

# Professional Learning for Cultural Mathematics in Papua New Guinea's Elementary Schools

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A design of principles for teacher professional learning was developed to improve the teaching of *Cultural Mathematics* in elementary schools in Papua New Guinea. The design's appropriateness for PNG elementary schools is the focus of the research implemented through week-long workshops using technology enhancement. Implementation has been in different ecologies and through workshops with different numbers and diversity of languages of teachers attending. This paper outlines the design of the principles and the structure of the workshop.

Papua New Guinea has a good reform education policy (Owens, 2012a) that encourages the use of local languages and cultural practices, using the *Cultural Mathematics* syllabus. However, implementation at elementary (Pre-Elementary to Grade 2) needs strengthening to provide children with a strong foundation for their identity and for future development of strong mathematical proficiencies, especially in remote schools. Literacy in elementary schools in any language is a major issue (Petterson, 2013). School mathematics is often taught by talk and rote learning methods with limited meaning for the children. Mathematics is present everywhere in practical day-to-day and cultural activities (Owens, 2012b). A feasible elementary teacher professional learning process is required guided by a design of principles. This research is being undertaken at a time of change as the policy has recently shifted towards the use of English rather than the vernacular as the language of instruction at elementary level, where previously there was a transition from the vernacular to English at Year 3. This is an issue as many elementary teachers are not fluent in English.

## The Research Project

The project aims to improve elementary mathematics teaching in Papua New Guinea by using the local languages, improving teachers' understanding of how young children learn mathematics, and improving their understanding of best practice for early childhood education. There is a particular focus on building on measurement knowledge and how teachers can connect this to mathematics in school. The research questions were:

Focus 1: What are appropriate guidelines for elementary teachers to recognise and use cultural mathematical proficiencies for transition to school mathematics?

- a) Can past research be converted to guidelines for the many languages and ecologies of PNG?
- b) Can linguistic guidelines be developed to guide communities to determine appropriate vernacular phrases for school mathematical concepts?
- c) How do the guidelines need refining for elementary teachers to understand?

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Focus 2: How can technology assist professional learning?

- a) Has technology, infrastructure, costs changed sufficiently to permit this?
- b) How can technology/video enhance this professional learning?

This paper outlines our research to date on the first focus question, particularly 1a) and 1c). First a design of principles for professional learning to improve teaching of *Cultural Mathematics* was set up. After preliminary workshop implementations in Hela and Tubuseria, the design was revised, emphasising early mathematical thinking and appropriate learning experiences. The design is presented in Figure 1.

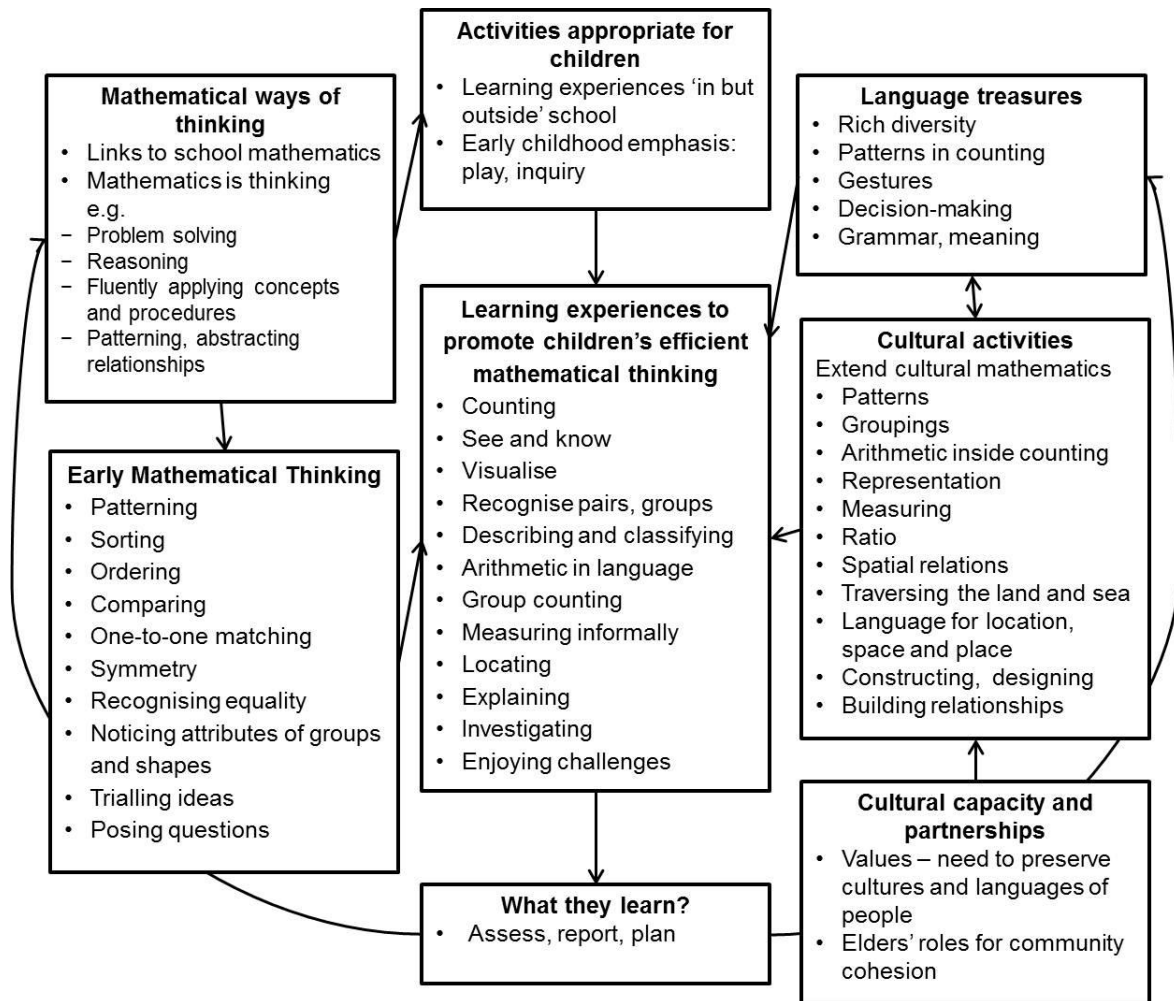


Figure 1. Design of key principles for teacher professional development in *Cultural Mathematics*.

## The Workshops

Workshops are held over five days (40 hours). There is a workshop manual with an explanation of each of the principles. Words are kept to a minimum. We introduce the inquiry method (Murdoch, 1998) and use exemplar learning plans. The steps in the inquiry method are:

- tuning in,

- finding out,
- sorting out,
- going further,
- making conclusions,
- taking actions, and
- reflecting, sharing, and discussing.

Also included in the manual are interview schedules for the teachers to use with children and with parents, and a questionnaire for the teachers themselves. Workshops begin with a small mathematical introductory activity – prepare a name tag and in each corner write four numbers that are meaningful to each participant. They then tell a partner why the numbers were chosen and then they give a relationship between the numbers. Patterns are introduced by having participants form a pattern such as standing in a line with one teacher, one assistant teacher, one teacher, one assistant teacher, depending on participants. This is the introductory *tuning in*. We incorporate a *check in* to find out what people were expecting. We include *check in* and *check out* a few times to see how participants are faring during the workshop. The introductory activities set the scene for interaction and show how simple tasks can lead to people talking mathematics rather than just listening. It also shows the use of a question that has multiple answers.

To continue the *tuning in* and engagement, an overview of the project and their involvement is provided. The *finding out* phase of the professional learning begins with a video of a PNG cultural activity relevant to the ecology (Owens, 2012b) and a discussion of the mathematics involved in it. Groups then discuss a cultural activity and any mathematical thinking involved and respond to a few in-depth questions to draw out the ethnomathematics. This activity really engages teachers as their cultures are important to them (Owens, 2014). Then for *sorting out*, groups share their discussions and the framework of principles is introduced briefly. In *going further*, one activity is discussed in terms of what mathematics the children might learning using the *Cultural Mathematics* syllabus. We discuss how that relates to knowledge of children learning the related school mathematics topics and of early childhood education, play and inquiry, being, becoming, and belonging (Department of Education, Employment and Workplace Relations, 2010). After a *check in*, the workshop continues with *making conclusions*. The group looks at early arithmetic in detail and plays some purposeful games using simple equipment. We summarize the key points together. We use a number of slogans like ‘who is doing the talking?’ The next step in the inquiry method is *taking action*. Different groups read and discuss the exemplar learning plans together from the manual and then share their new knowledge with another group, using a jigsaw method if possible. We use some readers on measurement which we have created; one of the group practices reading interactively with the rest of their group, with as many teachers as possible reading books. Then we discuss measurement concepts in terms of cultural experiences. Small groups then prepare their own learning plans using the inquiry method. To extend their professional learning, teachers develop key questions for observation of cultural activities and ways of developing and extending the ideas for school mathematics. Where possible, teachers teach their lessons to a class or else to peers. This is followed by reflection and another check out.

Language treasures, that is, local mathematical concepts embedded in the vernacular, are drawn out and discussed. Treasures that can help with school mathematics concepts include the terms for a complete group, ways of grouping food for multiplication, patterns

and order in making cultural objects for patterns and sequencing. Designs used in decorations and their names and features are discussed.

Then we look at assessment of children, the use of learning stories and the use of the individual interview which they practice on each other after a demonstration. This activity reinforces much of what is discussed on mathematical concepts and children's learning during the workshop. Where possible the teachers test a child next morning.

For *reflecting, sharing and discussing*, we discuss working with community in the classroom or in the outdoor 'classroom', and setting up dictionaries for concept understanding. The questionnaire for teachers and parents are provided for data gathering and reflection purposes to be completed after a term. Further planning occurs using the format: title of mathematical activity and school mathematical concept, learning objectives (to be taken from the syllabus), resources (especially people in the community who could be involved), and the steps of the weekly learning plan. Finally there is an evaluation of the workshop covering the principles, a check out and celebration.

As can be seen from this description, there is a great deal of material covered in the workshop, ranging from general principles for teaching young children to specific mathematical activities and games. This contributes substantively to the total professional learning of many of the teachers, some of whom have as little as six weeks previous formal training. Through utilising Murdoch's (1998) inquiry method in the workshop structure as well as the practical activity of designing and teaching their own inquiry-based learning plans, the teachers have the opportunity to begin the process of integrating their own learning with their current practice. The range of examples that are presented in the workshop operated as points of recognition or points of departure, as the teachers identify similarities and differences with their own cultural and ecological contexts. The iterations of the workshop that have been implemented so far demonstrate that design of both the workshop and the principles are offering enough flexibility to cater for the range of circumstances in which it is offered, while providing concrete professional learning for the elementary school teachers who participate in the workshops.

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