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CONTEXTUALISING *the* TEACHING *and* LEARNING *of* MEASUREMENT *within* TORRES STRAIT ISLANDER SCHOOLS

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■ Abstract

A one-year mathematics project that focused on measurement was conducted with six Torres Strait Islander schools and communities. Its key focus was to contextualise the teaching and learning of measurement within the students' culture, communities and home languages. Six teachers and two teacher aides participated in the project. This paper reports on the findings from the teachers' and teacher aides' survey questionnaire used in the first Professional Development session to identify: a) teachers' experience of teaching in the Torres Strait Islands, b) teachers' beliefs about effective ways to teach Torres Strait Islander students, and c) contextualising measurement within Torres Strait Islander culture, communities and home languages. A wide range of differing levels of knowledge and understanding about how to contextualise measurement to support student learning were identified and analysed. For example, an Indigenous teacher claimed that mathematics and the environment are relational, that is, they are not discrete and in isolation from one another, rather they interconnect with mathematical ideas emerging from the environment of the Torres Strait communities.

■ Background

In 2008, members of the YuMi Deadly Centre at the Queensland University of Technology commenced a project that focused on ways to enhance measurement teaching and learning to Torres Strait Islander students. Preliminary discussions and consultations were held with key educationalists and community members in the Torres Strait Islands about how mathematics could be contextualised within Island community schools and, at the same time, address the Torres Strait Islander Educational Framework (see Figure 1). At the core of the discussions were questions about why students were underperforming in all strands of mathematics. Through the consultancy process, agreement was reached that a one-year project would be conducted focusing on the strand of measurement (e.g., Queensland Studies Authority, 2009). This strand was nominated to enhance the ways that teachers taught and how students learned both number and measurement when it was contextualised with Torres Strait Islander culture, community and home languages. Although addressed more extensively later in this paper, here, contextualisation refers to that which already exists, that is, Torres Strait Islander cultures, home languages (including the sky, the sea, the land and spiritual values) and "Indigenous knowledge systems" (Nakata, 2007b, p. 2). Researchers in the project worked in close consultation with the schools and community members over the course of the year to ensure that the integrity of the project remained contextualised and in line with the core elements of the Torres Strait Islander Education Framework (see Figure 1).

In collaboration with the communities, the key elements of the framework were used as a guiding focus for the writing and rewriting of major documents, namely; the teaching and learning of measurement; a scope and sequence; a measurement tasks-based resource booklet; and a diagnostic interview assessment that focused on the sub-strands of measurement. This process was not without its challenges, and the geographical location of the islands made travel, the consultation process, trialling, implementation, and evaluation very complex.

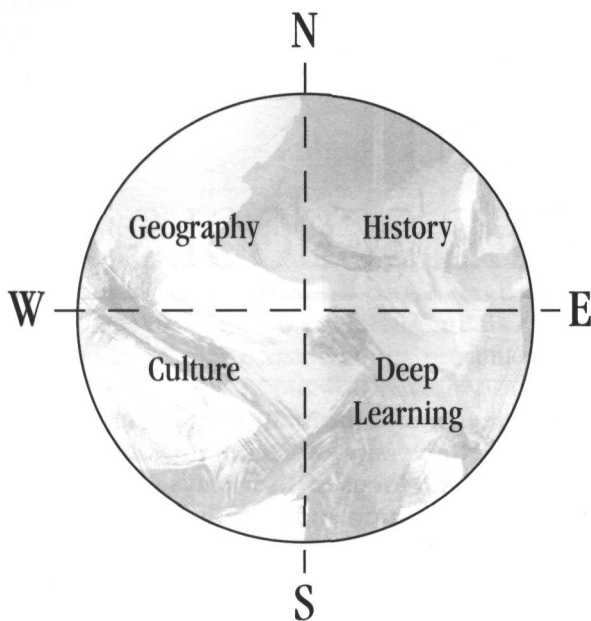


Figure 1. Torres Strait Islander Education Framework (Permission to use diagram from Torres Strait Islands Cultural Induction Program was granted by Steve Foster (2009) Associate Principal, Primary, Tagai State College, Torres Strait Islands).

■ The project milestones

The project attempted to contextualise the teaching and learning of the strand of measurement within Torres Strait Islander culture, communities and home-languages to improve the mathematical education outcomes of students. Topics and activities of measurement were designed to align with the four directions of the Torres Strait Islander Education Framework as follows: a) geography – length/perimeter, angle and area; b) history – time, money, volume, mass and temperature; c) culture – applications in language, art, marine studies and sport (the four areas identified by the Torres Strait Islander Regional Education Council; and d) deep learning – measurement processes and principles, unit conversions and relation to place value and formulae.

The topics and activities were written using five stages of progression for the teaching and learning of measurement as adopted by the Indiana Mathematics Methods Project (Kerr et al., 1970): 1) identify the attribute, 2) compare without units, 3) non-standard units, 4) standard units, and 5) formulae and applications. It placed greater emphasis on the first three stages, discussing how the introduction of units changes perceptions of reality from whole to part and from continuous to discrete.

The materials for the project were then developed using the Torres Strait Islander Education framework and the stages of measurement namely a) a new scope and sequence, b) measurement tasks that addressed

the topics of length, mass, capacity, perimeter, area, money, angle, temperature, and solid volume across the five stages, and c) an interview diagnostic assessment across the stages to identify students who were underperforming and to provide teachers with directions for further instruction. The administering of the assessment was designed to allow students to respond in their home languages. A general perception in the school community was that often it was not that the students did not know the mathematical concepts; rather, it was that they did not understand English and consequently what was being asked of them. Embarking on writing these substantial documents in close collaboration with schools and the community was a challenge intellectually, linguistically and geographically.

■ A geographic, linguistic and cultural excursion

The Torres Strait Islands consist of 18 island and two Northern Peninsula Area communities (Torres Strait Regional Authority, 2010). They are geographically situated from the tip of Cape York north to the borders of Papua New Guinea and Indonesia and scattered over an area of 48, 000 square kilometres. There are five traditional island clusters in the Torres Strait: top western, western, central, eastern and inner islands. The research project was conducted in nominated schools in all the clusters.

Specific languages are spoken in the schools including Standard Australian English, Yumplatok, Kala Lagaw Ya (KKY), Kala Lagaw Ya (Mabuyag) and, Meriam Mir (Ober, 2009, pers. comm.) The traditional languages of the top western and western islands, Kala Lagaw Ya (KKY & Mabuyag) are understood to come from the mainland of Australia, with the eastern island language, Meriam Mir, emerging from Papua New Guinea. Yumplatok, identified as a modern language and stemming from colonisation, is derived from “meshing” both traditional languages and English thus creating a language in its own right (Morrison, 2009, pers. comm.). This language is identified as unifying, that is, it is the one that everyone in the Torres Straits can speak, whereas the western traditional language speakers cannot speak and understand the eastern language speakers (Morrison, 2009, pers. comm.). The presence and use of a variety of different languages compounded the challenges presented throughout the project because the researchers could not speak these languages. Equally, these intersections of language were identified as problematic for students and teachers, particularly non-indigenous teachers (for further discussion see Shnukal, 2003). This issue has ramifications for how students come to know and learn about mathematics and see the links to their own culture and community. The classroom then becomes a terrain where complex elements of culture intersect.

It is difficult to define culture without discussions of language and Torres Strait Islander languages are

no exception. Both are embedded and intertwined to express meaning in particular Torres Strait Islander contexts. This complexity is highlighted by Erickson (2001) who rightfully points out that culture is a difficult concept to grasp and that it has many definitions. He argues that culture is habitual, with habits becoming largely invisible, thus, it shifts “in and outside our reflective awareness” (p. 32). Further, he asserts that it has many alternative definitions. For example, culture as a symbol system which considers culture a set of large chunks of knowledge that is taken as “reality” by members of social groupings (Erickson, 2001, p. 36). Culture as a social process views social structures and culture as intertwined as practice in the routines and habits of everyday life. Such practices may include the customs that social groupings become emotionally and motivationally attached to. This is culture as motive and emotion (Erickson, 2001). Customs that are learned are also ones that social groupings become emotionally attached to and which can be transmitted from community elders. Hence, culture can be explicit, implicit, learned and shared outside of conscious awareness. For the purposes of this paper, culture is understood to include Torres Strait Islander languages, knowledges, histories, experiences and the social practices that are constitutive of communities.

The assumptions: Western mainstream education as beneficial for Aboriginal and Torres Strait Islander students. The assumptions foundational to Western mainstream education advocate that it is beneficial for Aboriginal and Torres Strait Islander students; suggesting that it enables them to better participate and contribute to society beyond school (Arbon, 2008; Nakata, 2007b; Stewart, 2009). Arbon (2008) rightfully questions how such an education, written to English conventions, can provide Aboriginal and Torres Strait Islander students with the knowledge and skills to participate in daily life when it does not recognise their cultural identity and home language. She argues that until such time that students’ culture and language is respected and recognised students will continue to be marginalised by the very institutions that are purporting to support students. It can be argued that such institutions are at the cultural interface.

The cultural interface is described by Nakata (2007b, p. 199) as the intersection of two distinct cultures on a trajectory that is very complex; a space that is multi-layered and multi dimensional. A space that is constituted by the interactions of time, place, distance, different systems of thought, competing and contesting discourses within and between different knowledge traditions, and different systems of social economic and political organisation intersected (Nakata, 2007b, p. 199).

Different people with different histories, experiences, languages, agendas, aspirations and responses navigate this intersecting space (Nakata, 2007b). All the while, it is overlaid by theories and

narratives that work to produce “cohesive, consensual and co-operative social practices” and contradictions, ambiguities, conflict and contestation of meanings (Nakata, 2007b, p. 199). Here, education does not sit outside of this space. Therefore, if the focus of education is on achieving the best outcomes for Indigenous students and how they identify themselves as learners, then it must be conducive to Aboriginal and Torres Strait Islander cultural, physical and economic sustainability as defined from Indigenous knowledge positions (Arbon, 2008; Nakata, 2007b). That is, to bring about educational success, Indigenous knowledges, experiences and home languages need to be valued, respected and given currency in the same way as non Indigenous knowledge (Nakata, 2007b). Such recognition is critical if teachers are to work with Indigenous peoples in their communities to enhance the mathematics education of their children. In concert with Nakata (2007b), Taylor (2003, p. 45) argues that education needs to work in both directions, the intercultural space where two distinct cultures’ meet “through processes and interactions which retain the integrity and difference of both cultures and which may involve a blending of elements of both cultures but never the domination of one over another”.

A number of documents provide explicit ways to blend Indigenous cultural knowledge and mainstream knowledge to ensure that Indigenous students receive the best possible literacy and numeracy education: *Preparing the Ground for Partnership* (Priest, 2005), *The Indigenous Education Strategic Directions 2008-2011* (Department of Education, Training and the Arts, 2007) and the *National Goals for Indigenous Education* (Department of Education, Employment and Work Relations, 2008). Key themes from these documents are the need to provide students with the best possible start to education, and the importance of contextualising literacy and numeracy within students’ communities and cultures (see Priest, 2005 for a detailed review).

■ Contextualising mathematics within culture

Contextualising within culture situates learning in that which already exists, that is, Torres Strait Islander culture, community and home languages (including the sky, the sea, the land and spiritual values) and “Indigenous knowledge systems” (Nakata, 2007a, p. 2). Others, such as the Canadian Indigenous people (Assembly of First Nations, 2005) and Cajete (2000) are calling for learning systems that are similarly contextualised and holistic. To achieve this call, relevant regulations and curriculum need to be established where cultural values, beliefs, traditions and language are contextualised and interwoven in all learning programs (Cajete, 2000). Ezeife (2002, p. 185) argues that Indigenous people belong to “high-context culture groups”. That is:

High-context cultures are characterized by a holistic (top-down) approach to information processing in which meaning is “extracted” from the environment and the situation. Low-context cultures use a linear, sequential building block (bottom-up) approach to information processing in which meaning is constructed (Ezeife, 2002, p. 185)

Accepting Ezeife’s (2002) claim, it can be argued that students who use holistic thought processing are more likely to be disadvantaged in mainstream mathematics classrooms because mathematics is presented largely as hierarchical and is broken into parts with few clear connections made between concepts and their daily lives (Nickson, 2002). When learning is decontextualised, that is, where there is a dissonance between the curriculum and pedagogical approaches embedded in the official education and Indigenous knowledge systems, student engagement in desired learning is less likely to occur. For example:

If the instructional method favours the learning styles of students from Western cultures (as seems to be the case in contemporary formal school settings), then these students would perform quite well, while the performance of the disadvantaged students from indigenous cultures would not be as good. However, if indigenous students are given the opportunity to learn through an instructional medium that favours their learning or cognitive styles, then the likelihood is that learning would be facilitated and enhanced (Ezeife, 2002, p. 180).

What is critical is that Torres Strait Islander students are provided with effective education that recognises in explicit and implicit ways their culture, community and home languages and that they are used as sustained entry points into all areas of student learning.

An important caveat is necessary here. The term “high-context” cultures should not be interpreted as an inability of a particular culture to engage in abstractions. Here abstraction refers to some kind of lasting change, that is, the result of abstracting which enables the learner to recognise new experiences as having the similarities of an already formed experience (White & Mitchelmore, 2002).

■ Language as an abstraction

Language is considered the first that communicates concepts that have been created and developed by individuals from a particular cultural worldview (Baturu & Cooper, 2006; Payne & Rathmell, 1975; White & Mitchelmore, 2002). Concepts are particular ideas or images that an individual has of an object or process. To be concept literate then, the learner is required to

read, understand and use specific mathematics words and terms and related language in such a way that it forms part of the knowledge formation in mathematics (e.g., Young *et al.*, 2006). To develop concept literacy within students from different cultural backgrounds whose first language is not English, the focus initially must be on connecting concepts with the students’ first language (Adler, 2001; Schäfer, 2010; Young *et al.*, 2006). Through this process, students are more likely to gain access to the concepts because they identify and recognise their own culture in what they are learning. Their educational experiences show them that their teachers are interested in the language that they bring to the classroom.

Educators need to demonstrate in explicit ways the importance of recognising and respecting the languages of the students they teach (Disbray *et al.*, 2004). In doing so, students are more likely to gain access to learning and engage in ways that are conducive to educational success. Further, they need to accept that Torres Strait Islander culture is still predominately oral, with all important knowledge transmitted orally and in context (Shnukal, 2003). The reality, of course, may be substantially different, particularly when there are differences between access and who endorses a student’s entry into learning, and the way in which that entry is managed (Ewing, 2009). The process of gaining access is further confounded by curriculum material that is decontextualised and lacking in practical purpose and connection to the students’ identity and culture.

Gaining access to a learning context is contingent on the ways that students are granted opportunities to safely express their thinking in their language as they develop and apply mathematical understandings. Such a context provides a stable social audience and an environment where reasons, justification and so on are shaped (Clark & Holquist, 1984). This is a two-sided act – the language used to communicate is a reciprocal relationship between the student and teacher or other student. Thus, a point of view is given from the learning context to which the students and teacher belong. It is a bridge or territory shared by teachers and students. When they use language, they are not transmitting information, they are consciously engaging in simultaneous understanding. It is through this process of active, responsive understanding that meaning – here mathematical meaning – is realised (Volosinov, 1973). In this dialogic framing, interaction, meaning and understanding are intrinsically relational (Clark & Holquist, 1984). These experiences and the knowledge formulated from them serve as a basis for further construction and negotiation of meaning, here, mathematical meaning. They provide a purpose for a learning community, allowing students to participate in the activities of that community. All the while, students’ identities as successful learners of mathematics are shaped and developed over time.

This section has provided discussions of key aspects pertaining to the project. That is, statements about the assumptions of Western mathematics education as beneficial for Aboriginal and Torres Strait Islander students has been provided and in consequence, has elaborated what is meant by contextualisation to culture and the importance of recognising and respecting students' home languages in the classroom. It has argued that for students to gain access to learning they must have opportunities to discuss their ideas and thinking in their language as they apply their developing mathematical understandings in contexts.

■ Methodology

This project adopts two methodological approaches: participatory collaborative action research (Kemmis & McTaggart, 1988) and community research (Smith, 1999). Community research is described as an approach that "conveys a much more intimate, human and self-defined space" (Smith, 1999, p. 127). Community research relies upon and validates the community's own definitions. As the project is informed by the social at a community level, it is described as "community action research or emancipatory research" (Smith, 1999, p. 127), that is, it seeks to demonstrate benefit to the community, making positive difference in the lives of Torres Strait Islander school communities. Thus, a collaborative approach to inquiry is adopted, where participants are provided with the means to take systematic action (Smith, 1999) to improve the teaching and learning of mathematics.

Participatory collaborative action research is described as a "collective, self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own social and educational practices" (Kemmis & McTaggart, 1988, p. 5). The research team established strong working relationships with the teachers and teacher aides in six Torres Strait Islander schools. This

paper reports on data from the questionnaire survey conducted during the first Professional Development (PD) session with teachers and teacher aides at participating schools.

The data were collated and analysed using discourse analysis as described by Fairclough (1995). The task of this method is to provide an analysis of the survey questionnaires from the context of the participants' schools and in doing so, attempt to theoretically and empirically connect the responses to understandings of contextualisation to culture, community and home language. The analysis draws on the representations dimension of the three dimensions of discourse (Fairclough, 1995). This dimension focuses on the happenings and relationships in the worlds of the participants and who and/or what is involved in these happenings and/or relationships. It serves as a framework for the identification of declaratives in the participants' comments.

Declarative mood enables statements to be made that provide or give information (Halliday, 1990). It is the "order Subject before Finite that realises declarative" (Halliday, 1990, p. 115). A declarative sentence is generally instigated by the person who has the knowledge, although it can also be initiated by a person who wants the knowledge (the interviewer) (Fairclough, 1995). Such statements are the most frequently used when speaking or writing. Although there are other forms of exchange, participants' statements about their views of the process of contextualisation to culture, community and home language will be used for this analysis.

■ Participants

There were six teachers and two teacher aides from six Torres Strait Islander schools participated in the Tagai Maths for Employment Project (Ewing et al., 2009). Participants have been grouped into three categories, that is, non-Indigenous teachers (five

Table 1. Teacher and teacher aide's survey questionnaire.

Q1	Teachers' experience of teaching in the Torres Strait Islands.
	1. How long have you been teaching in Torres Strait Islands?
Q2	Teachers' beliefs about effective ways to teach Torres Strait Islander students.
	2. What do you believe mathematics to be in Torres Strait Islander culture and the wider community beyond the Torres Strait Islands?
	3. What do you believe are effective ways of teaching Torres Strait Islander students?
	4. What is the role of the teacher aide in this process?
Q3	Contextualising measurement within Torres Strait Islander culture, communities and home languages.
	5. When you are teaching mathematics do you blend Torres Strait Islander knowledge of mathematics with Westernised mathematics?
	6. Why do you believe that Torres Strait Islander students should be taught measurement?
	7. In what ways do you contextualise the teaching and learning of measurement to Torres Strait Islander culture, home languages and communities?

in total), Indigenous teachers (one in total) and Indigenous teacher aides (two in total). Pseudonyms have been used to protect the identity of participants and specific schools.

■ Data collection techniques

A 10-item survey questionnaire was designed and used in the first PD session to identify the teachers' thoughts about the teaching and learning of mathematics and how they contextualise it within the Torres Strait Islander culture, communities and home languages. This technique allows for a large amount of data to be collected in a short amount of time (Stringer, 2004). The written feedback was followed up by focus group discussions with teachers and teacher aides. Data collected using the survey questionnaire were reviewed and classified in order to identify: a) teachers' experience of teaching in Torres Strait Islands, b) teachers' beliefs about effective ways to teach Torres Strait Islander students, and c) contextualising measurement within Torres Strait Islander culture, communities and home languages (see Table 1).

■ Analysis

The participants' responses have been placed in a matrix beginning with the Torres Strait Islander educators, that is, teachers and teacher aides and then the non-Indigenous educators. Their responses to the first question (Table 2) refer to their experience of teaching in the Torres Strait Islands.

The other nine questions can be grouped into three main themes 1) Table 3: beliefs about of maths in a cross cultural context (Question 2 – 4); and 2) Table 4: contextualisation of mathematics (Questions 5 – 7). Composed largely, though not completely, in the declarative mood, the statements represent beliefs about mathematics and contextualisation as effective teaching and learning strategy.

Beginning with non-Indigenous teachers in Table 2, Carly has been teaching for 23 years and Alex has been teaching for three years in the Torres Strait Islands.

Mark has been teaching for five months and, Lania and Phillip have been teaching for 13 weeks. The longevity of Alex and particularly Carly is rare for schools in remote areas, which generally have a high turn-over rate of teachers resulting in a number of teachers being young and inexperienced (Roberts, 2004). Hence, the length of service of the other three teachers is more indicative of remote area schools. Marcie, a Torres Strait Islander, has been an educator for 19 years (at the time of the study) and the teacher aides Marline and Lorrie have been educators for 10 years and one year respectively.

Questions 2 to 4 of Table 3 were designed to explore the teachers' beliefs about mathematics and how such beliefs translate into the effective teaching of Torres Strait Islander students. Given that the project team was interested in the contextualising of mathematics with Torres Strait Islander cultures, it was also interested in how teachers perceive the role of teacher aides in the classroom, that is, the extent that their cultural knowledge is valued, the kinds of relationships that exist between teachers and teacher aides and how these relations contribute to the education of the students.

Of interest was the difference in beliefs about mathematics of the Torres Strait Islander educators and the non-Indigenous educators. Marcie, a Torres Strait Islander teacher identified maths in relationships and environment. A presupposition (Fairclough, 1995) from this statement is Marcie's belief that maths is about mathematical relationships that are linked to the students' environment, here the Torres Strait Islands. It could be argued that she views mathematics and local culture not as discrete items, but as closely linked – contextualised as described by Nakata (2007b). Interestingly, Lorrie, one of the Indigenous teacher aides, calls for the recognition of local Torres Strait Islander number systems but qualifies this statement with "however the delivery of the maths should be equivalent to Western system". This statement can be interpreted as the Western system having more to offer thereby devaluing local mathematical knowledge. However, given the responses to other question, it is

Table 2. Teachers' experience of teaching in the Torres Strait Islands.

Teachers	Names (Pseudonyms)	Question 1. How long have you been teaching in Torres Strait Islands?
Indigenous teachers	Marcie	Since 1990
Non-Indigenous teachers	Alex	3 years
	Lania	13 weeks
	Phillip	13 weeks
	Carly	23 years
	Mark	5 months
Indigenous teacher aides	Marline	10 years
	Lorrie	1 year

Table 3. Teacher and teacher aide's response to teachers' beliefs about effective ways to teach Torres Strait Islander students.

Teachers	Name (Pseudonyms)	Question 2. What do you believe mathematics to be in Torres Strait Islander culture and the wider community beyond the Torres Strait Islands?	Question 3. What do you believe are effective ways of teaching Torres Strait Islander students?	Question 4. What is the role of the teacher aide in this process?
Indigenous teachers	Marcie	Maths in relationships and environment.	I value their experiences/ background/ language.	Use as a para-professional.
Non-Indigenous teachers	Alex	Estimate, shopping, cooking.	Hands on, visual, model – joint practise, individual practise.	Translation, explanation, clarification, link to outside knowledge same as teacher.
	Lania	After only 13 weeks I am still looking at mathematics as a tool for students in the Western world. I realise I need to contextualise Mathematics for the students in my class and make it more hands on.	Hands on activities – less talking more doing- reminding students that they learn from incorrect attempt[ts]. I am still trying to find effective strategies in this context.	Lorrie will often explain concepts for students in language and Creole to aid in their understanding.
	Phillip	We use maths everyday; it is a true universal language. Maths is a vital skill in life.	Hands-on activities within context; students love to have that sense of discovering something for themselves.	Assist with language, work with individuals or groups.
Indigenous teacher aides	Carly	In some ways, not as complicated e.g., number little bit – plenty and yet navigation would be quite complex. Practised more on islands than mainland – needs based.	Small groups, within a context as real life as possible. Move out of classroom, model and practice, hands on, less talk.	Provide translations for non indigenous teachers, small group instructions.
	Mark	Non-standard units.	Lots of concrete materials, lots of repetition of language, visual representations.	To support the children's understanding.
	Marline	More at school but probably estimating outside of school.	Creole over English for large amounts of verbal instruction.	Clarify and explain to children in Creole.
	Lorrie	Torres Strait Islander number system should be acknowledged, however the delivery of the maths should be equivalent to Western system.	N/A	My role is to assist a teacher in explaining or interpret SAE into local dialects.

more likely a statement about providing students with the skills and (mathematical) language to deal with the Western system but at the same time demonstrating to students that mathematical knowledge exists within their community. This potentially could have a positive effect on the identity of Torres Strait Islander students as mathematical learners and a pathway for connecting with other local mathematical knowledge. Another Indigenous teacher aide, Marline, did not give a response that connected mathematics with Torres Strait Islander culture. Marline saw mathematics as done predominantly at school with the exception of some “estimating outside of school”.

A recurring theme in Table 3 shows that the non-Indigenous teachers perceive mathematics as about dealing with everyday life and, in particular, mathematics is a “vital skill of life” (Phillip) or a “tool for students in the Western world” (Lania). Such a view may be limiting in terms of how mathematics may be contextualised, that is, the context may be more to do with Western cultural knowledge perspectives than the Torres Strait Islander worldview. This outlook may be the case for Alex who perceives contextualisation to be about “estimate, shopping and cooking”, which also connects with the everyday mathematics concepts. However, Lania realises that she needs to “contextualise mathematics for the students” but interestingly connects the notion of contextualising with more hands-on activities, which may relegate contextualisation to similar notions presented by Alex.

A presupposition (Fairclough, 1995) here is that Alex sees these processes replacing the teaching of mathematics. What is crucial is that the teaching of mathematics occurs throughout these processes and does not sit in isolation to them. Begehr (2006) argues that when explicit links are made by teachers, students have opportunities to interact genuinely in and with the overall mathematics content. They are more likely to develop and learn the rich body of language associated with mathematics and use it when talking about their learning. Lania’s statements emphasise mathematics as a tool that students can use in Western culture. She also indicates the need to contextualise mathematics to the students’ culture and to provide more “hands on” learning opportunities. The word, “only”, in the phrase “after only 13 weeks” is associated with uncertainty and insecurity.

The interest is in the authenticity of Lania’s claims to knowledge, with strategies indicating what she needed to do to ensure that she contextualised mathematics within students’ culture for successful learning. Of interest is the reference to Western mathematics. It is not clear what Lania understood this term to refer to, for example, pedagogy, curriculum and so on. Her response to the second question highlights uncertainty and insecurity, particularly in the phrase “after discussion in this meeting”. Here, it could be argued that the meeting

brought to the fore aspects of her teaching that need attention to further support student learning.

Phillip’s statements serve a strategic role (Baker *et al.*, 1993) that is, to make his perspective stand out with respect to the phrase “it is a true universal language”. A presupposition here is that Phillip was stating that Western mathematics is desirable and that everyone needs to know and learn this language. Such a statement assumes the authority of “the truth” (Hall, 2001, p. 76) and has the power to “make itself true” (Hall, 2001, p. 76). That is, once mathematical knowledge is applied in social contexts such as classrooms, it has effects, and consequently “becomes true” (Hall, 2001, p. 76). Mathematical knowledge in this sense has the power to regulate the conduct of students and in doing so involves constraints, and regulations about what mathematics is considered important to teach, learn and know. Here, Phillip may experience some difficulty with the process of contextualisation because of his view of mathematics as a true universal language. This is implied through his statement that he seeks help from his assistant, however, it is not clear the extent of the assistant’s mathematics knowledge, which could work as a hindrance rather than as help.

Carly states that mathematics is not complicated. She indicates that although number is used, navigation is complex and practised more in the island region, indicated by the use of the term “needs based”. Her response to contextualisation suggests that she draws on local applications such as model boat building. The extent to which mathematics is linked to this task is not made evident in her response.

The statement “non-standard units” in Mark’s response suggests his knowledge of the importance of the stage of non-standard units of measurement. This stage is pivotal to students learning subsequent stages of this topic. Here, the invention of the unit is introduced with students shown how it has enabled a discrete entity that is, number is applied to continuous entities such as length, area and so on. Students learn that the application of unit and number to attributes brings with it a baggage of principles that are best introduced in this stage before standard units of measure. It could be argued that the students Mark teaches move between two worlds in this stage, 1) the culture and context of the Torres Strait Islands, and 2) informal understandings and language that can bridge from everyday life to abstract mathematics through problem solving.

Contextualisation was further elaborated by Indigenous teachers such as Marcie’s second response in Table 4. In that response, she identified that before she could address the process of contextualisation and teaching mathematics to her students, she needed to understand the mathematics and contextualise it to her culture. For this teacher, the process is emancipatory, that is, it affords the articulation and interchange

Table 4. Contextualising measurement within Torres Strait Islander culture, communities and home languages.

Teachers	Name (Pseudonyms)	Question 5. When you are teaching mathematics do you blend Torres Strait Islander knowledge of mathematics with Westernised mathematics?	Question 6. Why do you believe that Torres Strait Islander students should be taught measurement?	Question 7. In what ways do you contextualise the teaching and learning of measurement to Torres Strait Islander culture, home languages and communities?
Indigenous teachers	Marcie	Not really "blend". I start off with Torres Strait knowledge and lead into Western maths. During lesson might need to revisit Torres Strait knowledge.	Education is a right. Maths measurement is a part of this.	I, myself have to understand it and contextualise it myself as a teacher before I can teach it.
Non-Indigenous teachers	Alex	Discussing, giving examples (comparison): non-indigenous teacher.	To be a functional member of society so they do not get exploited, for employment.	Use Creole to give opportunities for children to access prior knowledge and understanding
	Lania	I do the best I can to contextualise concepts. I use Lorrrie's knowledge.	For everyday use- estimation (discussion).	After discussion in this meeting I feel I need to contextualise the learning of measurement a lot more – everyday use – recipes.
	Phillip	I am still learning what Torres Strait knowledge is; this is an area where the teacher's aide is also valuable.	We make decision each day based on measurement.	I have been unable to contextualise as I am still on a steep learning curve. I do ask my assistant to help with language.
	Carly	Probably not to the extent that could be due to the demands or getting through curriculum seasons, tides, distances.	Students need to be able to operate in both Western mathematics and local knowledges – be informed and able to make choices.	Use examples of the use and need for measurement e.g. model boat building, navigation, planting, building (from pig pens to beach huts etc.)
	Mark	No, I am still understanding Torres knowledge.	To be able to become effective and successful in adult life.	Using and referring to things from the island using real life experiences in problem solving.
Indigenous teacher aides	Marline	Discuss and explain as above.	Yes so they should [be] taught so one day they don't get rip[ped] [off].	Explain to them in creole so they can understand.
	Lorrrie	N/A	... is part of Australia therefore children should have the same privileges as other Australian regarding work (Trades).	N/A

between mathematics and her culture – the Torres Strait Islands.

From Marline’s statement, mathematics is seen as something taught in school only, and thus disconnected from her culture. The process of estimation however, is what is probably learned at home. The use of the term “probably” works to indicate a median probability and a degree of uncertainty to her claim about estimation outside of school. Further, the use of “probably” falls between two extremes, such as does learn/does not learn, with the meaning and interpretation of whether the students estimate or not left unclear. Marline’s statement about explaining is much the same as Alex’s. That is, translating the mathematics into Yumplatok might not be sufficient. If this is indeed the case, the value of the translation process is questionable if the mathematics content is not understood and explained to support students’ understanding. In short, simply translating may not support student learning, it must go beyond this process and include the context(s) in which mathematics is used in the classroom and beyond. Further, translating the words to the students’ home language may not be enough, particularly if the teacher or teacher aide does not have a solid grasp of the mathematics content. Here, translation may be of little value.

Of interest in both Marline’s and Alex’s responses is the reference to exploitation. These instances imply that when students who are not strong in mathematical knowledge and understandings, they may be at risk of financial exploitation. Marline’s response reinforces this point, “yes so they should [be] taught so one day they don’t get rip[ped] [off]”. Lania’s response to contextualisation highlights uncertainly and insecurity, particularly in the phrase “after discussion in this meeting”. Here, it could be argued that the completion

of the questionnaire brought to the fore aspects of her teaching that might need attention to further support student learning. Of particular interest however, is that she indicates that she does “the best” she can to contextualise concepts, but in doing so, she identifies explicitly that she draws Lorrie’s knowledge. It could be argued here that Lania is actively seeking out the knowledges of members of the community in which to school is situated so as to support the students she teaches.

Phillip’s responses indicate that he experiences some difficulty with the process of contextualisation because of his view of mathematics as a true universal language. This is implied through his statement that he seeks help from his assistant with language, however, it is not clear the extent of the assistant’s mathematics knowledge. Carly’s response to contextualisation suggests that she draws on local applications such as model boat building. However, the extent to which mathematics is linked to this task is not made evident in her response.

Lorrie’s statement reflects a particular stance, that is, Torres Strait Islander knowledges should be acknowledged and given the same currency in terms of “delivery” as Western mathematics. A presupposition here is that he is calling for both-ways education, where Western knowledge is blended with Torres Strait Islander knowledge of mathematics learning.

This analysis has attempted to address the issues surrounding teachers’ and teacher aides’ beliefs about how to teach students mathematics and how to contextualise this subject to Torres Strait Islander culture, community and home language. In doing so, it has analysed the comments from teachers and teacher aides who are associated with their beliefs about mathematics and how they contextualise.

Table 5. Four phase matrix.

Teachers’ names	Phase 1: limited understanding of the application of mathematics to Torres Strait Islander culture, community and home-language.	Phase 2: able to describe aspects of the application of mathematics to Torres Strait Islander culture, community and home-language.	Phase 3: able to describe and consider possible alternative explanations about the application of mathematics to Torres Strait Islander culture, community and home-language.	Phase 4: discussion is expanded to incorporate insights from a different perspectives i.e. from Torres Strait Islander culture, community and home-language perspectives.
Lania				
Marline				
Phillip				
Lorrie				
Alex				
Carly				
Mark				
Marcie				

Table 5 provides a four phase matrix that has emerged from the analysis to assist with developing a preliminary understanding of the participants' application of mathematics to Torres Strait Islander culture, community and home language. It could be argued that they are at varying levels of knowledge and understanding about what they perceive mathematics to be and further, how they contextualise mathematics to culture.

■ Discussion and conclusion

The focus on the experience of teachers working in the Torres Strait Islands highlights the under-representation of Indigenous teachers in schools even though they can assist with making the connections with communities and with supporting all teachers with succeeding with their teaching in such communities (HREOC, 2001; Roberts, 2004). The Human Right and Equal Opportunity Commission's (HREOC, 2001, p. 1) findings into teacher education in rural and remote Australia acknowledged that schools in such communities are difficult to staff indicating that disincentives affecting the recruitment and retention of teachers include "isolation, the cost of travel, lack of professional development, feeling out of touch with the latest teaching issues and decreased contact and networking with teachers in the same subject area". The HREOC inquiry found that Indigenous students require quality teachers in schools for reasonable periods of time, however, "it is against this backdrop of student rights that the needs of teachers should be met" (Roberts, 2004, p. 14).

The data highlight Nakata's (2007b) descriptions of the cultural interface. Here, the teachers and teacher aides bring their histories, their narratives, their contradictions and their ambiguities to provide their interpretations of mathematics at the level of the school community and the wider community. They do not sit outside this space, nor do they follow the same trajectory "in" it, because each one brings a range of histories, narratives and so on to such a space. It is where cultural boundaries are unclear and where cultural tensions are present and require negotiation (Taylor, 2003). Such negotiation may start with building respectful and trusting relationships with communities and learning about their shared knowledges of mathematics.

In taking Nakata's (2007b) work into consideration here, Taylor (2003, p. 46) argues "we are influenced by both Indigenous ways ('traditional forms and ways of knowing, or the residue of these'), as well as by non-Indigenous ('Western') ways and that *for many of us a blend of both has become our lifeworld*". Taylor (2003, p. 45) explains that such a blend, here, both-ways education, must work within an "intercultural space". That is, a meeting of two distinct cultures through interactions which retain the integrity and difference

of both cultures and which involves a blending of elements of both cultures but never the domination of one over another. What is crucial here is that the cultural knowledges, experiences and languages of Indigenous people need to be valued and respected and given the currency in the same way that non-Indigenous knowledge is (Taylor, 2003) for both-ways education to work.

This paper provided a discussion of some of the literature that pertains to the intentions of the project conducted in the Torres Strait Island schools and their communities. It also presented the Torres Strait Islander Educational Framework and recognised the importance of working with the schools and communities on ways to improve the teaching of learning of mathematics. The issues around language and contextualising to culture were identified as important, however this process was a challenge for teachers. To this end, the literature associated with these aspects was reviewed to highlight the barriers that had to be addressed from the commencement to the end of the project; all the while recognising that the teachers and students were experiencing the same barriers but from a range of histories, narratives, contradictions and ambiguities – the intersecting points at the cultural interface. The project team became one of the many elements that traversed the cultural interface in the Torres Straits Islander communities, acting in this space and drawing on their own understandings, histories and viewpoints. Nakata (2007b, p. 9) very clearly points out that Torres Strait Islander communities understand the need to be educated in the ways of the world beyond the islands. He asserts that such an education requires the use of English, and knowledge and understandings of the practices of the developing world in order to effectively "defend our own position, while incorporating and making effective use of the new". It is hoped that the work with the communities in the Torres Strait Islanders goes some way toward this aspects.

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