Ethnomathematical Ideas in the Curriculum

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A study has been undertaken to investigate the implementation of an ethnomathematical unit in a mathematics classroom in the Maldives. The research was conducted at two primary schools and involved teaching grade 5 students an ethnomathematical unit of work on measurement. The unit was designed in conjunction with the teachers. This paper discusses ethnomathematical curriculum models and the approach used in the study. Data are presented indicating teachers' and students' reactions to using such a curriculum unit. The data show that despite the very traditional education of the Maldives, the ethnomathematical approach was appreciated and understood by teachers and students.

Classrooms or other learning environments cannot be isolated from the communities in which they are embedded. They are part of a community with defined cultural practices. When students come to school they bring with them values, norms, and concepts they have acquired as part of growing up. Some of these are mathematical (Bishop, 1994). However, the mathematical concepts of the school curriculum are presented in a way that may not be related to the students' cultural mathematics. It has been hypothesised that low attainment in mathematics, especially in the Third World countries, could be due to lack of cultural consonance in the curriculum (Bakalevu, 1998). Moreover, there is research evidence that including cultural aspects in the curriculum will have long term benefits for mathematics learners. That is, in terms of deepening their understanding of mathematics, recognising mathematics as part of everyday life, and enhancing their ability to make meaningful connections (Bishop, 1988; Boaler, 1993; Zaslavsky, 1991). The field of ethnomathematics presents some possibilities for educational initiatives that would meet this situation.

The trend towards ethnomathematical approaches to mathematics curriculum and pedagogy reflects a comprehensive development in mathematics education. Ethnomathematical approaches are intended to make "school" mathematics more relevant and meaningful to learners, and to promote the overall quality of education. However, by implementing the ethnomathematical approaches, are we sure that the teachers and learners "get the idea" of ethnomathematics and, as a result, enhance the learning of mathematics? How would we know? As an essential step towards answering these questions, a study has been initiated in the Maldives where an ethnomathematical unit has been designed in conjunction with teachers, and implemented in their classrooms.

This paper looks briefly at what is meant by an ethnomathematical curriculum and the ethnomathematical curriculum model used in this study, and then presents the method used for data collection. Research findings with respect to teachers' and students' reactions to using an ethnomathematical unit are given and the extent to which the ethnomathematical ideas behind the curriculum were understood is discussed.

The Ethnomathematical Curriculum Model

The term ethnomathematics was coined by D'Ambrosio (1985) to describe the mathematical practices of identifiable cultural groups and may be regarded as the study of mathematical ideas found in any culture. Moreover, ethnomathematics

can be described as the way people from a particular culture have common systems for dealing with quantitative, relational, and spatial aspects of their lives (Barton, 1996). As such, it provides insights into the social role of mathematics. Ethnomathematicians argue that the pervasive view of mathematics as Eurocentric and value-free misrepresents the evolution of modern mathematics through the ages. Some of these researchers plead for a more culturally sensitive view of mathematics to be incorporated into the school curriculum (Adam, 2002; D'Ambrosio, 1985; Zaslavsky, 1991).

From the literature on ethnomathematics, five different possibilities for an ethnomathematical curriculum can be identified. Many implemented programs offer aspects of more than one of these. However, all characterisations are premised on the belief that an ethnomathematical curriculum is one in which the cultural aspects of the students' milieu are infused in the learning environment in a holistic manner (Adam, Alangui, & Barton, in press).

One possibility for an ethnomathematical curriculum could be labelled as "mathematics in a meaningful context", for example, New Zealand Mathematics Curriculum (Ministry of Education, 1992). This vision is epistemological in the sense that mathematics is presented as a cultural response to human needs. Every culture is assumed to have such mathematical responses and these responses are valid content for a mathematics classroom. It has been hypothesised that a curriculum of this type would affect how students would think about mathematics rather than how or what they learn (Bishop, 1988; Zaslavsky, 1991).

A second possibility is of ethnomathematics as a particular cultural content that is distinct from the universal mathematical concepts taught at most schools, for example, distinctive designs or decorative forms such as those exhibited in weaving. This ethnomathematical content could make up any part of the curriculum, from a small section to a major proportion of the total. It has been presumed that a curriculum of this type will have benefits for student learning for motivational reasons (Zaslavsky, 1991).

Another conception could be built on the idea that ethnomathematics is a stage in the development of mathematical thinking that a child goes through in his/her mathematics education. The ethnomathematical curriculum is that part of the curriculum that focuses on the mathematical world of the child's culture (Begg, 2001). A curriculum of this type may benefit student learning in terms of students being aware of the mathematics found in their own culture and seeing mathematics as a living and growing discipline (Barton, 1996; Zaslavsky, 1991).

A fourth ethnomathematical curriculum could be the mathematical part of the idea that all classrooms are situated in a cultural context involving cultural values, beliefs and culturally specific learning theories. The component of this cultural view of the classroom that is specific to mathematics could include, for example, whether learning mathematics is predominantly oral or written, what a mathematics classroom looks like, what sort of mathematical authority is required in a teacher, and what should be the format of assessment. If this way of thinking about an ethnomathematics curriculum is adopted, then it has to be decided

whether a culturally specific classroom is a good thing and whether or not and how students during their education will experience other norms and values. This type of an approach to curriculum is suggested by Bishop's (1988) work on "mathematical enculturation". In terms of learning, this curriculum will presumably help students to make connections between school and the real world and would develop the capacity to handle real life situations.

The approach this study is aligned with, however, is an ethnomathematical curriculum as an integration of the mathematical concepts and practices originating in the learners' culture with those of conventional, formal academic mathematics. The learners start from the experiences they have from the environment and build upon these mathematical ideas ultimately realising and understanding such things as the need for accuracy and the use of formulae, in mathematics and in real-life situations. The work of Lipka (1994) is an example of this type of an approach to curriculum. It is assumed that a curriculum of this type will motivate students to recognise mathematics as part of their everyday life, enhance students' ability to make meaningful mathematical connections and deepen their understanding of all forms of mathematics (Adam, 2002; Barton, 1996; Boaler, 1993).

Before designing and implementing an ethnomathematical curriculum therefore, there are several questions that need to be addressed: What might be the reasons for adopting this kind of curriculum? How do we decide which cultural mathematical ideas are to be included in the curriculum? Why are some cultural ideas valued and not others? Do the learners who share the same indigenous cultural environment, have the same experiences and mathematical knowledge? Is it possible for a teacher who has been schooled in conventional mathematics to identify mathematical ideas that do not resemble conventional mathematics? Does an ethnomathematical approach imply a specific teaching style? What are the links between an ethnomathematical approach and the indigenous language? What are the effects of such an approach to the quality of conventional mathematics being learned? (Adam, 2002; Vithal & Skovmose, 1997).

The framework for the ethnomathematical curriculum model (Fig.1) used in this study was devised by adapting the ideas of Lipka (1994). The objective of this model is to allow students to become aware of how people mathematise in their culture, and to use this awareness to learn about formal mathematics.

Figure 1 illustrates possible linkages between areas of mathematical activity and the connections indicated by highlighted arrows are privileged by an ethnomathematical curriculum (Adam, 2002).

Figure 1. Framework for an ethnomathematical curriculum unit.

In addition to theoretical pedagogical justifications, the rationale for developing an ethnomathematical curriculum model for the Maldives, is as follows:

- The Maldives has a rich heritage of mathematics because of its close connections with the traditions of both Arabs and Indians. Mathematics has persisted through many generations and has been well adapted to Maldivian society. However, in recent years, the dependence on British examinations and the consequent reliance on Western mathematics tradition have almost displaced indigenous mathematics skills. An ethnomathematical curriculum may revalidate these skills.
- Another purpose of such a curriculum is to preserve the mathematical heritage of the Maldives. The march of globalisation, with its imperative for a single language and culture for communication, is decimating the linguistic and cultural pluralism of the world (Barton, 1996; Bockarie, 1993; McConaghy, 2000). A culturally based education may preserve the mathematical culture of the Maldives.
- Maldivian Ministry of Education statistics show that the pass rate of students in mathematics in public examinations has been relatively low. Research carried out in developing countries has shown that a culturally rooted pedagogy can be meaningful to mathematics learners (D'Ambrosio, 1985; Bakalevu, 1998). A study of this nature can further the debate about how to achieve better learning. A similar rationale may apply for any homogeneous Third World society.

Method

The aim of this study is to investigate the implementation of an ethnomathematical curriculum in a primary classroom in the Maldives. However, the practical intervention is moderated by what is practically possible, so a small sample of one unit of work was used to illustrate for teachers and students what an ethnomathematical curriculum would be like. This study was designed with an ethnographic orientation, as it was necessary for the researcher to be actively involved in the research and the data are collected from the participants' point of view, namely, their beliefs, ideas, behaviours, values and assumptions.

The research was conducted at two primary schools involving grade 5 teachers and students using an ethnomathematical unit of work on measurement (area, perimeter, volume). One school was in the capital - Male', where the medium of instruction is English and the other from a rural island (Mahibadhoo) where the medium of instruction is *Dhivehi* (mother tongue). The study involved seven teachers and about 210 students in the Male' school, and two teachers and about 60 students in the Mahibadhoo school.

Workshops were conducted with teachers before the implementation of the unit, to induct them into the idea of the ethnomathematical unit and to work with them on draft material. The unit planned and written at these workshops was then taught over three weeks replacing the standard unit in the curriculum. The three-week unit included:

- Visiting different sites such as carpentry, boat building sheds, and markets, to explore mathematical aspects of these activities. The purpose of this was to

understand the nature and origins of mathematics better, and to value and appreciate the existing knowledge.

- Doing activities in the classroom using cultural objects related to measurement. The purpose was for students to understand and experience the cultural activities from a mathematical point of view, thereby enabling them to make the connection between the real world and school mathematics.
- Doing activities in the classroom that were outside students' experiences or culture. The purpose was for students to connect their "mathematics" to parallel ideas outside their culture. This is to enable them to appreciate that each culture has its own way of mathematising, and that different strategies can be and were invented whenever the need arose, and that standard measurements enable communication among cultures in a globalised world.
- Doing activities in the classroom to learn about and learn to use conventional mathematical systems, notations, and techniques by discussing the need for accuracy and examining real world instances where mathematical accuracy and formulae are needed. The purpose was for students to understand the link between the real world and conventional school mathematics.

During the data collection, information was sought from teacher workshops, questionnaires, classroom observations, interviews, teacher resources, and a research journal. A questionnaire was given to all teachers before and after the implementation of the unit, and interviews were conducted with all teachers after the implementation of the unit. Interviews were held with two students of each class in the Male' school and a questionnaire were given to all students at the Mahibadhoo school, after the implementation of the unit.

During the implementation some classes were observed throughout. Some of the parameters used for observation were: the use of context during the lesson; the teacher helping and encouraging students to talk about mathematics in the classroom; the teacher and students' use of their own ethnomathematical experiences; and the teacher and students linking ethnomathematics to school mathematics. The researcher participated as a colleague with the teachers involved and did not stand in a formal role with the students except by association with the teacher. During the implementation, informal discussions were held with the teachers most days. This process of collaboration was insightful for both the researcher, trained in the Western way as a secondary mathematics teacher doing research at primary level; and for the primary teachers trained in the Maldives as they come to understand the concept of an ethnomathematical curriculum.

All the data from questionnaires, interviews, journals and other resources were analysed using the data handling tool – NUD*IST (Quantitative Solutions & Research, 2002).

Evidence

With reference to some fundamental themes that emerged from the qualitative analysis of the data, the following discussion examines whether there was any evidence from the teachers and students that the idea of implementing an ethnomathematical curriculum unit was appreciated. Some themes that emerged

from the data included: motivation and interest; awareness of mathematics in the society; and facilitation of understanding of mathematical concepts.

Motivation and Interest

All teachers appreciated the motivational aspect of the model. They felt that once the measurement topic started, students were motivated and interested in learning mathematics. Moreover, from the survey, in which students were asked which method of mathematics learning they preferred, 91 percent of the students said that they preferred to learn mathematics the way they learnt the ethnomathematical unit on measurement. Typical of teachers (T) and students (S) comments were:

T9: The implementation was very effective. Students' interest in mathematics changed a lot and they were very motivated to study. I would also like to note that it was a great encouragement for the weaker students.

S11: I prefer to learn mathematics this way … this way it is easier for me to understand and it is more interesting and fun.

This aspect of motivation was not included explicitly in the ethnomathematical curriculum model framework for this study. However, it was quite prominent in the data, as is evident from the above comments. This is an important aspect for any curriculum model as there is ample empirical evidence that these aspects are necessary for meaningful mathematics learning (e.g., Zaslavsky, 1991).

Awareness of Mathematics in the Society

Most of the teachers and some students volunteered the information that they had not previously been aware that mathematics exists outside school and in their culture.

S1: Before the measurement topic was taught, I did not think of mathematics outside school. Now I see mathematics everywhere. On the street….Mum also use measurement in cooking – to measure the rice. At the fish market to sell the fish.

T2: It was easier for them [students] to understand that mathematics is something which is done everywhere, not only at school …this was something I also haven't thought of before.

The raising of awareness of mathematics in outside school activities prompted the realisation for some teachers that their traditional method of teaching had led to students thinking that school mathematics was not useful in the outside world.

T8: I will include activities related to culture when teaching mathematics. When taught the way we have been teaching, students don't know how to use mathematics they learn at school when doing real life activities. They can't make the connection.

The field trips and making connections between school mathematics and real world activities in the classroom during their investigations on perimeter, area, and volume was appreciated by students, and integrated into their view of mathematics.

S4: People use area and perimeter when building houses and tiling the floor. Volume is used when dad build water tanks … when we grow up we have to know how to measure, so it is important to learn these things … without mathematics we cannot do anything in life

The students' realisation that they would be using mathematics outside school led to the unexpected finding that they as well as the teachers seemed to be viewing mathematics as a human activity.

S10: I see mathematics outside school especially the mathematics in the activities that people do

T2: When students go out and experience different activities for themselves and ask questions … they also learnt about how people use mathematics in doing different activities in the society

S12: … before I never thought about other people using mathematics in their work

From an ethnomathematical perspective, mathematics is a human creation that emerges as people attempt to understand their world (Adam, Alangui, & Barton, in press). Therefore, this "active" view of mathematics is an important criterion for success for an ethnomathematical curriculum.

Facilitation of Understanding of Mathematical Concepts

Not only did this ethnomathematical approach allow students to make the connections between school mathematics and real world activities, but also seemed to assist their understanding of the formal conventional mathematics.

T5: Previously when taught using chalk and talk, students were not very involved in learning mathematics. But this time … they had a better understanding and they were able to apply what they've learnt and it was easier for them to grasp the mathematical concepts. By the time we introduced the formulae, the students had an understanding of the concepts of area, volume and perimeter.

T2: This [approach] helped students' thinking processes and it was easier for them to understand the mathematical applications.

S12: I can understand mathematics better now … I know how to use formulae and things better after seeing how people do things in [for example] construction of houses.

The ethnomathematical unit of work enabled some students and teachers to become aware of and "see" mathematics in various work contexts; and to facilitate their understanding of mathematical concepts through practical examples using cultural objects, investigations, and by relating school mathematics to real world activities. An ethnomathematical curriculum is not just about application of relevant contexts in learning and teaching mathematics. It is also about introducing formal mathematics using cultural ideas, in such a way that formal mathematics is better understood, appreciated and made more meaningful to learners who study in Maldivian primary classrooms.

Conclusion

There are many different approaches to an ethnomathematical curriculum, and which approach to use depends upon what one is trying to achieve. Some of the ways that an ethnomathematical approach has been used include:

- Using examples of ethnomathematics to make mathematics more interesting;
- Using ethnomathematics to teach about particular groups of people;
- Showing how the same mathematical idea is present in many contexts;
- Enhancing feeling of cultural worth and unity - often used to try to help students from minority groups in a society;
- Using ethnomathematics as an educational tool to help students to understand what mathematics is about, and to help them make it part of their own knowledge.

It is this last use of ethnomathematics that was the focus of this study, in the Maldivian classrooms.

The reactions of teachers and students indicated that the ethnomathematical approach appeared to be welcomed, appreciated, and understood by both the teachers and students. Teachers and students were able to identify activities and experiences in Maldivian culture exhibiting measurement systems, and were able to link this to the conventional mathematics that is part of the Grade 5 measurement syllabus.

Research data suggest several levels of ethnomathematical awareness and responses. The basic level is motivation and interest, the next level is seeing

mathematics at work in the society and being able to connect school mathematics to real world activities, and the final level is understanding mathematics actively as something that humans develop in response to particular situations.

Whether these awareness and response levels can be attributed solely to an ethnomathematical curriculum model is debatable. Also open is the question of whether they can be achieved across all teachers and all students. It may well be that Maldivian teachers and students, who are used to the traditional method of "chalk-and-talk" teaching and learning mathematics, were relieved from boredom, as they were able to go out on field trips, and explore mathematical activities in class. Further research needs to be done to establish firm causes to changes in attitudes.

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