Ethno-mathematics, ethno-knowledge, and ethno-education

Andy Begg, *University of Auckland*

Abstract

My concern is curriculum and I interpret curriculum as *all planning for the classroom*. Curriculum therefore involves what is taught and how it is taught, learned, and assessed, and the planning occurs at regional, school, and classroom levels. When thinking about ethnomathematics and curriculum I see a need for consideration of the 'ethno' aspects of education and knowledge as well as of mathematics and with this paper I have tried to stimulate this process. For me such consideration implies involvement of and listening to the people from the various cultures, solutions cannot be imposed by outsiders.

My intention in presenting these issues is to raise questions not provide answers. The answers will vary across cultures and the people of each culture must make the decisions for their people. The role of mathematics educators is to provide opportunities for debate and decision making, to empower people of different cultures, to listen to the debates, and to provide professional legitimization if and when necessary so that mathematics education can move forward. However, there is a risk that mathematics educators may be too well indoctrinated in their own privileged academic culture and not hear what people really want.

Introduction

From a curriculum perspective I am concerned with 'inclusiveness' in terms of meeting the needs of learners from a range of cultures. I am therefore interested in:

- the place of ethno-mathematics in the curriculum
- the nature of knowledge and how it is organized across cultures
- ways of learning and teaching that are culturally appropriate
- achieving educational aims that are not subject specific, and
- who 'owns' the curriculum.

In considering these issues I have come to see that colonialism is alive and well, the colonial masters being from the west and from the power elite within countries, I see a need for a fundamental rethink by ordinary people about what is wanted from education.

Previously, working with colleagues (Begg, Bakalevu, Edwards, Koloto & Sharma, 1996), we defined ethnomathematics as the mathematics of a culture and discussed how aspects of Polynesian cultures had influenced aspects of mathematics and education. At that stage the aspects we considered from culture were language, beliefs and experiences; the aspects of mathematics were content (arithmetic, algebra, geometry, statistics), and the processes (communicating, reasoning, problem solving, making connections, using tools); and the aspects of education were curriculum, teacher/student roles and relationships, learning/teaching/assessment activities, and informal learning situations. In doing this we took a western perspective on mathematics, culture and education and this is now problematic for me. I see a need to reconsider the way that education/schooling and mathematics have developed and to look for culturally appropriate alternatives.

Historically—education/schooling and mathematics

Since Plato's time in the west formal education has been linked with schooling and mathematics has been one of the subjects taught. The reason for such formal education was to train future leaders so that they could preserve what was seen as the 'ideal' society. In other words, education was to preserve the power and privilege of the ruling/upper class. The curriculum emphasised academic subjects—practical knowledge was seen as something that only the lower classes needed.

This tradition of academic schooling for the upper classes continued for many years and still influences schooling. Writers such as Foucault (1980) have raised awareness with respect to the power structures and knowledge that exist in education and schools, while writers such as Freire (1972) have offered alternatives that question the traditional notions of power and privilege.

School subjects such as mathematics are part of a western view of knowledge. This view is a 'partitioning' of knowledge that separates rather than integrates topics, and privileges academic knowledge over other forms. I acknowledge that the development of subjects such has mathematics has contributed significantly to society in many ways, but alternatives also need to be considered.

I believe that formal education and subjects have not changed markedly over the last 50 years, that colonialism is alive and well, that the west and the ruling/upper classes are retaining power and privilege; and that we are part of the privileged class.

Purposes and aims of education

If aspects of culture including ethnomathematics are to be considered for a curriculum then there is a need to first decide the aims of both education and mathematics and to see if ethnomathematics fits with these aims. This is likely to occur in regions where different or non-western cultures exist and needs to be done by the people of those cultures, not by the privileged members of the educated class or even worse, by overseas experts.

I would envisage such a consideration as not being a consultative process (not the giving of advice by experts) but a listening process with 'experts' listening to the people, and this may best be facilitated by the experts not being present at all meetings. By listening I mean hermeneutic rather than evaluative or interpretive listening, as Davis (1996, p 53) has said

> … evaluative listening is an uncritical *taking in* of information that is *out there*, interpretive listening involves an awareness that one is *projecting onto* one's understandings particular biases that are *in here*, and hermeneutic listening is a *participation in* the unfolding of possibilities *through collective action*.

Such a process is likely to take many months as traditionally people have not been empowered to make such decisions and the choices are complex. Interrelated questions about aims such as the following are likely to slowly emerge and while they might seem simple, none of them are either/or questions: Preserve or transform society? (And if transform, towards the west or some other ideal?), Cultural or western values? Cooperation or competition? Economic or sustainable development? Societal or personal development? Capitalism/consumerism, communism, or communalism? At the same time other related questions might include: Formal (school) or informal (home and community) education? Compulsory or optional courses? Western subjects or traditional knowledge? Individual or communal learning?

The nature and organization of knowledge

As teachers we usually think about curriculum in terms of subjects. However, many subjects have been depreciated over the years, partly by assessment. Topics have been analysed and broken into small measurable objectives involving facts and simple procedures, the notion of connection or synthesis is often forgotten. As part of this analysis aspects of subjects like mathematics—content (knowing), processes (doing), and thinking—are too often dealt with and tested separately (or even omitted).

Within Western knowledge traditions there are different views. One classification is from Belenky, Clinchy, Goldberger & Tarule (1986), they talk about knowledge as being received, subjective, procedural, separate, connected, and constructed—and these different forms of knowledge seem to arise in different cultures as well as with women.

Hart (2001) presented another perspective by focussing on what matters in education and in life. He sees knowing and learning as unfolding through six interrelated layers: information, knowledge, intelligence, understanding, wisdom, and transformation. For Hart information involves discrete facts and basic skills. Knowledge involves the development of systems of information instead of discrete pieces. Understanding moves beyond the rational and the sensory, it is cultivated through empathy, appreciation, openness, accommodation, service, listening, and loving presence. Wisdom involves a degree of awareness that enables discrimination. Hart sees schools as too often skimming the surface of information at the expense of knowledge, intelligence, understanding, and wisdom. My belief is that often schools mistake information for knowledge yet wisdom rather than knowledge should be their concern. Hart's view involves more than rational knowing and other ways of knowing need to be considered when one asks what knowledge is valued within a culture. In the west it seems that rational knowledge is valued more highly than other forms of knowledge such as sensory, intuitive, bodily, and spiritual knowledge.

Another aspect on knowledge is the emphasis given. Some people take a practical stance and see knowledge in terms of knowing *how* and *when*; others take an abstract position and focus on knowing *what* and *why*. These are not either/or positions; they are positions within a field of many possibilities. According to one's stance towards knowing, ones view changes on whether knowledge is for practitioners, for everyone, or for anyone who wants it; and this links with responsibility, power, the danger that goes with possession of knowledge, and the respect one has for specialist practitioners.

In contrast to the western partitioning of knowledge, Bishop (1988), in the context of ethnomathematics, argued that mathematical activity is often embedded in other activities such as counting, locating, building, cooking, designing, and playing; and in a similar way I would assume that other subject activities are likely to be also embedded in a range of everyday activities. This raises the issue of whether traditional subjects are the most culturally appropriate way to organise learning.

These issues raise questions. Should mathematics and other subjects be taught as subjects or embedded within learning activities (a holistic or integrated curriculum), or is there a middle way? Should the focus be on practical or theoretical knowledge? How best can topics be 'connected' within the discipline, with related topics, and with other subjects? What knowledge other than rational knowledge is valued? What constitutes wisdom?

Ways of learning, teaching and assessing

Cognition is the *process of acquiring knowledge through thought, experience, and the senses* (Pearsall, 2001). In mathematics it seems we emphasise knowing through rational or logical thought. In any culture I would ask: Are enough opportunities given to develop mathematical knowledge through experience and through the senses? Is the rational emphasised at the expense of intuition and awareness? Can other ways of knowing co-exist with the proof paradigm in terms of justification within mathematics? And these questions seem to me to be culturally dependent.

Considering awareness, Depraz, Varela, and Vermersch (2002) have written on becoming aware through introspection, phenomenology, and the contemplative traditions—these approaches raise questions about becoming aware in mathematics, ethnomathematics and ethno-education. Perhaps developments from ethno-education into ethnomathematics and then to mathematics will enrich the ways that all people might come to know mathematics in the future. Certainly we know that in western mathematics results are accepted when proven, but we also know that that was not how they were discovered.

The learning of mathematics in Western cultures traditionally relied on teacher talk and chalk and students listening, then usually doing a number of drill problems from which it was assumed they would practice and learn the concepts and procedures being taught. This drill associated with practice was often quite different than the eastern tradition where the aim of drill is understanding. More recently learning has begun changing to involve more:

- questioning of and by students,
- discussion between teacher and students and between students,
- use of 'concrete' materials,
- applications involving real-world contexts
- use of extended project-type investigations,
- group work,
- technology use.

The teaching/learning process in some cultures excludes questioning of or discussion with the teacher because of students' respect for the their authority. In addition, in some situations students feel uncomfortable if asked a verbal question in front of a whole class because of the 'shame' they might feel by being wrong or the humiliation of being separated from their community. This may be countered by organizing groups and having a group member discuss the group's findings and represent the team rather than presenting a personal opinion. Discussion may be fostered in some cultures by having student groups debate alternatives with the teacher refusing to say 'what the right answer is'. However, these differences are not true for all cultures.

The use of 'concrete' materials seems to be helpful with most students but there is a need to ensure consistency between the methods used with the concrete and desired with the algorithmic procedure. Real world contexts are often used as a form of concrete scaffolding, to be helpful these contexts need to be familiar to the students, and one problem is that contexts in textbooks from developed countries may be totally unfamiliar to students in remote situations. This also arises with contexts in ethnomathematics, for example, a context on navigation at sea from a coastal settlement is likely to be totally unfamiliar to a learners in an inland mountain village.

The use of extended project-type investigations, or at least extended activities is more likely to occur in situations where the mathematics is embedded in other meaningful contexts. Related to projects is the notion of experience, and as Dewey (1938) argued, experience is more important than being told.

In many settings for indigenous learning considerable emphasis is put on learning by observing and imitating. In the west this occurs to some extent in home situations but is rarely encouraged in schools.

It is evident that there is no right or wrong way to educate people of different cultures. Just as non-westerners, whether teaching mathematics or ethnomathematics will consider Western practices, so those of us in the West need to consider non-Western traditions. As Reagan (2000, p. 206–208) suggested, we have much to learn from indigenous educational practices. He identified seven broad themes for consideration. These were:

- In the West we conflate and confuse 'formal schooling' with 'education'.
- In the non-West education is more community-based and communal. Adults and older children have important roles, and little focus is on educational specialists. In such communities everyone is a teacher
- The emphasis on 'civics' education in some non-western countries is political, while in others a more spiritual concern is at issue.
- In virtually all non-Western countries education involves vocational education, some vocations are chosen by the child and others by parents, some are restricted, some are chosen at birth, others determined by gender
- The role of the family is central to education in most non-Western countries
- Language is important. Some countries have written traditions, others have been entirely oral and this alters the way language is taught and used.
- The principal goal in most non-western traditions is the development of the *good person*. Thus values, morality, and spirituality and the meaning of life are part of their traditions.

Assessment has three main forms—diagnostic, formative, and summative. The first two of these are better thought of as part of the teaching-learning process rather than as assessment. Summative assessment is important in the West because of the "concern with formal certification and degrees rather than with competence" (Reagen, 2000), or as Jacobs (2005) puts it, the issue is "credentialing versus education". Perhaps we need to ask whether information from summative assessment is of any value beyond the educational community, and if it is not, then what information is of value. Again, the west may have something to learn from traditions with less emphasis on measurability.

I believe that summative assessment should reflect the aims of education and of the subject, and the learning activities used in the course. This can often be achieved by collecting portfolios of work and this may be more appropriate than assessing by testing in some situations, for example, in countries considering ethnomathematics when a range of cultures exist, in developing countries that can not afford to set up test regimes, and in cultures that emphasise group work.

These different ways of learning and teaching raise questions about effective learning, cultural appropriateness. At the same time they seem to relate to achieving general educational aims.

Achieving educational aims

Typically the aims of education focus on the development of cognition, self, and community. These interrelated foci can be interpreted in different ways, cognition may be limited to rational knowing or be broader, personal development might be concerned only with preparation for work, or include self-awareness, and community development might be about national economic prosperity or about the building of community in terms of relationship skills. While different cultures will see these differently my concern is how does a subject such as mathematics contribute to such general aims. Lerman (2005) said, "of all the subjects mathematics is the only one where the learner's identity is left at the door." I see this as an important concern because in teaching mathematics (in terms of both subject matter and teaching approach) we have a responsibility to help develop aspects of self and community. I wonder if forms of cultural mathematics, being more embedded in the culture/community of the learners, and taught in a culturally appropriate way may help meet this challenge, and be better able than traditional mathematics to achieve the goals of both the subject and of the education in general.

Hamilton (2005), taking a systems view of knowledge and an enactivist position on learning, has argued convincingly for the interdependence of 'connectedness' and 'the building of caring and empowering relationships' with successful learning. Her perspective suggests that alternative ways of teaching are needed if subjects (including mathematics) are to contribute to such desirable general aims.

Each subject has its aims—I argue that the purpose for studying any subject is to help learners develop other ways of making sense of their worlds. More mathematics compreises three interrelated areas:

- content (facts and basic procedures in arithmetic, geometry, algebra, …),
- processes (problem solving, reasoning, communicating, …)
- thinking (specialising, generalising, conjecturing, visualizing, changing representations, …).

The aims with respect to these areas may relate to using, understanding, identifying and selecting, and having confidence. Whether these aims are best met with traditional or cultural mathematics is one question, but if the processes and thinking are given more emphasis rather than content, then it seems to me that they can be learnt using a very broad range of mathematical topics. In addition to the aspects of mathematical thinking there are more general aspects to consider, these include critical thinking (questioning assumptions), creative thinking , and meta-cognitive thinking (thinking about thinking). Whether considering ethnomathematics as a subject in its own right, as part of an integrated curriculum, or as a dimension of mathematics, there is a need to ask, what are the differences between the subject aims for mathematics from the west and from the particular culture, and does ethnomathematics contribute to these aims? Personally I see ethnomathematics and western mathematics as complementary in that they provide different ways of making sense, but this raises questions of curriculum focus. In some cultures people talk of 'two-way' education, their aim being to preserve traditional knowledge and have the advantages of the knowledge of the dominant culture—this is a valuing of complementary ways of making sense, but it raises questions about possibilities within countries educational systems that operate with both time and financial restraints.

Culture and curriculum
Aims, subjects, and ways of teaching and learning are all basic to curriculum if one thinks of it as planning for the classroom rather than merely a list of topics to be taught. If the aim is 'connection' then ethnomathematical topics are more likely to connect with the world of the students, However, culture and subjects may value different things and these need to be thought about. An example of this is with logic. In mathematics logic is emphasised and generally follows traditional western philosophic logic—something is either 'this' or 'that'. Other forms of logic argue for 'this' or 'that' or 'both this and that', or 'neither this nor that' or 'this and that and more' and even 'this and not this at the same time'. This raises the questions, what is the logic system of a particular culture? and, can alternative logic systems be used within mathematics? A related issue is, how important is logic in mathematics? While logical reasoning has been central to Western mathematics some cultures put greater emphasis on the utility of mathematics, and on its recreational aspects. This raises the whole issue of the emphasis put on reasoning and proof within a curriculum.

Who owns the curriculum?
The points raised so far relate to the people of a culture being empowered and making decisions about school mathematics. However, the curriculum is for the students, and as Hamilton (2005) suggests, it is important that students be empowered. Perhaps Davis (1996) phrase 'curriculum anticipating' is preferable to 'planning', Student empowerment suggests that students need to have opportunities to choose topics, approaches to these topics, and ways of working—and this is threatening to many teachers.

Looking ahead
Ethnomathematics and ethno-education enrich ones views of mathematics and of the teaching/learning process by offering alternative ways of looking at both the subject and the educational process. The advantages that may accrue from implementing ideas from ethnomathematics and from ethno-education may be relevant to developing countries where mathematics is not a traditional subject, and to countries with bicultural or multicultural populations. However each situation is unique; no policy about ethno-mathematics or ethno-education fit all circumstances. Each culture (country, region, community, or school) has to decide what they see as best for themselves and alter their curriculum accordingly. Having cultures making different decisions means we will have diversity, and from diversity comes progress (which implies there are dangers in current globalization trends with curriculum).

Finally I would like to emphasize that the questions that I have raised are not intended to stop experimentation within curriculum, quite the reverse, they are intended to extend the range of experimentation beyond the constrictions caused by current Western curriculum thinking. I do not believe that these questions can be answered by logical analysis alone, they are more likely to require an iterative cycling process involving traditions, school practices, experiments, discussion, and responding to these with an awareness of reactions from the head, the heart, the spirit, the self, and the community. And for colleagues from western cultures, and I include myself, we are not experts in the mathematics or education of other cultures, we need to sit at the feet of the masters, to listen, and to learn.

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