in the Indigenous language, bilingual schools have sometimes decided that these concepts are better taught initially in English (Murray, 2017). A variety of mathematics curricula have been developed in Australian Indigenous languages, most notably the Yolngu Garma Maths curriculum (Watson-Verran, 1992). However, there is little documentation of the language development work entailed, with the notable exception of the Talking Namba project (Wilkinson & Bradbury, 2013), which was referred to for its description of some of the challenges, team working processes and time and care required.

### *Indigenous Paraprofessionals in Mathematics Education*

Team-teaching has been an integral part of remote schools in the Northern Territory, both bilingual and otherwise, teaming an English-speaking non-Indigenous teacher and an Indigenous language speaking teacher or assistant teacher. In bilingual schools, the general idea has often been for each to teach in their own language, and to support the other when they are teaching. In practice how this is done varies widely (Graham, 2017). Where instruction is only or predominantly in English, the role of the assistant teacher can include

a primary expectation to translate in an *ad hoc* manner for the teacher, “to make comprehensible to the students the non-Aboriginal teacher’s discourse” (Moses & Wigglesworth, 2008, p. 130), and well as the expectation to engage in behaviour management. Team-teaching that is collaborative and two-way, whether in a bilingual or otherwise, is dependent on the provision of shared time to plan together, and also to explore each other’s cultural and academic knowledge (Graham, 2017; Wilkinson & Bradbury, 2013). Where the role of the assistant teacher has largely comprised translation and behaviour management, it can be challenging for the assistant teacher to take on more teaching responsibility and leadership (Thornton, Giles, Prescott, & Rhodes, 2011). It was therefore essential in this project that sufficient planning and preparation time be taken, and that the assumption of teaching leadership by the assistant teacher be appropriately scaffolded.

### Mawng Maths at Warruwi

This paper reports on a teaching intervention that involved the design and delivery of mathematics lessons in Mawng language in the Early Primary class at Warruwi Community School. The class was a mixed level class from Transition to Year 3. However, mathematics lessons were grouped according to ability, so some students in Years 4 and 5 from the next class participated in the lessons. Children’s ages therefore ranged from five to 11 years. The study also included pre- and post-assessment of the students in the form of individual interviews conducted in both English and Mawng. This paper only reports on a small element of one multilingual mathematics lesson, chosen as a moment of significance in establishing the status of Mawng in mathematics, and other elements of the study will be reported elsewhere.

The lessons were developed collaboratively by the researcher and the class’s assistant teacher Jacobina, a Mawng woman whose other languages include Kunwinjku, Yolngu-matha and English. Jacobina is an experienced and confident assistant teacher who is accustomed to leading groups in lessons as part of her normal teaching responsibilities. She uses her multiple languages during her work to talk with the students in her class. However, she did not have previous experience of planning lessons or of formally teaching in Mawng. The class teacher, an English-speaking non-Indigenous woman from a city in the southern states, was highly supportive of the project but did not actively participate in the planning or delivery of the lessons.

As a researcher interested in mathematical languages in different languages, my focus was on assisting Jacobina to identify and embed appropriate Mawng terminology in the lessons and support her in using Mawng as medium of instruction. I explicitly decided that in this project, I would minimise my input into the choice of pedagogical practices, for example whether lessons would be teacher-led, student-led, or inquiry-driven.

Normal mathematics lessons were structured with two rotating groups, each of which would spend half the lesson with the class teacher, and half the lesson with Jacobina. This meant that implementing the Mawng mathematics lesson could be delivered to each group by Jacobina without disrupting the normal routine of the class.

In the DISTAR lessons in which the children were accustomed to participating, and which Jacobina was accustomed to delivering, questions are never open – the necessary information is always first provided to students to respond correctly to the teacher’s closed questions or prompts. Some Mawng lessons that Jacobina prepared included open questions from her in the early part of the lesson that developed the context and ensured that there was the required shared background knowledge to continue with the lesson. However, the bodies

of the lessons were carefully scripted, which was similar to the DISTAR lessons she was accustomed to deliver.

The focus language was a series of four sequencing terms, shown in Table 1, with the verbs in masculine singular present tense.

Table 1  
*Mawng sequencing words*

Mawng word	Word type	Meaning	Example
<i>Kiwraka</i>	verb	Go first, go ahead, be in front	<i>Kawuraka ta kurrampalk.</i> 'They're in front of the house.'
<i>Kinilurlku</i>	verb	Follow, stay with	<i>Kiwraka la karrilulku.</i> 'He goes ahead and we keep up with him, follow him.'
<i>Kinnyayatjayatpi</i>	verb	Next in sequence (age or importance)	<i>Kinnyayatjayatpi la yamin.</i> 'They're side to side, next to each other.'
<i>Warrwak</i>	Adverb; does not change	Behind, last person, later on	<i>Ngarri ta warrwak mira ngarrurakangung.</i> 'We were the last people that got back.'

All the words other than *warrwak* "last" were verbs that change form according to the number and gender of participants, as well as tense and mood. The degree of semantic mapping between the Mawng terms and related English terms varied, and added complexity to the lessons. For example, *kinilurlku* means "follow" but was used to mean "second," and *kinnyayatjayatpi* means "next" but was always used in the place of "third." This is the sort of situation that Meaney, Trinick, and Fairhall (2008) were referring to when they discuss how the use of language in school activities can change the meaning of a word.

### *The Lesson*

The focus in this paper is on the uses of different languages during the teaching intervention, including the choice that all students in the class would participate in the Mawng mathematics lessons. In particular, the focus is on Jacobina's uses of multiple languages during one particular lesson and how considering her languages practices can assist us to think more deeply about the role of languages in mathematics education. Jacobina was somewhat nervous in preparation for the delivery of the lessons, and wanted to be sure that she had rehearsed the correct Mawng to use. She practised the lessons with myself, with other Mawng people working on the project, and with her own children both at home and in the language centre where some of the planning took place.

Jacobina introduced the lesson by speaking in Mawng about the languages used at school, mentioning that that both English and Mawng were used in the literacy program. Similarly, she said, the students were now going to learn both English maths and Mawng maths. The first two lessons had focussed on introducing the key terms in both masculine and feminine forms, using people as the objects to be sequenced. She had modelled the sequence with students in the class, who had answered questions about the sequence, drawn appropriate figures in sequence on a worksheet, and pasted in figures on a worksheet.

The third lesson that Jacobina taught was the first to use concrete materials, which were a set each of four small rubber animals that needed to be arranged according to the Mawng sequencing words. The students were also given some small sticks and stones on which to balance the animals. The animals were a pig, a cow, a sheep and a horse. Although these animals are not native to South Goulbourn Island, they were all animals with which the children were familiar, and that have common Mawng names, as well as being resources that were already present in the school.

That day there were 23 students present, nine in the older group, and 14 in the younger group. This was a larger than usual younger group, and there were not enough materials for each student to have their own set, so some students had to share in pairs. The students did not seem accustomed to sharing materials in this way. The lessons had used people, sequencing them in terms of age and size, so there was a natural and non-negotiable sequence associated with the activities. This lesson was more challenging, as there was no natural order for the animals, but the students had to listen to Jacobina telling them in which order to place the animals. Jacobina distributed the materials to the students and then gave verbal instructions in Mawng to the whole group. The students varied in how quickly they followed the instructions, and to what extent one student in the pair took the lead, or whether they cooperated.

However, there were some students who did not seem to know what to do, who sat without moving the animals. Jacobina approached one of these, a girl, and spoke to her individually and at length in Kunwinjku. This was a girl who lived permanently at Waruwi but whose family had made the choice to teach her and speak with her in Kunwinjku, and who knows little Mawng. Jacobina explained the task in Kunwinjku, after which the girl was able to attempt it.

Next, Jacobina approached another student, a boy, and spoke to him individually in Yolngu-matha. He was new to the island, had not long been in the school, and who also spoke no Mawng. Jacobina's husband is Yolngu, and she is fluent in it as well as Mawng and Kunwinjku. After her explanation, the boy was able to attempt the task.

Unfortunately, that session was not being video-recorded, so there is no record of Jacobina's exact words with each of the students, as it would no doubt be fascinating to investigate the extent of the equivalence between her carefully planned and scripted instructions in Mawng and her spontaneous explanations in Kunwinjku and Yolngu-matha. Nevertheless, this is a critical incident for thinking about how multiple languages can be used in a mathematics lesson. The Mawng teaching staff and School Council had decided that it was desirable for all the children to participate in the Mawng mathematics lessons, recognising that this was a first language for some of the students, a language being learnt additionally by others, and for some a language of which they knew very little

Notably, Jacobina did not use English for her additional explanations, despite at least the Kunwinjku student also speaking English, and the usual dominant language of the classroom being English. While mathematics lessons in Mawng for Mawng-speaking children may be using language-as-a-resource, introducing Mawng mathematics for children of other language backgrounds such as Kunwinjku and Yolngu speakers recognises Mawng's political status as the language of the land in which the community and school are situated. Jacobina utilised Kunwinjku and Yolngu-matha as-a-resource for primary communication with these two students. Nevertheless, these students were being expected to learn Mawng for their mathematics learning, in a similar way to how all the students were also expected to learn English for their mathematics learning. In fact, Jacobina's use of Kunwinjku and Yolngu-matha as-a-resource served to privilege Mawng as the medium of instruction of the mathematics lesson. Through this movement, Mawng becomes not only the language of the Mawng people, but a language of formal mathematics education in Mawng country.

## Conclusion and Future Directions

In this teaching intervention, the Mawng language was both the language of instruction and the object of mathematical learning. In her lesson introduction to the students, Jacobina was explicit in situating English maths and Mawng maths on equal grounds. Mathematics has a specific high status as a school discipline, and using Mawng for this purpose serves to raise the status of Mawng. The project diverged from an initial aim that using Mawng would provide foundational cognitive access to the mathematics concepts under investigation, to include the aim of strengthening the Mawng of students whose Mawng learning was incomplete. This project was highly dependent on the language skills and teaching commitment of the assistant teacher who stepped into a role of co-designing lessons and teaching them independently. Jacobina used her multilingual abilities in Mawng, Kunwinjku and Yolngu-matha to reinforce Mawng as the primary language of instruction in the mathematics lesson. The decision to include students who did not yet speak Mawng in the lessons was highly significant in reinforcing Mawng's political status as the language of Waruwi Community and South Goulbourn Island. The key message is the need to think more deeply about the diverse socio-political roles of Indigenous languages in mathematics education.

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