SECONDARY TEACHER BELIEFS AND PRACTICES ABOUT MATHEMATICS IN THE PAPUA NEW GUINEA CONTEXT

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INTRODUCTION

For decades school mathematics was taught as a 'culture free' subject. It cannot be denied that much of the teaching that goes on in the classrooms still portrays mathematics as culture free. However, the realisation that mathematics exists in cultural activities and that mathematics can be learnt outside of the official school situations has led to the emergence of 'ethnomathematics'.

DEFINITION OF ETHNOMATHEMATICS

There are a variety of definitions of ethnomathematics (for examples, see D' Ambrosio, 1990:22; Howson & Wilson, 1986; Presmeg, 1996; Frankenstein, 1990; Borba, 1990; Pompeu, 1992). This paper adopts Barton's (1996) definition which states that "Ethnomathematics is the field of study which examines the way people from other cultures understand, articulate and use concepts and practices which are from their culture and which the researcher describes as mathematical" (p. 196).

This writer also supports the view that '*ethnomathematics*' is not the *mathematics* of particular groups of people but is an academic field of *study of mathematical ideas (knowledge), practices, activities* which can be identified in socio-cultural contexts. It is not a mathematical field of study as such, but is more like anthropology or history.

These mathematical ideas, knowledge and activities are acquired and practised by various socio-cultural groups in all cultures. It is not the writer's intention to give a detailed definition of ethnomathematics. However, in the context of this paper the term 'cultural mathematics' (rather than ethnomathematics) will be used to differentiate between the mathematics that is learnt in schools and the 'other' mathematics that may be identified in out-of-school or in socio-cultural contexts. The term 'cultural mathematics' (or CM) will therefore mean the mathematical ideas, knowledge and practices that can be identified in socio-cultural contexts through the study of ethnomathematics. Mathematics that is learnt in schools will be referred to as 'school mathematics' (or SM).

Examples of Mathematics from Other Cultures

In this paper actual examples from different cultures will not be given. However, references are given of examples of mathematics from some cultures. For example,

Gerdes (1988 & 1990)	-	Mozambique weaving to illustrate mathematics and geometric thinking and mathematics in traditional sand drawings;
Keitel, Damerow & Bishop (1989)	-	Mathematics from Africa and other parts of the world;
Finau & Stilman (1995)	-	Geometric skills in tapa designs in Tonga;
McMurchy-Pilkington (1995)	-	Mathematical activities of Maori women in the Marae kitchen;
Ascher (1991)	-	Bushong sand figures and Malekula and Vanuatu sand tracing to illustrate graph theory, Inca strip patterns and Maori rafter patterns to illustrate geometry, Iroquoi games to illustrate chance:
Barton & Fairhall (1995)	-	Mathematics from Maori designs, patterns and carvings;
Lean (1994)	-	Counting systems of PNG and the Oceania region; and
Kaleva (1995)	-	Bamboo wall patterns from PNG for number patterns.

Educational Challenges for PNG

One of the challenges of education in PNG and elsewhere is how school mathematics can take the learners' out-of-school knowledge into account or how the curriculum can incorporate this 'cultural mathematics.' Official education policies of the Papua New Guinea (PNG) Government encourage a 'community oriented and a culturally based' education and curriculum. These policies support a 'culturally oriented' curriculum. A perusal of mathematics curriculum documents, however, shows a curriculum which is similar to those found in other countries - assumed to be culture free and 'canonical' (Howson & Wilson, 1986). The mathematics taught in PNG schools and the classroom practice clearly shows that the intentions of the government are not being implemented.

THE STUDY

At the forefront of any implementation process are the teachers, which is why the research by Kaleva (1998) examined teacher beliefs about mathematics and culture and the observed teacher classroom practices.

Sample and Participants

The sample size (n = 135) was made up of lower and upper secondary mathematics teachers in PNG High schools and included 34 (25 %) females. The respondents from 50 schools included 7 (5 %) Head Teachers and 12 (9 %) Subject Heads. The schools were from 16 of the 21 provinces and from the four main regions. Forty-six percent (46 %) of the teachers had less than three years teaching experience, 43 % had four to ten years while the rest (14 %) had more than ten years teaching experience. Most of the teachers (67 %) had diplomas in Secondary Teaching while 25 % had first degrees.

Twelve teachers (including 4 females) were interviewed and 5 teachers (including 2 females) were observed in class.

Data Collection

Three main methods were used to collect data: questionnaire, interview and observation. The questionnaire was divided into two main sections. Section A was Likert-type, with statements about "School mathematics" (SM) and "Cultural mathematics" (CM). These statements were grouped according to four teacher belief categories (or scales) based on a theoretical construct. The four scales were teacher beliefs about: *where learning takes place (Locus); mathematics teaching; the nature of mathematics, and the status of SM and CM.* Section B contained a list of activities and the respondents indicated how much mathematical knowledge was needed for the activity.

Teacher questionnaires were mailed to 112 PNG high schools in early 1995. After the initial analysis of the returned questionnaires, five teachers from three schools were selected for observations, based primarily on the responses which determined the position of the teacher on an imaginary 'beliefs' continuum. Other considerations in the selection of the teachers were where the teacher was teaching (urban or rural school, region) and the gender of the teachers.

The observations of the lessons were conducted in Term 3 of 1995 and an observation guide was used. All the lessons were audio taped and each teacher was observed for a week. An interview schedule with questions about their responses to the questionnaire and their use of CM was used in the interviews.

QUESTIONNAIRE RESULTS

Table 1 below shows teacher responses to statements in section A of the questionnaire as grouped according to the three beliefs categories (see notes on *Statistical test results* which explains why the three beliefs categories were used).

Table 1.

Teacher Responses to Selected Items in Section A of Questionnaire.

STATEMENT		RESPONSES		
Item	**Mathematics Teaching**	**A/SA**	**NS**	**D/SD**
		(%)	**NS**	**(%)**
(4)	Mathematics identified in traditional cultural activities should also be taught in schools	**81**	**4**	**15**
(7)	Traditional mathematics found in ones' own culture should not be taught in schools	**20**	**4**	**76**
(11)	Teachers should show how mathematics is used in cultural contexts	**94**	**2**	**4**
(15)	In schools, teachers should teach only the mathematics that is prescribed in the syllabus and textbooks	**16**	**1**	**83**

(19)	When teaching mathematics teachers should take into account students' prior knowledge learnt out of school	**89**	**1**	**10**
(26)	School mathematics should teach students about values in life.	**85**	**10**	**5**
(27)	Some mathematics identified in cultural activities should be included in the secondary mathematics curriculum.	**82**	**7**	**11**
Mathematics learning: where mathematics learning takes place				
(1)	Mathematics can also be found in traditional cultural activities	**100**	**0**	**0**
(5)	The only mathematics students learn are those taught to them by teachers in schools	**26**	**1**	**73**
(10)	Traditional practices such as counting, measuring, drawing are also mathematical	**100**	**0**	**0**
(24)	Students come to school to learn "school mathematics", not cultural mathematics	**27**	**3**	**70**
Nature of mathematics				
(2)	Mathematics consists of a body of knowledge whose truths should be questioned	**68**	**13**	**19**
(6)	School mathematics is made up of abstract concepts and ideas which are value free	**45**	**13**	**41**
(14)	Mathematics is about learning arithmetic, algebra and geometry.	**43**	**4**	**53**
(16)	Mathematics identified in traditional culture is too simple (at the arithmetic level)	**58**	**10**	**32**
(22)	Rules are the basic building blocks of all mathematical knowledge	**74**	**7**	**19**
(23)	Mathematics is about knowing when to use rules and formulas to find answers to problem	**71**	**3**	**26**
(30)	Mathematical knowledge consists of facts, theories and formulae which are unquestionably true	**59**	**10**	**30**
(32)	Mathematics is culture free	**39**	**25**	**36**

Table 2 shows teacher responses to section B of the questionnaire where respondents were asked to indicate how much mathematical knowledge was needed for the activity.

Table 2.

Teacher Responses to Section B of the Questionnaire.

Activity	*% of "No math" response*	*% of "Some math" responses*	*% of "Lot of math" responses*
pilot flying an aeroplane	1	2	97
carpenter building a house	1	29	70
estimating the height of a tree	3	70	27
selling (betelnut) buai	8	82	10
children playing a traditional game	42	58	0
making patterns on bamboo walls	34	56	10
woman weaving a mat	27	64	9

villagers building a traditional house	17	64	19
villager using the stars to navigate by canoe from one island to another	17	55	28

STATISTICAL TEST RESULTS

A number of statistical tests were carried out on teacher responses to the questionnaire items. One-way Analysis of Variance *(ANOVA)* tests of significance for various independent variables showed that there were no significant differences($p \leq 0.05$) for gender, teaching experience, teacher level, specialist areas, qualification, schools, school location (urban/ rural or region) and school type. This indicated that the teacher sample was fairly homogeneous. This was not surprising because the response frequencies showed that there were no variances for many of the items (i.e., high percentage of unanimous or near unanimous responses).

Item reliability tests were carried out for the overall items and the four beliefs categories (scales which were based on the theoretical construct of teacher beliefs about mathematics learning, mathematics teaching and nature of mathematics). The *Cronbach's Alpha* (which measures the internal consistency of a test) for all the items in Section A was 0.75. This is a measure of a single construct. For example, if the items were a measure of teacher beliefs about cultural mathematics, the Cronbach's Alpha measurement would be 0.75**.** Although this was acceptable, the *Item / Total correlation* ('Pearson's correlation coefficient' between each item and the other items) showed that most of the items had correlations of less than 0.4 which indicated a weak relationship between each item and the other items, so there was no strong basis for considering the overall items as the measure of a single construct: e.g., a measure of teacher beliefs about cultural mathematics. The Cronbach's Alpha for scales 1- 4 were 0.49, 0.24, 0.38, 0.64 respectively. These results show that there was *no basis* for the use of the scales. *Factor analysis* was therefore used to group the items into the three categories (rather than scales) shown in Table 1 (see also the section on teacher conceptions about SM and CM).

CLASSROOM OBSERVATION RESULTS

Table 3 gives a summary of the results of the classroom observations.

Table 3 Summary of Classroom Observation

Teacher	***Classroom Activities***	***Examples/ Exercises used***	***Resource Use***	***Explanation/ Exposition***	***Methods of Solution***	***Portrayal of Maths***
Teacher A	Typical classroom activities – Teacher gives examples, explains, exercise, students do exercise.	Formal mathematics examples – from textbooks, worksheets. No example of mathematics from traditional culture. Activities and	Text books and work sheets	Explanation of formulas, procedures with questions. When giving solutions, students are asked, *"Why is ?*	Methods of solution not necessarily negotiable but explored ways of getting an answer. Impression seems to be, other methods of	Mathematics is so well organized, defined, no room for mistakes, all about facts.

		exercises used from text book: 5/5 worksheets photocopied from texts			solution not possible, they are well defined.	
Teacher B	Impression of student learning passive learners. Not much communication between teacher and students – interaction mostly one way.	Activities & exercises used from textbooks: 6/6 (work sheet supplemented 2/6).	Use of textbooks, sticks to textbooks, worksheets. Activities and exercises used from textbooks.	Asks for solutions to problem but as if there's only one way to solve it. There are other ways of writing … algebraic solution but did not explore, pursue this line.	There is really one way of finding areas of rectangle and squares – by using rules, formulas.	Mathematics is precise with rules, solutions with algebraic manipulations.
Teacher C	Teacher gets students to suggest ways of findng a solution, not call out answers. Teacher fields suggestions eg. Sum of nos. from 1 to 20 Actual dramatisation of handshake problem in class. Contextualising problem Handshake problem, 9 people, how many handshakes – relates handshake problem to class.	The kinds of examples used were typically textbook exercises but his approach to teaching was to use appropriate procedures to solve problems eg. Negotiate methods of solution. No examples of mathematics from culture were actually used.	Activities/ exercises used from textbook: 1/5 lessons. Used own examples: 4/5. Mentioned textbook at end of one lesson. Did not mention textbook often, although some problems were obviously from textbook. No other resources were used.	Shows steps to solution by asking questions, Does it together with students	Methods of solution are negotiable, allows students to use own methods of solution, gets students to actually participate in finding solution.	Presents mathematics as a debatable subject.
Teacher D	Typical maths lessons: Example, explain, student exercise.	Activities/exercises used from textbook: 6/6 lessons. Used own examples: 4/6. Most exercises from textbook.	Textbook only resource used this week. Mathematics from textbook only.	Typical maths lessons, relies on rules and formulas.	Formal methods of solution, formal explanations.	Mathematics is all about rules and formulas. Maths as decontextualised subject.
Teacher E	Typical maths lessons: Open text book, do exercise on page … Mathematics	Activities/ exercises used from textbook: 8/8 lessons. Used own examples: Once	Uses mostly text books. Predominant use of textbook – study of	Mathematics presented as a reproductive subject. Mathematics lessons are	Teacher does not seem to promote other possible methods of solution. There is one correct way	Mathematics is portrayed as a one way subject (mathematical knowledge

	lessons are all about going through the text book.		mathematics centres around textbook. Text consulted constantly to check for answers.	about going through the textbook.	to find the solution, through the use of formulas.	transmitted from the teacher to the pupils).

DISCUSSION OF FINDINGS

The findings may be discussed under several sub headings, including teacher beliefs about mathematics teaching and learning, the nature of mathematics, teachers' conceptions of school and cultural mathematics, and appropriate classroom practice.

Teacher Beliefs about Mathematics Teaching

Eighty-two percent of the teachers agreed or strongly agreed that mathematics identified in traditional activities should be taught in schools and that some of this should be included in the secondary mathematics curriculum (also 82 %). The result is confirmed by the seventy-six percent who disagreed with the converse statement, that traditional mathematics found in one's own culture should not be taught in schools. When asked if they thought some examples of school mathematics could be found in traditional activities, an affirmative answer was given citing geometry, patterns, measurement, area, volume and counting systems as examples.

It is interesting to note that although the majority of the teachers agreed that mathematics from culture (CM) should be taught in schools, almost all the teachers interviewed agreed that this type of mathematics was simple and was at the basic elementary level (remember that this sample is made up of secondary teachers). Almost sixty percent of the respondents to the questionnaire either strongly agreed or agreed that mathematics identified in traditional culture was too simple (thirty percent disagreed, while ten percent were unsure). It was clear from the interview data that although most of the teachers agreed that mathematics from culture should be taught in schools, they also believed that cultural mathematics was basic mathematics which was best taught at the primary level. Many believed that if CM were to be included in the secondary school curriculum, then the appropriate level would be the lower levels (e.g., Grades 7 and 8 or what is now the upper primary).

Those who disagreed that CM should be taught in schools (15 %) did so because they did not believe any mathematics had been found in PNG culture that was worth teaching in high schools. For example, when asked if mathematics from traditional culture should be included in the secondary curriculum, the response from one of the interviewees was: "If there is any maths that has been found in PNG (culture), then it's okay". Even though eighty-three percent disagreed that teachers should teach only the mathematics that was prescribed in the syllabus and textbooks and ninety four percent agreed that teachers should show examples of how mathematics was used in a cultural context, the observations suggest that in reality the prescribed mathematics is the only mathematics that most of them teach.

Teacher Beliefs about Mathematics Learning

Statements about mathematics learning sought to establish whether PNG teachers believed that mathematics could be learnt outside of the official systems of mathematics learning, particularly in a traditional cultural context.

Ninety-one percent of the teachers believed mathematics could be learnt by participating in traditional cultural activities and another ninety-one percent agreed that mathematics could be learnt 'out-of–school', with the majority (94%) disagreeing that mathematics is learnt in schools only or that it is found in mathematics textbook only (92 %).

The result that almost all the teachers believed mathematics could be learnt in a cultural context, for example, by taking part in traditional cultural activities, such as fishing or building traditional houses, was surprising. It was surprising because mathematics is associated with schools and school mathematics exercises almost always give examples of applications of mathematics in activities associated with 'western' culture or a modernised society with hardly any examples of mathematics associated with traditional cultural activities.

The most likely explanation for these results is related to the home backgrounds of the teachers in the sample. Because ninety percent of the PNG population live in rural areas where traditional practices and activities are the norm, most of the teachers would have experienced this lifestyle. For most, their first experiences of mathematics would have probably been with activities which involved counting in their own languages, measuring the length of a pandanus floor for the house, using a rope or cutting out a round cricket sized ball from the cylindrically shaped soft tissue that forms the inside of a fern.

Research elsewhere on children's mathematical knowledge shows that mathematics is acquired outside of the structured systems of mathematics learning, for example, in every day activities out of school, at work, in the street or informally (Nunes, 1992). These results show that PNG teachers are culturally aware.

Teacher Beliefs about the Nature of Mathematics

Previous studies of teacher conceptions about mathematics noted that views about the nature of mathematics fall into variations of an internal and external continuum (Dossey, 1992). External views regard mathematics as an externally existing body of knowledge, facts, principles and skills available in syllabi or curriculum material while internal views regard mathematics as a personally constructed or internal set of knowledge, where mathematics is a process or a creation of the mind. There is a third perspective which states that mathematical knowledge (facts, concepts and skills) results from social interaction that relies heavily on context (Dossey, 1992; Bishop, 1985 & 1988).

PNG teachers had differing views to the statements in this category. Responses to the statement: "Mathematics consists of a body of knowledge whose truths should be questioned" showed that 68 % of the teachers agreed or strongly agreed while only 19% disagreed or strongly disagreed (13% not sure), seeming to indicate that a lot of

the teachers had strong internally oriented views. The picture becomes more revealing when one considers the responses to the other items in this category. For example, in response to the statement: "School mathematics is made up of abstract concepts and ideas which are value free", 45% agreed or strongly agreed, 41% disagreed while 13% were not sure. In response to the statement: 'Mathematics is culture free' 39 % agreed, 36 % disagreed while 25 % had a 'not sure' response. The responses indicate that the number of teachers who hold internally oriented and externally oriented views is about equal (40 %).

The higher percentage of 'not sure' responses (25%) may be noted. This may indicate that the teachers are genuinely not sure whether, for example, mathematics is culture free because they have not been confronted with the issues dealing with mathematics and culture. More importantly, it may reflect the conflict that exists between their perceptions of mathematics and the mathematics they portray in class - usually one that is culture free.

The above results are also surprising as they show that a lot more PNG teachers than expected have strong internally oriented views about the nature of mathematics. Based on the writer's experience as a mathematics student and then as a mathematics educator, mathematics in PNG (as elsewhere) is taught as an abstract and context free subject which does not seem to have any connection whatsoever with traditional culture (Kaleva, 1992). The classroom observations also confirm this.

Teacher Conceptions of School Mathematics (SM) and Cultural Mathematics (CM)

The teacher responses to the questionnaire show that the teachers manifest distinct perceptions about school mathematics (SM) and cultural mathematics (CM). It is important to make this distinction because teachers' expressed beliefs distinguish between SM and CM. Three distinct teacher conceptions (including teacher conceptions about SM and CM) were identified from the factor analysis (of the items from section A of the questionnaire). They were teacher conceptions about: teaching and learning out-of-school mathematics (e.g., as in traditional culture or CM); teaching and learning in school mathematics (SM); and mathematical concepts and knowledge, which refer to teacher conceptions about the nature of mathematics (Kaleva, 1998).

An important point to note about the factors identified above is that they are separate factors. It does not mean that the teachers believe either one factor or the other. It cannot be assumed that if a teacher has strong beliefs about teaching and learning CM, then this teacher will have less strong beliefs about the teaching and learning of SM. It is quite possible that the teacher who has strong beliefs about CM can also have strong beliefs about SM. What this means is that the teachers in PNG will have distinct beliefs about SM and CM, and at times these views may seem contradictory. At the beginning of the study it was assumed that views supporting cultural mathematics (CM) would be more internally oriented. It can be seen that this is not so as the teachers' views about SM and CM can be both internally and externally oriented. This will also explain why teachers were not sure in regard to the statements in the nature of mathematics category: 'mathematics is culture free' and 'school mathematics is made up of abstract concepts and ideas which are value free'.

The interview data further support this distinction. For example, one of the teachers interviewed agreed that there were mathematics in culture. However, when asked if it should be taught in schools the teacher replied: "Yes, if it can be found." This indicated that according to the teachers' perception, mathematics in culture was different, yet to be discovered. The idea that mathematics is an externally existing body of knowledge, waiting to be discovered is consistent with 'Platonic' (external) views which teachers have about mathematics. The other teacher conception of mathematics is the 'Aristolean' (internal) view which regards mathematical knowledge as a personally constructed internal set of knowledge (Dossey, 1992).

Teacher responses to section B of the questionnaire (see Table 2), where teachers were asked to indicate how much mathematical knowledge was needed for a list of activities, also show teachers' distinct perceptions of SM and CM. Many teachers still believe that one does not use any mathematics in performing traditional activities. The percentage of teachers who believe that one does not need any mathematics to perform the activity is higher for the traditional activities than for the non-traditional activities.

A specific example is the response to children playing traditional games. Forty-two percent believed that no mathematics was involved while fifty-eight thought that some mathematics was involved while none of the teachers believed it involved a lot of mathematics. Yet research clearly shows that it involves a lot of mathematics (Nunes, 1992). Implications for teaching are that if teachers do not think there is any mathematics involved in those activities, they will not use it as a teaching strategy.

The teacher responses to the questionnaire clearly show that the teacher beliefs are in line with government policies. The teachers are culturally aware and believe that CM should be taught in schools, and that examples of CM should also be included in the curriculum. The important question is: What happens in practice? Do the teachers use examples of CM in their teaching?

Classroom Practice

The 'social construction' framework by Bishop and Goffree (1986) was used to analyse the mathematics lessons that were observed. These researchers offer "the social construction frame" as an alternative conceptualisation of the mathematics lesson. This view recognises the social aspect of classroom interactions and " views mathematics classroom teaching as controlling the organisation and dynamics of the classroom for the purpose of sharing and developing mathematical meaning" (Bishop & Goffree, 1986:315). An important aspect of this view of classroom teaching is the concept that any new mathematical idea only has meaning if it can make connections with an individual's existing knowledge. Bishop and Goffree proposed three main components of the mathematics classroom as *activity, communication and negotiation*. The use of this framework was important for this study because it was sensitive to the cultural aspects of mathematics teaching. In particular, it helped to identify "teachers' portrayal of mathematics" and also allowed for an analysis of the methods of solutions used in the classroom (see Table 3).

The emphasis of the analysis on "how mathematics was portrayed" in the lessons that were observed was based on the premise that teacher beliefs about the nature of

mathematics are manifested in their portrayal of mathematics (Thompson, 1992). The researcher recognised that "how mathematics is portrayed" is highly inferential, but by using other categories, questions related to methods, examples, formulas and rules, language and resources, inferences about how mathematics is portrayed could be made.

The beliefs of the observed teachers were identified before the observations. Teachers A and B were identified as having strong school mathematics oriented views. Teacher C was identified as having strong cultural mathematics oriented views. Teachers D and E had mixed SM and CM oriented views.

In most (80%) of the lessons of Grades 7 and 8 classes that were observed the teachers did not use examples from traditional cultural activities. Of the teachers who were interviewed and observed, only one teacher indicated that he had used examples of CM to introduce a lesson. The content of the mathematics taught by all the teachers consisted typically of text book exercises but there were differences in their teaching approaches, particularly in the methods of solution and the portrayal of mathematics.

As can be seen from Table 3, the methods of solution used and how mathematics was portrayed by teachers A, B, D and E are typical of most mathematics lessons. The methods of solution are not negotiable, formal methods of solutions are used with formal explanations and emphasis on use of formulas for solutions. Mathematics is portrayed as well organised, precise with rules and formulas, and as a one way subject with knowledge transmitted from teacher to pupils. There were no differences in the way mathematics was portrayed in class between these four teachers. They employed school mathematics (SM) methods. There were differences between these teachers and Teacher C. Teacher C used methods of solution which were negotiable, allowed students to use their own methods of solution and portrayed mathematics as consisting of facts which were debatable.

Although the teachers unanimously agreed that CM should be taught in schools, in practice that does not happen. This is understandable considering that there are curricular constraints. Because the mathematics curriculum is nationally prescribed and is centrally imposed, the teachers teach according to the syllabus. The pressure of examinations forces teachers to 'cover the syllabus'.

What this suggests is that teacher beliefs about mathematics teaching and learning are probably not as important to classroom practice as teacher beliefs about the nature of mathematics. The educational system under which the teacher has to operate can act as constraints to practice. However, teacher beliefs about the nature of mathematics can have an influence over the way mathematics is portrayed. As can be seen from the observations, teachers with SM oriented views or mixed views portrayed mathematics as consisting of facts, rules and formulas where the methods of solution were not negotiable. Teachers with the CM oriented view negotiated mathematical solutions with the students and portrayed mathematics as a debatable subject.

CONCLUSION

This study confirms what has been reported by other studies (Howson & Wilson, 1986; Travers & Westbury, 1989). There is a mismatch between teachers' stated

beliefs and their practice. For example, although the teachers' stated beliefs are that they should teach CM in school and show how SM is used in a cultural context, in practice it doesn't happen.

The findings also support those of Sosniak et al. (1991) who found that teachers did not seem to hold theoretically coherent points of view. For example, teachers' unanimous responses to two categories of teacher beliefs (mathematics teaching and mathematics learning), seemed to indicate that teachers had internally oriented beliefs. However, their responses to the nature of mathematics category indicated that they had differing views - some internally oriented while others had externally oriented views.

Teacher beliefs are not the single most important factor that influences practice. Practice is largely determined by curricular context, curricular constraints and situations. Curricular constraints, such as, pressures of external examinations, or to 'cover the syllabus', ensure that the teachers do not deviate from teaching the prescribed content.

The relationship between beliefs and practice is not linear but circular. Practice changes beliefs and beliefs develop, change and evolve. Curriculum context is necessary before beliefs can be put into practice. For example, the availability of material on CM will determine if teachers can include CM in their classroom practice.

Teachers in PNG manifest beliefs which indicate that CM exists and that CM should be taught in schools. However, the curricular constraints are such that it does not happen in practice. One of the curricular constraints is the lack of available CM materials. If CM in the PNG context can be identified and included in the curriculum, it 'legitimises' the mathematics and also provides teachers with the opportunity to put into practice their beliefs. I repeat the statement made at the introduction that one of the educational challenges for PNG in the 21th century is how school mathematics can take the learner's out-of-school knowledge into account or how the curriculum can incorporate this 'cultural mathematics'.

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