Mathematics funds of knowledge: *Sotmaute* and *Sermaute* fish in a Torres Strait Islander community

Bronwyn Ewing
Yumi Deadly Centre, Queensland University of Technology

The purpose of this article is to describe a project with one Torres Strait Islander Community. It provides some insights into parents' funds of knowledge that are mathematical in nature, such as sorting shells and giving fish. The idea of funds of knowledge is based on the premise that people are competent and have knowledge that has been historically and culturally accumulated into a body of knowledge and skills essential for their functioning and well-being. This knowledge is then practised throughout their lives and passed onto the next generation of children. Through adopting a community research approach, funds of knowledge that can be used to validate the community's identities as knowledgeable people, can also be used as foundations for future learning for teachers, parents and children in the early years of school. They can be the bridge that joins a community's funds of knowledge with schools validating that knowledge.

What can be learned from Torres Strait Islander parents' funds of mathematical knowledge and incorporating into the transition to formal school?

At a time when a number of strategies have been implemented to increaseTorres Strait Islander parents' participation in education with their children (see for example, Department Education, Employment and Work Relations 2011; Torres Strait Islander Regional Education Council 2011), I argue that going beyond the simple dichotomy between parents' funds of knowledge (experience, out-of-school, intuitive, tacit) and academic (in-school, linear, deliberate) is critical. For children in the early years of schooling, instruction must be underpinned with authentic engagement in productive activities, drawing on prior knowledge and complexity and the dialogical emergence of instruction. What this means for educational practice is that by inviting children into a world of motivating activities where the everyday and spontaneous comes into contact with school, the children's and their parents' engagement with both the activity and the social context are foregrounded so that questions and inquiry can occur (Gonzalez et al. 2005). That is, the classroom becomes an information exchange that draws on multiple funds of knowledge that are activated and tied with mathematics curricula (see, for example, Australian Curriculum and Reporting Authority 2009; Department of Education and Training, Queensland 2010; Department of Education, Training and the Arts, Queensland 2008).

At the heart of this project a funds of knowledge approach is adopted because it provides a powerful and rich way to learn about communities in terms of their resources, their mathematical

competence related to *sotmaute (*sorting) and *sermaute* (partitioning) through the giving of fish and the way they utilise these processes to support the education of their children. Through familial and social networks, Torres Strait Islander parents build capacity amongst one another and with their children (Makuwira 2007). Such networks validate the parents' own definitions of maths as they exist in their communities—'funds of knowledges' that are applied in daily life (Moll 1992: 133). The idea of funds of knowledge views that people are competent and have knowledge that has been grown and developed through their life experiences that have given them that knowledge.

If one accepts the premise of this article, that funds of knowledge of mathematics are those that reflect the unique histories and culture of communities and which are historically and culturally accumulated, then the question arises: How are these knowledges and the learning of them connected with and situated in communities and the voices of the people? Here, I draw on the work of Lahn (2006) who describes the practice of giving fish. Giving a *sermaute* (share) of fish is a significant practice for Torres Strait Islander women. While the choice of fishing companions can illustrate a range of relationships, for example, family and friendships, the 'distribution of fish is not as flexible' (p. 301). With the division of caught fish come the expectations to give a share to relatives as well as elderly neighbours. Distributing the fish is generally towards 'ascending members of their own family and that of their husband' (p. 304). This emphasis reciprocates

> the earlier physical and social nurturance received by the individuals in this generation (in particular, parents, aunties, mother's brothers). These individuals are viewed as having nurtured them to adulthood, an idea communicated locally through expressions like *lugaut* (look after) and *gromape* (raised). ... This ethic in fact extends to all older members of the community, who are seen as responsible in a more general sense

for creating (nurturing) the physical and social community to which the younger generations now belong. (p. 304)

Women are expected to provide their relations with fish of reasonable size and type in relation to their overall catch. Through this process, the idea is to make individual buckets 'less unequal' by comparison with others that are not necessarily equal (p. 301). The preferred way to control fish distribution after returning home is to choose the fish to distribute to specific 'households and individuals free of scrutiny or pressure' (p. 301). But the distribution of fish occurs among a number of houses that function as 'multi-house networks' (p. 303). It is through such networks that funds of knowledge are learned, shared and practised.

Where is the community, and what did I do?

The project adopted a community-based approach because it 'conveys a much more intimate, human and self-defined space' (Smith 1999: 127). It relies upon and validates the community's own definitions. I established a relationship with community members over time as a consequence of another project that was based at the primary school, but chose to embark on a preliminary process in collaboration with the community following cultural protocols, respect for the community and because this project was based within the community and not school. Where is the community?

The Torres Strait Islands consist of eighteen islands 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 (see Figure 1, Torres Strait Regional Authority Map 2011).

Figure 1:   Torres Strait Regional Authority Map
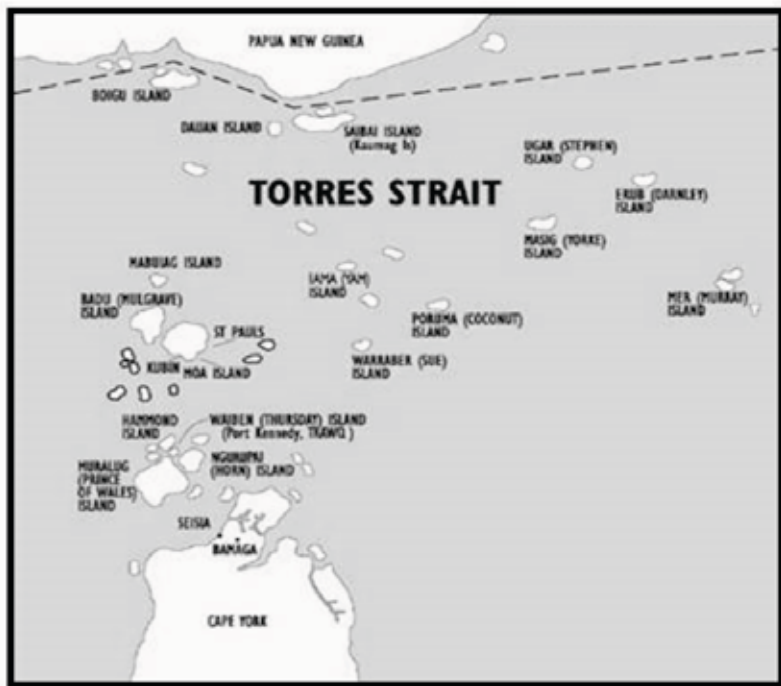
Although I had visited the island on previous occasions, I come from a background of speaking only one language, English, which was one of three languages spoken on the island or one of four spoken in the Torres Straits. Specific languages are spoken in Torres Strait Islander communities including Standard Australian English, Yumplatok (Creole), Kala Lagaw Ya (Mabuyag) and Meriam Mir (Osborne, 2009; Shnukal, 2004). Kala Kawaw Ya (KKY) is understood to be a dialect of Kala Lagaw Ya (Osborne 2009). The traditional languages of the top western and western islands, Kala Lagaw Ya (KKY and 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 (Osborne 2009; Shnukal 2004). 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 (Osborne 2009; Shnukal 2004).

Who are the community?

Community members who had a voluntary desire to participate were included. There is little benefit derived from commanding that people should attend. When there is a sincere interest in reciprocal learning in a community, relationships and trust can grow. Twenty adults and eight children took part in the community consultation meeting. All reside in the community where the meeting was held. Four adults took part in the workshop which was held in an Indigenous Knowledge Centre that is centrally located in the community. All participants live in that community. Their identities are protected in this paper using pseudonyms.

How did the meeting and workshopcome to be and what were the methods for doing this?

Recent involvement with communities taught me about the importance of meeting with community. I have learnt,and continue to learn, about what works and what does not. What works is predicated on the assumption that, if community can engage and identify with what is discussed, the more interest and enthusiasm is shown. Individual meetings were held with several people, for example, the school campus leader and the Island Councillor and to seek permission to meet under the 'Omei Tree'—Tree of Wisdom— which was suggested by Denise, a senior community woman. A meeting was also held with the local radio announcer for the Island radio which then resulted in a radio interview that was broadcast to the Island community. With support from Denise, and a parent

from the community, a paper-based flyer was delivered face-to-face to the homes of Island parents to let them know about a proposed community meeting and a workshop gathering. The content of the flyer was brief and aimed to provide succinct information for ease of reading and clarity. As per the flyer schedule, the meeting was held for one hour under the Omei Tree with a number of community members in attendance. According to one community member, the fig tree is believed to be over one hundred years old and has been a significant meeting place for the Island community. During the meeting I explained the project and how participants might be involved. Gaining consent was respectful of the community's place and environment as also was that, as a visitor, I needed to be mindful of my actions and presence and conduct in the community.

What kinds of questions did I ask?

The kinds of questions I asked emerged as a conversation rather than a research interview format. I carefully explained that confidentiality would be maintained and that pseudonyms are always used to protect the community's identities. At the meeting I asked the group where they used mathematics in their daily lives. The responses included: buying food at the supermarket, cooking and counting fish and shells, indicating that it emerges through daily activities. As the discussion progressed, I explained some of the early number ideas such as sorting/classification using shells, sticks, leaves, and Poinciana pods that I had gathered from the community. These items were collected after seeking permission from Julia, a Senior community member. At the subsequent workshop I asked about sharing and where it was used in daily life.

Data collection techniques

For the purposes of this paper, the data collection techniques included: digital photography, field notes and audio-recording of a workshop. Digital photography as a non-written source of data

allowed for the capturing of visual images that were central to the preliminary process and which served as a reminder for me (Stringer 2004). Field notes provided descriptions of places and events as they occurred. They provided ongoing records of important elements of the setting and assisted with reporting and reflecting back over events. Audio-recording served as a detailed reminder, capturing participants' knowledge and understandings verbatim (Stringer 2004). It also provided ongoing records of important elements of the setting. Each technique afforded the value of insight into the important preliminary planning of the project (Stringer 2004).

What happened at the community meeting?

In recent years, building on what communities bring to particular contexts and on their strengths has been shown to be effective in engaging with communities (Gonzalez & Moll 2002). How does this occur? A way to engage community was to draw them in with knowledge that was already familiar to them, and which then served as a basis for further discussion and learning (Gonzalez et al. 2002). However, with this process there was a challenge and dilemma. How did I know about the knowledge that they brought to the meeting without falling into stereotyping their cultural practices? How did I address the dynamic process of the lived experiences of the community? Smith (1999) has argued that the responses to these questions have emerged from community-based research that relies on the community's definitions and discussions.

In the meeting, I introduced myself and explained who I was and where I was from. I also explained some of my background and experiences as a matter of protocol and respect. By introducing myself to the community, I provided information about my cultural location 'so that connection can be made on political, cultural and social grounds and relations established' (Moreton-Robinson 2000: xv). This process then allowed the community to locate me in the context

of ancestry, where I was from and my family relations. As the meeting progressed, I asked a couple of open-ended questions to invite stories about where mathematics might be used in daily life on the island. This led to conversations amongst the group about where they used maths. Their responses helped to conceptualise the maths they used, for example, sorting.

When asked how they might sort shells, Denise volunteered to sort a range of different shells into groups. We then had to identify what criteria were used for the grouping. Sorting activities assist with the promotion of understandings of grouping. Children learn to sort objects into groups from their daily experiences. They learn to identify sameness that defines the characteristics of groupings (Sousa 2008). The idea of creating and naming groups continues throughout life and is a way of creating and organising information and making connections with people's experiences. Before young children can learn to count groups, they begin the process of defining a collection using the objects in their daily lives (Baroody & Benson 2001; Sousa 2008). Hence, they need experiences that have a rich variety of two- and three-dimensional objects. Noticing likenesses and differences among objects, children become aware of the features that different objects have. They also become aware of grouping objects. Such an understanding paves the way for learning about partitioning. Denise established the features of each of the sets of shells. If the criteria for membership to a group are vague, it is more challenging to decide whether the shells belong to a particular group. We talked further amongst ourselves, with Denise allowing us time to identify the features of each group.

From my experience, I could not identify the criteria that defined the groups; however, there was consensus amongst community that criteria had been established—edible and non-edible shell creatures. In this example, the community used their daily lives and activities as an opportunity to talk about sorting using their home

language—Yumplatok and English. When I asked when children learn about edible and non-edible shells, there was consensus that this occurs at a very young age, for example, one to two years, and during times when families walk along the shores of the Island and when fishing or playing in the water. This example reinforces Moll's (2002) statement that learning can be rich and purposeful when it is situated within that which already exists—the culture, community and home-language of the group. Gonzalez (2005) explains this further by stating that maths is embedded in social knowledge and mediated through language and the activities of the community. It is not learned nor is it disembodied from its social meaning and context as happens within formal schooling and becomes a linear process of dialogue. The learning about sorting edible and non-edible shell creatures was distributed among the group. It was a shared, collective construction of mathematical knowledge. I found that this experience of shared knowledge, rich in its own complexity, evinced knowledge that had been historically and culturally accumulated and shared through daily living. The community validated their definitions of knowledge, sorting using shells from their environment. In doing so, this process provided a rich way to represent their knowledge and competence to support their children.

As the meeting came to an end, members were asked if they would like furthermaths workshops to be organised for, and with, the parents and children. Of importance was that the community needed time to network and discuss whether they wanted me to return and work with parents and children on the Island and if they identified that there were benefits for their community. The next section talks about one workshop and what happened.

What happened at the workshop?

Building on what communities bring to particular contexts and on their strengths has been shown to be effective in engaging with

communities (Gonzalez & Moll 2002). This was evident from the community meeting and first workshop conducted that focused on early algebra. A second workshop was held, with parents invited to identify its focus. It was during that workshop that sharing and partitioning emerged as mathematical processes that parents used in their daily lives. Using a semi-structured,informal discussion and using items previously collected, allowed for understandings of how this knowledge might be used to support their children's learning. I was invited to do the workshop in the Indigenous Knowledge Centre on the Island, a place of agency that permits and promotes engagement in a range of activities for the community (Taylor 2004).

Partitioning experiences are important for building rational number understandings (see, for example, Piaget, Inhelder & Szeminska 1960). The ability to divide an object or a group of objects into equal parts is identified as critical to understanding the logical development of part-part and part-whole relationships and notions of equality and inequality (Lamon 1996). This ability may also influence children's understandings of mathematical topics such as measurement and geometry. Partitioning is a process that generates quantity and, in doing so, builds understandings of rational numbers(Lamon 1996; Pothier & Sawada 1983). It is an activity that is intuitive and experienced-based; indeed, this process connects the process of constructing rational numbers with children's informal knowledge about fair sharing (Pothier & Sawada 1983). Unitising, however, is a cognitive process for coming to know and understand the amount of a given item or share before, during and after the sharing process. In the following excerpts the process of partitioning is described by Ailia, one of three women who attended the workshop. Ailiae explains the process of giving fish. This explanation came about as a consequence of a question I asked about where maths is used in the women's daily lives. Ailia draws on language that is associated with partitioning—division. Of significance in the following excerpt is that she explains how 'we'involve 'our kids' in giving fish.

> Ailia: Like you asked me what we do here like, now when we come in with the fish and the share for the community [unclear] we do with our kids and they watch.

In this excerpt two aspects are significant. The first is the use of the term 'share' and the secondis that, after the women have gone fishing, that 'share' is for the community and their children are engaged in the activity. Through the process of watching, the children learned the substance of sharing experiences that can then be used as opportunities for experimenting in other contexts and, in doing so, building their knowledge of fair sharing via family activities and relations. This process is in line with what Lahn (2006) identified in her work of fish giving practices in the Torres Strait Islands. The reciprocal,nurturing relationship occurs across generations with the women nurturing and modelling to the children how 'older members' are cared for in the community.

Here, the specific characteristics of community relationships and activities seem to converge on very similarly organised networks of relations based on 'dense exchange' (Velez-Ibanez & Greenberg 2005: 53). For each family from which the women and children come, the funds of knowledge accumulated and that form the basis of daily life contain much of the previous generation's repertoire of information and skills for living. These funds of knowledge are embedded in either historical or contemporary experiences of families. The funds and experiences are a 'currency of exchange' (p. 54) between generations and families that form the 'cultural glue' (p. 54) that maintains cultural relations. This exchange and the idea of sharing are embedded in the social knowledge of the women. It is mediated through the sharing experiences that the women perform and distribute among the group including the children. In the next excerpt, Ailia describes sharing as a practice which is mediated and distributed amongst the families, activities and contexts.

Ailia: When we divide the fish among the families, like if I've got my three sisters and two brothers that I need to catch fish [unclear], with the fish, it doesn't, we don't all [get] the bigger ones in this family and then the other sister get the small ones, we divide it quite evenly, like all the big fish in the basket, we get one each. And then we go down to the second size, even it up.

Bron: So then everyone can go home and feel like it has been a fair sharing out?

Ailia: Yes.

Bron: And that's the process most of the time?

Ailia: Yeah.

Bron: And the children learn that?

Ailia: Yes.

Bron: They grow up knowing that?

Ailia's explanation provided critical insights into how division was deeply embedded in fish giving practices. It is these same practices that have the potential to be invisible through the trained eyes of formal education (Gonzalez, Andrade, Civil & Moll 2005). The mathsinvolved in such practices, go 'beyond facile constructs of social context and must take into account the deeply felt relationships of co-participants, the social relationships involved in undertaking the practices as well as the deep engagement of connection with a product, and not just a process' (p. 264). Ailia was interested in explaining the fish-giving process but, in doing, so was also interested in uncovering the maths in a systematised way. For example, she explained that she had three sisters and two brothers that she needed to catch fish for and distribute evenly. The fish were first sorted into different sizes. The groups were created based on sameness, that is, fish were sorted by weight through the action of hefting, and measuring length and girth by sight (see Figure 1 below).

Figure 1:   A fair share
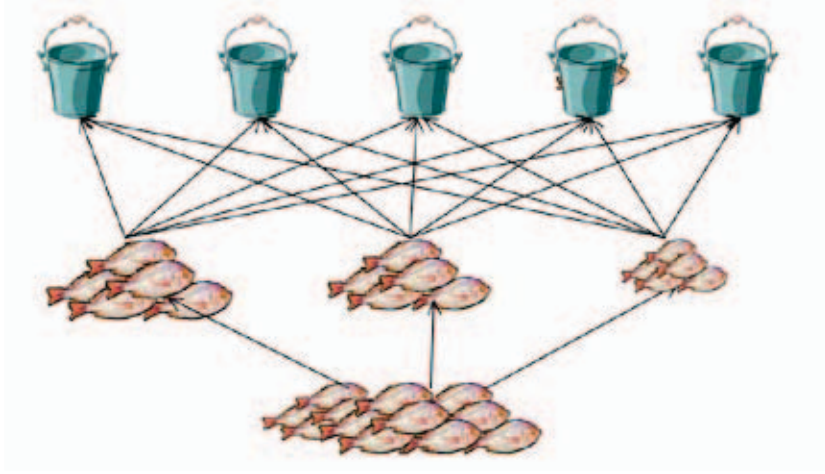
This process affords young children with opportunities to learn about sorting, sharing and partitioning. How many parents and children are aware that this knowledge as it relates to division resides in their daily practices? In the above example, the fish were distributed and then checked to see how many each bucket received. When partitioning, the number of groups is already known, but how many objects must be placed in each group is not known. In the next excerpt, Ailia explains the sharing process further:

Ailia: If we only have four buckets, even if we only have three big fish that needs to go into and then we take two smaller ones that will make it like a big

Bron: Oh, okay.

Ailia: And then there's [one] for that, and these three buckets will be this big [one] and this one, two in there.

Bron: You know feel in terms of weight or by sight?

Ailia: Just by [moves arms to indicate hefting action].

Bron: Sight?

Ailia: Yeah.

In Figure 1, the size of the set is unknown and is called fair-sharing or a partition problem. In Ailia's excerpt above, the whole (five fish) is shared among a known number of buckets (four) to determine the number of fish in each bucket and equality. Equality was represented as two smaller fish equalling the size of one larger fish. When asked about how the size of fish were determined, Ailia responded by hefting and gesturing towards her eye to indicate by sight.

In this example partitioning was found to not be a possession that resided in Ailia's head as a fixed attribute or skill only known to her. Rather, partitioning was a practice, and giving fish created a context for the development and teaching of that practice. Gonzalez et al. (2005) argue that understanding maths is not simply about the possession of funds of knowledge in mathematical domains. The key point here is that such domains must be socially mediated into 'productive knowledge in order to be meaningful' (p. 266), as demonstrated in the following excerpt from Ailia:

> Ailia: When we do that, kids will stand there and say, why don't you put [indistinct] the question, so then we explain it to them.
>
> Bron: Yep.
>
> Ailia: So we want it even.

What is evident in the above series of excerpts is that Ailia and the women she referred to who were involved in the fish-giving practice have the skills, connections and understandings with how the process works. It is up to the women to pass on this knowledge and support to their children because they are brought up this way and therefore it is what is expected (Lahn 2006). The reciprocity among family was evident in the excerpt. Each step in the process revealed a network of family who gave or received fish and advised the children or each other, thus maintaining second generation and or third generation relations and practices. Such activities demonstrate how the process established enduring, social relationships and interdependence as

well as the partitioning process, where the focus was on equality and sameness.

The knowledge of giving fish had not been taught systemically to the children. But such knowledge becomes useful within the maths curriculum in schools as a means of stimulating and engaging students' curiosity about their environment and their cultural practices in a context that is relevant to their lives. When children begin school, and where there is an unequal distribution of funds of knowledge and where materials and textbooks may be limited, the use of a pedagogy that draws on the children's cultural knowledge and the resources available to them makes good sense (Browning-Aiken 2005). When children are provided with activities such as the examples above in their daily lives prior to schooling, a strong argument could be made that they should be much more closely linked when children commence formal learning ofpartitioning—division.

Conclusion

In evaluating the meeting and workshop as strategies for engaging with parents and their cultural practices and the maths that is part of such practices, the experience has revealed several themes that directly affect the nature of home-community relations-early years' schooling and have the potential for improving educational achievements on the basis of more knowledge of pedagogical practices. For one, Ailia placed high value on fair sharing—partitioning which was indicated in the daily practices used to share this skill as well as exhibiting respect for family members who were also teachers. Learning was something that occurred in the community and at home in a form of increasing household responsibilities and in the business of people in their family networks. Together, the themes have implications for the nature of the teaching that parents engage in and for the pedagogy within classrooms when

children begin school. Thus, teachers need opportunities where they can engage with parents to learn what funds of knowledge exist among their students because they provide an important part of the teaching and learning process when materials and resources are limited. Conversely, funds of knowledge can be considered as enriching as the curriculum where such resources are available.

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About the author

Dr Bronwyn Ewing *is a mathematics education researcher at Queensland University of Technology, specialising in the pedagogy of mathematics classrooms from the early years to VET contexts. She has a special interest in the teaching and learning of mathematics to Aboriginal and Torres Strait Islander students and the role of Torres Strait Islander women in their children's prior-to-school mathematics education.*

Contact details

Senior Lecturer, Yumi Deadly Centre School of Maths, Science and Technology, Faculty of Education, Queensland University of Technology, Kelvin Grove Campus, GPO 2434, Brisbane, Queensland 4001
Tel: +61 7 3138 3718   *Fax: +61 7 3138 3985*
Email: bf.ewing@qut.edu.au