Building bridges: ‘At home I add, at school I multiply’

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Introduction

The purpose of this chapter is three-fold: firstly to present an indigenous perspective to mathematics and mathematics education, with particular reference to Fijian and other Pacific cultures. Secondly, the chapter draws parallels between the traditional perspective of the home culture and the formal classroom, thereby providing alternative pathways for meaningful mathematics learning. Lastly, the chapter links the discussions to the concept of numeracy.

The identification of a cultural perspective comes under the research programme called ethnomathematics, which acknowledges the different mathematical ideas and ways of ‘mathematising’ in different cultures. In this way, ethnomathematics allows for parallels to be drawn between the traditional and the formal classroom perspectives. The cultural perspective sees mathematics as a cultural product that is born and developed in answer to human needs, and is something that people do and use meaningfully. However, the identification is defined by the
conventional decisions of ‘what is mathematics’ and what activities and processes can be deemed mathematical. Specifically, the paper attempts to focus on four key activities: counting, measurement, locating, and making patterns and designs. The mathematical ideas described in this paper are different but complementary to formal mathematics in that they serve the same mathematical purpose.

Numeracy is a more holistic and applied notion of school mathematics. It focuses attention on being able to use mathematical knowledge to solve practical, everyday problems. Thus, a numerate society is one that is empowered with life skills, including numeracy, to make effective decisions. Much of primary school mathematics resonates with the notion of numeracy. This paper proposes that the background knowledge of the students, particularly at primary level, should be an important component of the curriculum, and learning experiences must be based around those knowledge areas to ensure that learning is built from there.

**Background**

The traditional Micronesian story of a group of fishermen sailing a canoe to the moon (Phillips, 1998) has been retold many times over. It goes like this. One evening, as five men sat in their canoe waiting for the fish to bite and enjoying the stillness of the evening, they were drawn to the full moon out there on the horizon. With a strong sense of purpose the men pulled up anchor and paddled towards the moon. After some time, they realised that they were not getting any closer because the moon had started to rise in the sky. They stopped, looked up and decided to aim the canoe, not at the horizon, but upwards at the moon. But this required them to shift positions to the back, so with the canoe pointed upwards, they continued to paddle.

The Pacific is a very large geographical region with many small islands scattered over 30 million square kilometres of ocean. The total population of the region is about six million and the lives of many revolve around activities and processes related to the sea. Since colonisation, the people and communities have been on a journey to new horizons and inevitably the Pacific communities have become part of the bigger global community. The promise of ‘bigger and better’ held an appeal
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for individuals, families and communities, and education was embraced as part of
the search for the key to a vaguely-conceived new level of welfare. However, implicit
in formal schooling was a hidden curriculum that made us believe there was little of
value in our communities that might be useful in the modern world.

The education systems of most Pacific Island countries (PICs) are a legacy of
centuries of European and colonial experience. Formal education was introduced
through the Christian missions in the early 1800s and later maintained under the
control of colonial governments. A dominant feature of education at the time, and
one that is perpetuated today, is the imposition of imported academic curricula
in our schools, mainly from the United Kingdom, New Zealand and Australia.
As Thaman (1990, 1995) suggests, this has meant the promotion, both implicitly
and explicitly, of the dominant values and ideologies of European cultures, even
though some of them are antithetical to the beliefs and values of our own societies.
Eurocentric control in postcolonial Pacific is subtle in the way values and ideologies
are promoted through the concepts of universalism and naturalism.

In mathematics education, the knowledge and language of the English tradition
dominate the curriculum and are presented as necessary for participation in the
new global economy and market. This vision of linking the interests of our peoples
with the wider economy seems to have justified an academic and mechanistic
curriculum and, in turn, marginalised the knowledge and languages of traditional
societies. The latter are deemed necessary, although they impinge only peripherally
in the academic context.

All in all, the journeys of Pacific peoples into horizons of promise have been
challenging. We have gained in some areas and lost in others. We still have our
eye on the best of the global but, like the Yaap fishermen, we have to sail in our
canoes that define who we are and what makes sense to us. Global education must
recognise the sacredness of our cultures. This chapter proposes that as part of
the global community we can affirm that condition. We can make the distinction
between multicultural understanding and global education (Banks, 1989).
The state of mathematics education in Pacific Island countries

For an understanding of what I believe is the current state of mathematics education in most PICs, I wish to relate two experiences. In 1998 while attached to the Curriculum Development Unit (CDU) in Suva, Fiji, I was part of a visiting advisory team to one of the outer islands. Teams of officers from the CDU toured the schools regularly to conduct professional development and training for teachers and other stakeholders, to monitor and assess progress, and to offer advisory and support services. On the last evening of our week-long visit to this island, we held a combined question and answer session with all primary and secondary teachers. When it was my turn, one of the head teachers had this question about language and symbolisation for me: ‘When you want students to do a subtraction like 235−116, do you say 235 minus 116 or do you say 235 take away 116?’

I was surprised at the question and totally unprepared for it. I had never taught at primary school but I faintly recall some of my own learning in primary school many years back. I responded very cautiously and said I did not think it mattered which term was used as long as students understood the meaning of the concept of subtraction. I was then directed to the primary mathematics textbooks which specifically use the term minus. Apparently minus allows for ‘borrowing’ when one of the lower digits on the minuend is smaller than the corresponding digit on the number being subtracted; this is not so with take away, which could be confusing and also lead to errors. This was a case of an incorrect or partial understanding of particular words within the mathematical context, which made me realise how carelessly we use words in the mathematics classroom and create learning problems for students who are learning in a second language. I agreed with the need to regularly negotiate the meaning of words and symbols within the mathematics classroom.

Still in the context of ‘going by the book’, I could not resist the suggestion to develop in students an understanding and a feel for numbers so that they are comfortable with estimating and using invented strategies before attempting the algorithms. An example is if students were able to call up ‘nice, round’ numbers, say 240 and 120, rather than 235 and 116, carry out the subtraction operation...
and then compensate by adding or subtracting the extra units to arrive at the answer. I also mentioned that place value notation could clear the doubts about whether you need to ‘borrow’ or ‘carry’ and when you do not need to do so. The teachers appeared to agree with me but I suspected their minds were still focused on correct ‘book’ methods that earned the marks in examinations.

The second story is one that I heard. It was about a university professor and his research experience in Papua New Guinea (PNG). He related this conversation he (B) had had with a university student (St):

B: How would you find the area of a rectangular piece of paper?
St: Multiply the length by the width.
B: You have gardens in your village. How do your people judge the area of their gardens?
St: By adding the length and the width.
B: Is that difficult to understand?
St: No, at home I add, at school I multiply.
B: But they both refer to area?
St: Yes, but one is about the area of a piece of paper and the other is about a garden.

The professor drew two rectangular gardens on the paper, one bigger than the other:

B: If these two were gardens, which would you rather have?
St: It depends on many things, I cannot say. The soil, the shade …

The student’s answers indicate the depth of mathematical understanding in his society. For him there is much more to deciding land issues than mere size. Fijian society, like that of PNG and others in the region, has an education system that is different in some respects from formal education. For Fijians, learning is purposeful and practical; it is contextual, domain-specific and cooperatively organised. The primary aim is the preparation of the young for life in society. They live their learning by participating in social functions, activities, and everyday life processes under the guidance and watchful eye of families, elders and the community at large.
The PNG student, like most of us, straddles two mathematical traditions. However, this example clearly shows the power in traditional ideas that are lived and make practical sense. There is no denying the student’s affinity for his home knowledge. But note that he does not forget the school knowledge, which is remembered exactly as it was given—a rule for computation, devoid of context. It is unfortunate that the student has had to carry the extra cognitive load of two methods, adding (e.g. 4+4+4+4) and multiplying (e.g. 4 x 4), which are one and the same but presented differently. The examples discussed here summarise, to some extent, the flavour of the mathematics taught in our schools—mathematical truths with skills to be mastered. The misconception that mathematics is universal and the same for everyone across the globe has justified the didactic, abstract way that teachers teach mathematics through the use of rules, formulae, symbol notation and algorithms. Teachers perceive mathematics to be absolute, and the curriculum and examinations mirror this view.

**Changing notions of mathematics**

In many PICs, the relatively poor performance of students as evidenced by national mathematics examination results, students’ resistance and apathy towards the subject, and low enrolments in advanced courses have been cause for concern. Time and again it is the quality of teachers and teaching that have been called into question and the response has been to improve teachers’ professional capability. While there is probable cause for this and any attempt at improving teaching is a good thing, it is my view that the issue is a lot deeper. The concern is not only: What is the best way to teach? but also, and more importantly: What is mathematics really about?

Every time I ask trainee teachers this question the response is the same—silence and wonder. It is as if mathematics has no links to issues of belief. Dossey (1992:36) thinks otherwise, suggesting that:

The perceptions of the nature and role of mathematics held by our society have a major influence on the development of school mathematics curriculum, instruction and research. The understanding of different
conceptions of mathematics is as important to the development and successful implementation of programs in school mathematics as it is to the conduct and interpretations of research studies.

Our concept of a universal mathematics is defined in mathematics texts and our learning in mathematics lessons. Our definitions of what constitutes mathematics are mostly about numbers, calculations, and solving problems. With ongoing difficulties faced by students in making meaning in mathematics classrooms and the high numbers opting out of mathematics-related studies, research and scholarship have pointed to new understandings. A significant development was the emergence in the 1980s of a powerful new perspective on mathematics education—the cultural perspective (Bishop, 1992). Bishop saw this development as partly in response to national commitments to ‘mathematics education for all’. ‘The emergence of the cultural perspective challenges the provisions of homogenous curricula’ (Bishop, 1992: 169).

What is numeracy? What does it mean to be ‘numerate’?

‘Numeracy is to mathematics as literacy is to language’ (Steen, 1990: 1). The concept of numeracy and the word itself is British (Cockcroft, 1982); some American groups prefer to use terms like ‘mathematical literacy’ (MCATA, nd) and ‘quantitative literacy’ (Steen, 2007) to describe the same context of the work. Like mathematics, numeracy is a contested term (Zevenbergen, Dole & Wright, 2004), and in many spheres the term is used interchangeably with mathematics. Different sections of the community have their own definitions of numeracy. Some see it as ‘an ability to calculate’, thus relating it to arithmetic. Others relate it to the study of numbers only. Both these definitions are restricted. The Cockcroft Report (Cockcroft, 1982: 11) gives a more encompassing description by equating numeracy with ‘an ability to cope confidently with the mathematical demands of adult life’. This includes both the ability to perform basic arithmetic operations and to also use them confidently in practical everyday situations.

A similarly inclusive definition is used by the Australian Association of Mathematics Teachers (AAMT, 1997: 13): ‘the knowledge and skills needed for informed participation and decision-making in the world beyond schools’. The notion is of numeracy as a life skill that is important for living in the contemporary world.
The Cockcroft Report (Cockcroft, 1982: 11) defines two attributes of numeracy. The first is number sense or ‘at-homeness’ with numbers and the ability to use mathematical skills in everyday life. The second is an ability to appreciate and understand mathematical presentations, as in graphs. ‘Taken together, these imply that a numerate person should be expected to be able to appreciate and understand some of the ways in which mathematics can be used as a means of communication’.

In the New Zealand context, to be numerate is ‘to have the ability and inclination to use mathematics effectively at home, at work and in the community’ (Curriculum Update, 2001).

Zevenbergen et al. (2004) suggest that the current use of the term numeracy is politically motivated. The high number of students leaving school with a negative view of mathematics and poor mathematical skills has raised questions about the value of core school mathematics. Enter numeracy, which is a more holistic and applied notion where students would be expected to use and apply knowledge to solve practical, everyday problems. Many primary curricula resonate with the notion of numeracy.

As our societies are increasingly being driven by science and technology, they have become more complex. The infiltration of global communication and international trade markets has raised minimal levels of numeracy. The demands for numeracy are as high as those for literacy. A glance at our local newspapers reveals numerous examples of mathematical representations, as citizens are continually being bombarded with information expressed in numbers, rates and percentages. News items of the consumer prices index, gross domestic product, interest rates and many other statistical measures are common. Newspapers and the media in general expect readers to be well versed in basic mathematical ideas and computations and how these apply to various levels of the economy. The computer age has spawned not only an explosion of data but also new language forms that demand new understandings. Steen (1990: 2) rightly asserts that numeracy is not a fixed entity but is continually changing. The standards have changed and will continue to change.
As PICs face the daunting reality of having to compete in a global economy fueled by information technology, they are quickly realising the importance of a numerate populace. While expectations have increased tremendously, the same cannot be said of students’ performance. The demand is for people with a high level of both literacy and mathematical ability. It is not far-fetched to claim that mathematical ability (and numeracy) is the gatekeeper of many desirable jobs and provides an edge in successful participation in everyday life.

**What does this mean for students of Pacific Island countries?**

School mathematics is the main vessel of numeracy. Unfortunately for us, it is also the source of innumeracy. In PICs, mathematics is a status subject which, together with English, serves as a filter to many sections of a workforce that has become increasingly technological. Because mathematics is considered a sequential subject in most of the PICs, and because many sciences require a mathematical background, students are encouraged to take it throughout their schooling. However, the relatively poor performance of our students as evidenced in mathematics examinations, low enrolments in higher mathematics, and students’ observed resistance and apathy towards the subject are causes for concern.

Steen (1990: 7) offers good advice:

> Many trades and professions keep their numeracy standards high in order to select individuals with a certain quality of mind (or, critics charge, of a certain socio-economic status). So long as this is the case, prudent educators will require young students to continue their study of mathematics not because they will need it but because they may need it. The consequences for a student’s economic future are too serious, and the temptation to opt out of a difficult course too great, to justify electives as wise mathematics policy for students who are still in required school.

**Action plans**

Approaches to numeracy vary. In Australia there is a National Numeracy Plan (see:http://www.griffith.edu.au/school/cls/clearinghouse/) which highlights the federal government’s policy framework for school numeracy education and for the
enhancement of numeracy outcomes for all students. In addition, each state has
developed state and school numeracy plans and goals for achieving standards of
numeracy and literacy.

In New Zealand numeracy receives attention at national level and is being reflected
in national policy and research agendas. The New Zealand Numeracy Project (see
http://www.tki.org.nz/r/literacy_numeracy/num_materials_e.php) is a nation-
wide professional development initiative which introduces teachers to a new
approach to the teaching of mathematics. The focus of the Project is ‘improving
student performance in mathematics through improving the professional capability
of teachers’. Te Poutama Tau is the project arm that is particularly dedicated to
strengthening numeracy in Maori medium schools. The numeracy projects in New
Zealand and Australia have relied on very substantial funding.

It is suspected that in most PICs numeracy remains embedded in the mathematics
curriculum and arises out of mathematics teaching. It may be true that the school
curricula in the PICs do not as yet deal widely and uniformly with the topic. As
I described earlier, ‘going by the book’ and adherence to the rules and methods
for calculating are still prominent, even though some advances are being made
to encourage problem solving and mental strategies. The new Cook Islands
curriculum documents have made significant mention of numeracy; while still
primarily with mathematics it is also expected to develop within contexts of other
learning areas. Fiji is undergoing educational reform and a National Curriculum
Framework is progressing into development of specific learning areas; numeracy
is embedded in the mathematics curriculum.

PICs stakeholders must make a concerted effort to make numeracy a reality. Teachers
and teacher associations, parents and parent bodies, school systems, governments
and whole societies must affirm their commitment in a unified approach to
numeracy. This must begin with a re-examination of school mathematics, what
basic skills are important and how effectively these can be developed during the
years of schooling. Another important area is the need to integrate mathematics
across all subject areas, thereby increasing understanding of the pervasiveness of
mathematics in all aspects of society.
Mathematics and culture

The terms culture and mathematics carry different meanings when perceived by different people at different times. Both terms carry meanings that are broad at one end and precise at the other. Students of mathematics, especially pure mathematicians, would strongly resist the idea of establishing a relationship between culture and mathematics, mainly because they see the study of mathematics to be concerned with high order thinking, removed from physical influence. For this reason, school mathematics is perceived as being independent of a student’s background and culture and should therefore transcend any cultural diversity (National Research Council, 1989). However, evidence from anthropological and cross-cultural studies demonstrates that mathematics is a cultural phenomenon and that other cultures have created other mathematics. Ethnomathematics is the study of mathematical aspects of the ideas and practices of cultural or social groups (D’Ambrosio, 1985). Bishop (1988) developed a framework of six universal activities, namely counting, measuring, locating, designing, playing, and explaining, which he perceived as necessary pre-conditions for the development of mathematics in any culture. Here is a description of some representations in PICs.

Counting

Glendon Lean, who drew attention to and collated data on the rich diversity of nearly 900 counting systems in Papua New Guinea and Irian Jaya, also suggested that systems based on body parts and cyclic systems developed spontaneously (Owens, undated,a). This diversity is evident when questions such as the following are asked: What are countable objects? When are they counted? Which economies and exchanges use counting? Are different types of objects counted in different ways? Are all objects counted? How are totals recorded? An analysis of the counting systems of PICs on the basis of these questions would show differences as well as similarities. In Owens’ (undated,a) description of some of the case studies of PNG and Papuan societies, we can identify some degree of similarity with other Pacific systems. Some of the descriptions are:

- the extensive use of numbers in ceremonial contexts, as in Tongan society
- the tendency to count a wide variety of objects
Kiribati counts items using various numerical classifiers such as flat objects (-baa as in wanibaa), objects that are containers (-kuo as in nimakuo), moving objects (-wa as in waniwaa).

- placing little importance on counting, despite a 10-cycle system emphasising the indivisible mass of a visual display, as in most Pacific societies. Fijian society has a way of counting items of food and wealth used in traditional presentations in tens. Otherwise, in everyday circumstances, Fijians do not see the value in counting, do not like to count, and do not think it proper to count.
- the generation of arbitrarily large numbers, even though the people do not count large numbers.
  The Tongan system, which has single terms for numbers from taba (one) to kilu (one hundred thousand), as well as the system in Choiseul, Solomon Islands, where people traditionally count using Jijiru—which organises counting in multiples of ten: mano (ten), karabete (twenty), tulununu (thirty), etc.—may be related to this.
- that fractions, except for half, are generally not used.
  In Fijian society the only fraction that has a single term is veimama (half) while all others, if used, are part of the whole number. There is a tendency to perceive the whole and not the part, seeing ‘all or nothing’.

Lean’s work and learning about different counting systems demonstrates the fact that people invent mathematics and that this is a culturally developed phenomenon. In its own way, it also gives the base 10 place value systems more meaning (Owens, undated,a).

Measurement

Measurement is concerned with comparing things according to a shared quality, and it is done through the use of convenient units and standardised systems of units (Bishop, 1988). Tonga, Solomon Islands and Fiji measure using body parts, specifically the arms and legs. Dimensions of length are designated body parts and the main length units are the hand span (Fijian caga, Tongan banga); arm span (Fijian katu, Tongan ofa); shoulder length (taba) which is part of an arm span; and the stride (kalawa).
Measurement using body parts is a common activity in Fijian homes and Fijian students are very familiar with the body part measuring system. Versions of hand span measure the designs in mats and tapa cloth, while arm spans are used for the longer lengths of living room mats and tapa, and for farming and house building. A special application of the hand span is used by rice farmers to measure the distance between rice shoots when planting. Bent over and with knees deep in rice paddies, farmers would hold rice shoots in one hand and use the other to measure hand span intervals between each shoot. Since students, especially those who live in rural communities and the islands, are familiar with measuring by body parts, it makes sense to include these in the curriculum and also develop benchmarks that give them formal meaning. To ignore these informal measures and drive only the standard metric units is both naïve and a recipe for disaster.

Many Pacific societies estimate consistently and use estimations with descriptive forms and gesture phrases. In Tonga, for example, fakafuofua or estimation, is purposeful, and the language nicely discriminates the different usage. The degree of estimation in traditional societies would make students good estimators. Similarly in Fijian society, precision does not fit with our economic system and way of life and the Fijian language uses various forms of descriptive and gesture terms and phrases in place of numerical classifiers (Bakalevu, 1998).

**Locating**

Locating emphasises the spatial geometry of position and controlled movement (Bishop, 1988). Spatial orientation is discussed early in mathematics and concerns one’s position in relation to other things in the environment. In the cultures of many PICs, naming places is important to designate precise locations, so maps and graphs are important items of learning. Deacon (in Ascher, 1991) studied on the island of Malekula in Vanuatu and collected remarkable material that demonstrated ability and evidence of abstract thought. He reported (in Ascher, 1991: 64) ‘the amazingly intricate and ingenuous’ geometrical figure drawings in the tradition of tracing figures in the sand. The drawings, called nitus, are made in the sand by men, and ‘the figure is to be drawn with a single continuous line, the finger never stopping or being lifted from the ground, and no part covered twice. If possible the drawing is to end at the point where it begins’ (Deacon in
Ascher, 1991: 45). The patterns of drawings are accompanied by stories. As the story develops, the pattern changes, the story always ending in the same place as it began. All nitus have traditional meanings. Mathematically they vary in complexity from single closed curves to having numerous vertices, some even with degrees of 10 or 12. Symmetry, including rotational and line symmetry, is an important property common to most nitus.

**Designing**

We see shapes all around us and it is easy to find representations of geometry. Properties of shapes are always fascinating to students if parallels can be drawn with the environment. There are excellent geometrical representations in the everyday and communal tasks and activities of both men and women. For men, building a house, be it a Fijian bure, a Samoan fale, a Kiribati maneaba or a rectangular house in PNG, will introduce properties including symmetry, triangles and rectangles, and diagonals. The roof structures alone would bring up items of linearity and direction—horizontal lines, perpendicular and hypotenuse (Owens, undated,b).

For the girls, designs and patterns in embroidery and in the making of mats, baskets and tapa cloth and provide similar parallels. Mat and basket-weaving, popular tasks in all PICs, requires mathematical notions such as counting (strips), estimation, symmetry (of patterns), diagonal and perpendicular (weaves), and periodicity. The patterns in the weaves, especially in the design of tapa cloth (Tonga and Fiji) make excellent contexts for learning different aspects of geometry, especially transformational and rotational geometry. The intricate patterns of the tiwhaiwhai, or embroidered patched cloth, are unique to the women of the Cook Islands.

**Cultural ideas in the curriculum**

‘The choice of a curriculum … is a political choice’ (Mellin-Olsen, 1987 : 16). Mellin-Olsen warns that the different uses of mathematics in cultures can decide whether the members of those cultures learn the mathematics of a curriculum or not. We can turn a blind eye to the relevant mathematical ideas in our cultures and go on as before, or we can acknowledge the differences between the competing mathematical traditions and the impact of possible conflicts in our children's
mathematics learning, and make the necessary changes. I will use Robitaille and
Dirks’ (1982) curriculum model that was founded on certain positivist assumptions
and focused on three levels of the curriculum—the intended, the implemented and
the attained—to assess the cultural perspective on mathematics education (Bishop,

**Intended curriculum**

The intended level of curriculum is that planned at the national level by curriculum
committees and consultants and codified in the curriculum guides (Robitaille and
Dirks, 1982). The planned curriculum can be done at the national level from a
central education authority, such as the Curriculum Development Unit (CDU) in
Fiji, or it can be at a local level from an informal cluster of schools. Then there is
the planning at the school level where a head of department may develop schemes
of work for use by a group of teachers to help them work towards common goals
(Begg, 1994). At a more personal level, individual teachers develop lesson plans
from the larger scheme of work. Traditionally, most intended curricula ignored the
human aspect and presented mainly universalist thinking. In multicultural societies
like Fiji, the critical question has often been: Whose cultural knowledge should be
used and why? Unfortunately the result is the sanctioning of a culturally neutral
mathematics curriculum; Bishop (1992) labels it a ‘culturally blind’ curriculum.

I glanced through a few mathematics curriculum documents from the region and
was delighted at the evidence of a change in thinking. The Cook Islands Tree
of Learning is a powerful representation of their core values in formal learning.
‘The Tree symbolises the Cook Islands people’s close connection and affinity
with nature and the land, their bond to spiritual beliefs, and their relationship to
economic well-being’ (MOE, 2002:2-3).

Fiji’s curriculum framework is saying all the right things; I was particularly
delighted to read this statement, vague as it is, on the mathematics page: ‘Students
will appreciate the wider use of mathematics in the different cultures, for example
ethno-mathematics’ (MOE, 2005: 18). To make this work will be a challenge and
Fiji will need the wisdom and skills of elders and experts for an understanding of
traditional practices, knowledge and values.
The ‘rich tasks’ approach to curriculum that is being trialed in Nauru is unique and deserves mention. Nauru’s education system not only believes in sound educational theory but also in it being ‘grounded in the context of Nauruan culture and language’ (Department of Education, 2005: 1). Nauru rich tasks began as teacher practice tasks where teachers learnt to develop and use tasks to organise curriculum content. The Nauru document describes rich tasks as learning and assessment tools; they have quality standards built into them and, at present, a few rich tasks are used each term. The rich tasks balance the curriculum across all important areas. For example, *Growing up: maturing as a Nauruan teenager* is a Year 10 task and subject teachers develop lessons from it. The result is an integrated, holistic view of learning and knowledge. That the tasks are built on life in Nauru is a bonus.

**Implemented curriculum**

The implemented curriculum (Robitalle and Dirks, 1982) is the curriculum of the various texts and materials which are selected and approved for use in the schools, and communicated to students by teachers in their classrooms. This is the taught curriculum. Bishop (1992) suggests that the greatest impact of culturising mathematics can happen in mathematics classes through culturally responsive teaching. The important role of the teacher cannot be overemphasised. As Thaman (1997: 14) rightly suggests, ‘[a] new curriculum is only as good as the teachers who implement it because the quality of interaction between teacher and pupil is a critical factor in the latter’s ability to achieve’. Even if the content of the mathematics curriculum is rigid and defined, as it usually is, the context of teaching is open and teachers can negotiate and interpret it to suit their learners. The quality of classroom interaction is manifested in how much of the students’ background is included in the learning experiences teachers create and structure. The view of teachers as a cultural bridge fits well with this perspective.

Since most Pacific teachers would have been influenced by western ideas through imported curricula as well as foreign instructors, they would normally teach in the way they were taught. For a change in teachers’ perceptions of the nature of mathematics as well as their practice, important changes must happen in teacher education. Teacher education programmes have an obligation to foster new
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consciousness in teacher trainees. They must prepare teachers to be able to move flexibly and sensitively between both traditions, and help their students do the same. Using mathematical knowledge which is culturally informed, that students can use and relate to at school, at home and in the community, is the ideal way to go. This is the ideal way to empower students to become numerate.

Attained curriculum

This is the level of curriculum that is defined as that ‘learned and assimilated by students’ (Robittaile and Dirks, 1982: 17). Begg (1994:196) says that the amount of learning that may occur is strongly influenced by the ‘learning activities and the learning environment’ created and controlled by the teacher. He saw the attained curriculum as the critical one because ideally it is similar to the planned one. Therefore, if the intended curriculum was culture-blind then it follows that a culture-blind attained curriculum would result from it.

All things considered, it would seem sensible to make a concerted effort on two fronts: firstly at the initial planning and development stage where the indigenous voice must be strong, and secondly at the teacher training level where courses must incorporate aspects of learning about the culture and language of society. A vital part of this training will be to assure parents and teachers of the important contribution of local knowledge and language to students’ understanding of the perceived ‘universalistic’ ideas of formal learning.

The language issue

Mathematics is a powerful language of communication, a kind of hybrid language comprising ordinary English and mathematical English. The unique mathematical register and specially written form of mathematical texts can create confusion and difficulty in understanding mathematical problems and discourses. While for English speakers a mathematics lesson is generally a language lesson within the mathematics part, the situation is more complicated for students who have to verbalise in English as a second (or third or fourth) language, and also master the special mathematical register. The lack of a full mathematical lexicon in the local language registers makes the second step very difficult. Teaching in contexts relevant to the learner will help understanding. In the Pacific Islands, attempts to
develop mathematical vocabularies in the local languages have already started.

**Conclusion**

After years of relying on imported curricula, many PICs are now at the stage of developing the curriculum that they believe best suits them. It is interesting that, in these attempts, many of the countries still use overseas experts. What function these experts play is critical because, if they are in the driving seat, we may soon find ourselves travelling along the same road again. Overseas experts could in fact partner with local counterparts in building bridges between the traditional and conventional perspectives of mathematics. Careful consideration of the construction and nature of the bridges is very important. Ellerton (1997: 121) identified factors for building effective bridges:

> Bridges are likely to provide a more effective mode of communication if the architects and engineers who are involved in their design and construction have a sound understanding of the work done by those on both sides of the bridges, and a realisation that the bridges should not only include cultural and philosophical exchanges, but should also enhance the quality of existence of all parties involved.

Where differences arose, Ellerton (1997:121) suggested the need to reflect on respective cultures, to reach out and ‘incorporate a genuine sharing of ideas, marked by lively discussion, joint projects, and democratic partnerships’. Effective bridges will also help us to prioritise the mathematics topics better, given that some ideas are more important to our people than others. For example, the fact that most Pacific cultures are averse to counting and numbers are not used much suggests that the topic Numbers may not be the best one to start with. I am not suggesting that number not be covered, only that it should appear at the best place of learning. What then should come first? Would it be Space (locating), or Geometry of shapes, or Measurement?

If numeracy is about the ability to use mathematical knowledge effectively, I cannot think of a better example that that of the PNG student whose traditional
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knowledge appears to be more useful. I concur with the Australian Association of Mathematics Association’s slogan, Numeracy = Everyone’s Business. Curriculum developers and educators have the shared responsibility of finding a balance between a totalising global structure and the needs of Pacific cultural identities. The same values and understandings that are engines of growth, participation and livelihood in our societies have the capacity to serve the same purposes in a globalising world.

References


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