Explorations between ethnomathematics and anthropology in relation to mathematics education

Darlinda Moreira
Universidade Aberta, Portugal
Centro de Investigação em Educação, Departamento de Educação da Faculdade de Ciências da Universidade de Lisboa

Abstract

Mathematical activity has flourished all over the world. Such activity is organized either in formal systems of knowledge, or embedded in daily life, emerging in work, educational, leisure practices, professions, norms and artifacts. Several fields of study have contributed to uncovering the human diversity of mathematical ideas and practices, including the history of mathematics, psychology, theology, anthropology and ethnomathematics.
Addressing the question, "What is ethnomathematics (how is it related to mathematics, anthropology and the politics of mathematics education?)" posed by Discussion Group18 - the role of ethnomathematics in mathematics education, this paper focuses on the relationship between anthropology and ethnomathematics, explored from the view point of their connection to the field of mathematics education.

Introduction

There are manifold connections between ethnomathematics and anthropology. Both these fields of study share:

- an important object of study, which is local systems of knowledge that might be related to mathematics or are invoked as mathematics;
- an import corpus of literature and the same seminal key concepts such as culture, cognition, interaction and local knowledge;
- a characteristic seminal feature of the use participant observation as the most prominent research methodology.

Moreover there are important issues that are considered in these two fields, and that are also important issues in mathematics education and in education, in general, such as learning, cognition, literacy, human rights, diversity and multiculturalism. In addition, the role of mathematical knowledge in contemporary societies, along with the influences of literacy and schooling is developing wider social uses of mathematics. Therefore to strengthen dialogue and the mutual enrichment between these fields of knowledge I propose, in this paper, to explore mutual contributions that might have an impact on mathematics education.

Explorations

1- History and conceptualization

Ethnosience, as a multidisciplinary field of research, studies the role of systems of knowledge in the construction of reality, namely the relationship between humans and their environment, and it has been focused mainly on what has been called “the knowledge of others”. Thus, as a concept, ethnoscience has had a profound influence on the theoretical development of ethnomathematics, as a means of comprehending mathematical interrelationships among cultural contexts, cognition and social practices. These influences are visible, for example, in the first attempts to define ethnomathematics (Ascher & Ascher, 1986; D’ Ambrósio, 1985).

However the history of ethnomathematics is rather different and independent from the history of ethnoscience. It is noteworthy that seminal texts on ethnoscience usually employ terms such as ethnobotanic, athnozoology and ethno -, (Barrau, 1983; Sturtevant, 1964) but the term ethnomathematics is not typically. This is probably a consequence of the strong relationship between ethnoscience and the fields of natural sciences that underlay it (Barrau, 1983; Sturtevant, 1964). But I interpret this fact as a phenomenon that strengths the idea that although to some extend ethnoscience has influenced ethnomathematics the latter has an independent history that grew and developed mainly from and within the field of mathematics education, as a result of seminal work by Ubiratan D’Ambrósio, Paulus Gerdes, Eduardo Ferreira and Bill Barton.

In addition, although terms such as ethnobotanic, ethnozoology, etc. have been in use since the nineteenth century (Barrau, 1983; Campos, 2002; Gerdes, 1989, 2007; Sturtevant, 1964) what they stand for began to be polemic mainly because, when ethnoscience is fragmented into several “ethno X - ” (e.g., ethnobotanic, ethnozoology, ethnobiology, ethnoastronomy) the meaning of the prefix ethno attached to western scientific fields might be interpreted as a concept intended to subordinate or shape others’ knowledge into western scientific categories (Campos, 2002; Barrau, 1983; Sturtevant, 1964).

In regard to this issue, D’Ambrosio (2000, 2005) calls our attention to the existence of different ethnosciences (which include western science) and to mutual influences among them that created the field of mathematics as we know it now. In D’Ambrosio’s words (2000)

> The same as Western science and mathematics, ethnosciences and ethnomathematics have a symbiotic relation.
> Both are not new disciplines. Rather, they are part of a research program on history and epistemology. The pedagogical implications are obvious. Both research and educational programs take into account all the forces that shape a mode of thought, in the sense of looking into the generation, organization (both intellectual and social) and diffusion of knowledge.

Moreover, to the extent that ethnomathematical research reports on mathematical activity from all over the world it contributes to problematizing both what counts as mathematical knowledge and the hegemony of western mathematics. In addition, Geertz (1983) highlights that:

> We know, of course, that there is little chemistry and less calculus in Tikopia or Timbuctoo, and that Bolshevism, vanishing-point perspective, doctrines of hypostatic union, and disquisitions on the mind-body problem are not exactly universally distributed phenomena. Yet we are reluctant, and anthropologists are especially reluctant, to draw from such facts the conclusion that science, ideology, art, religion, or philosophy, or at least the impulses they serve, are not the common property of all mankind. (p. 74)

Currently ethnomathematics possess characteristics that go behind ethnoscience's claims (Gerdes, 1997, 2007). Namely, it focuses on the study of the mathematical ideas and practices that are imbedded in professional groups, on daily mathematical practices and patterns of organizing daily life in contemporary societies. The incorporation of these objects of study into the theoretical grounds of ethnomathematics has resulted in modifications to its epistemological assumptions. Namely, Barton (1998) argues that:

> A much more radical version of mathematical relativity is required. In this version it must make sense to talk about Maori mathematics, or English mathematic, or carpenter's mathematics. … This paper introduces the phrase 'QRS system'
> A QRS system is a system of meaning by which a group of people make sense of Quantity, Relationships, and Space. (p. 56)

Barton further argues that in order to push forward the foundations of ethnomathematics "One way is to see ethnomathematical investigations as going *below the surface*…. Another way of pursuing depth is to ask 'What if'?" (p. 57).

2- Diversity, constancy and change

Another issue that I want to bring into the discussion is the important role of ethnomathematics not only in reporting mathematical activity from all over the world but also in discussing and reflecting upon its findings mainly by relating them to educational and schooling practices and aims. These are ethnomathematics's notable contributions to enlarging anthropological conceptions of the role of mathematical activity in the development of humanity, which continues to need development and reflection in concert with anthropological theory.

For example, the topic of number and arithmetical operations has been well researched by both anthropologists and ethnomathematicians (Crump, 1990; Lancy, 1983; Mimica, 1988; Stafford, 2003a; Urton, 1997). The differences between number's conception and arithmetical operations appear for example, in the diversity of numerical systems as well as in the complex relationship between number, language and cognition. Despite these differences Crump (1990) argues that:

> The practical conclusion … is that the series of natural numbers, together with the basic arithmetical operations of addition and subtraction, multiplication and division, are a resource open to use in almost any culture. ...On the one hand, the extent of utilization, varies very greatly. The same is true not only of the different types of use, but also of the different ways in which numbers are understood. (p. 146)

Similar observations are elaborated by Ascher (2002) in regard to geometrical patterns: "the collections of patterns clearly show that despite differences in style, context, meaning, and materials, the same formal spatial orderings occur in many different cultures" (p. 198).

In addition we also need to take into consideration cross-contextual diversity. For example, speaking about number-use in China and Taiwan, Stafford (2003 a), raises the question:

> Do the numbers encountered by children in different contexts – e.g. when reading poetic calligraphy, when selling produce at markets, when learning arithmetic at school - have anything much in common? (p. 68)

Cross-cultural diversity in regard to number and geometrical patterns are being framed from different perspectives. For example, Eglash, Bennet, O'Donnel, Jennings & Cintorino (2006) observe that "ethnomathematics also participates in the 'science wars' debate over the social construction of science and technology: Is math universal or does it vary from culture to culture?" (p. 347). Along the same lines Crump (1990) asks

"What then are the factors which determine the character of a particular numerical tradition?" (p. 146).

Finally, Bloch, Solomon & Carey (2001) call our attention to the same issue using the lens:

> Core knowledge has the following hypothesized properties: 1) its acquisition is supported by innate, domain specific, learning mechanisms; 2) it develops early, under conditions of wide variation in imput; and 3) it remains constant throughout development. These three hypothesized properties have the consequence that core knowledge should be cross-culturally universal.
>
> (…)
>
> there are at least three domains of core knowledge: intuitive psychology, with intentional agent at its center...; Intuitive mechanics, with physical object at its center, … and intuitive mathematics, with natural number at its center (p. 1-2)

Each one of the above ways of framing the issue of diversity in mathematical activity has political consequences for mathematics education. Ethnomathematics' questioning and reflection about broader implications of ethnoknowledge diversity in education and especially focusing on its articulation with school mathematics is essential in order to anticipate argumentation and foster the debate about understandings of cross-cultural diversity.

Despite the cultural transversality what is meant and experienced by number-use and other mathematical themes, as well as the factors convened for the conception and relationship with the social, cultural and physical environment are rationalized in different ways, cross-culturally and within the same culture. Thus, according to different contexts, and simultaneously, people in all cultures are learning new ways of using mathematics. This is, in different social groups, changing visions of number, and other mathematical subjects, is happening as a result of schooling, globalization, cultural encounters and mobility. Recent ethnographic data shows different levels of, for example, number use (Bauchspies, 2000; Bello, 2000; Pires & Moreira, 2005; Verran, 2001). Not only are the contexts of number use changing but also its diverse uses mobilize cultural knowledge, school knowledge and even personally based cultural interpretations about numbers. Therefore ethnographic reports need to be re-examined using the lenses of newer and better understood of mathematics of indigenous people.

3 – Mathematical specialists

Another important issue brought up by the anthropologist Edmund Leach is the existence and role of the mathematical specialist in different cultures. Leach (1992) notes that:

> Mathematics is a necessary adjunct of science, but it is not a cultural universal, in the sense that we are discussing it here. The majority of cultures do not possess any kind of mathematical specialists, and when they possess their number is reduced. (p. 22)

Whether linked to religion or laic professions in different contexts, several studies show the existence of specialized mathematical knowledge in different cultures. The "formal training received by specialists in some cultures" (Ascher, 2002, p. 194) can be the case of Marshall Islands navigators (Hutchings, 1995), the Malagasy divination practices of sikidy, the knot divination in Caroline Islands and the Yoruba diviners who are Ifa specialists (Ascher, 2002).

Thinking about the role of mathematical based knowledge specialists in a given culture, we can ask what are their contributions to implanting mathematical practices and knowledge in societies at a broader level? What are specialists' roles in keeping the culture inside history, working for its survival? And, what are the influences, if any, of specialist knowledge in educational practices, literacy practices, schooling and the broader social and relational customs? In short, what similarities and differences might we think in terms of the existence of different kinds of specialists as having an impact on mathematics education? What are the political consequences for mathematics education of the existence of such specialists?

Summary and Conclusions

If we take into account that different cultures and social groups develop their own ways of knowing and their knowledge as well as interact with other social groups in this changing and multicultural world (Moreira, 2007a), mathematics education needs to take into account differences and particularities of each social group's specific mathematical knowledge. Considering ethnomathematics experience in dealing with different conceptualizations of mathematical-based knowledge around the world its contributions for mathematics education emerge, to provide what is meaningful for students, in regular schooling or adult education; to provide cultural consciousness and awareness about students' different mathematical practices at the level of teachers education; and to represent different mathematical-use traditions and related contexts in materials and curricula.

In addition to better understand the role of mathematical knowledge in contemporary societies, the meaning of mathematically based ideas around the world and their place in human cognition, we need to take into account the capability of ethnomathematics to empower ethnoknowledge and its importance in contemporaneous societies. At a broader level of society it is important to explain in more meaningful ways, for example to parents, community members, the media etc, changes of mathematics curricula and school activities in accordance with sustained social development.

References

Ascher, M. (2002) *Mathematics Elsewhere. An exploration of Ideas Across Cultures.* Princeton: Princeton University Press.

Ascher, M. & Ascher, R. (1986). Ethnomathematics. *History of Science*, 24, pp. 125-144

Barton, B. (1998) Ethnomathematics and Philosophy. *Zentralblatt für Didaktik der Mathematik*, 1999/2, 54-58 (http://www.emis.de/journals/ZDM/zdm992a2.pdf)

Barrau, J. (1984) A propos du concept d'ethnoscience. In, *Ministère de la Culture, Direction du Patrimoine, Mission du Patrimoine ethnologique. Actes du séminaire de Sommières*, 12 et 13 décembre 1983.

Bauchspies, W (2000) Images of mathematics in Togo, West Africa. In, *Social Epistemology*, Vol. 14, nº 1, pp. 43-53

Bello, S. E. L. (2000) Etnomatemática no context guarani-kaiowá: reflexões para a educação matemtática. In Ferreira, M. K. L. (Org.) *Ideias Matemáticas de Povos Culturalmente Distintos.* pp.297-325. Sáo Paulo: Global Editora.

Bloch, M., Solomon, G. E. A & Carey, S (2001) Zafimaniry: Un Understanding of What Is Passed on from Parents to Children: A Cross- Cultural Investigation. *Journal of Cognition and Culture* 1.1 pp. 43 – 68

Campos, M. D. (2002) Etnociência ou etnografia de saberes técnicas e práticas. Em, Amorozo, M. C. M., Ming, L. C. & Silva, S. P. *Métodos de Coleta e Análise de Dados em Etnobiologia, Etnoecologia e Disciplinas Correlatas*, p. 47-91. Rio Claro: UNESP

Crump, T. (1990/1992) *The Anthropology of Numbers*. Cambridge. Cambridge University Press

D'Ambrosio, U. (2005) Sociedade, cultura, matemática e seu ensino. Em, *Educação e Pesquisa*, vol.31 nº1 ISSN 1517-9702

D' Ambrosio, U. (2000) Ethnoscience and ethnomathematics. A Historiographical Proposal for Non-western Mathematics", http://iascud.univalle.edu.co/libro/libro_pdf/Ethnoscience%20and%20ethnomathematics.pdf

D' Ambrósio, 1985 Ethnomathematics and its place in the history and pedagogy of mathematics. *For the Learning of Mathematics* 5(1) pp.44-48

Eglash, B., et al (2006) Culturally Situated Design Tools: Ethnocomputing from Field Site to Classroom. In, *American Anthropologist*. Vol 108 Issue 2, pp. 347-362

Gerdes, P. (2007) *Etnomatemática. Reflexões sobre matemática e diversidade Cultural*. V. N. Famalicão: Edições Humus.

Gerdes, P. (1997) Survey of Current Work on Ethnomathematics In Powell A., B. & Frankenstein, M. (Edts) *Ethnomathematics. Challenging Eurocentrism in Mathematics Education*. pp. 331-371. Albany: State University of New York Press.

Gerdes, P. (1989) Sobre o conceito de etnomatemática. (Tradução da primeira parte da introdução ao livro 'Estudos Etnomatemáticos' (em alemão) ISP (Maputo) . KMU (Leipzig) (policopied manuscript)

Gertz, Clifford (1983). *Local Knowledge. Further Essays in Interpretive Anthropology*. Nova Iorque: Basic Books;

Hutchins, E. (1995) *Cognition in the Wild.* Cambridge: The MIT Press

Lancy, D. F. (1983) *Cross-Cultural Studies on Cognition and Mathematics*. New York: Academic Press:

Leach, E (1992) Universais Culturais e Singularidade das Culturas. Em, *A Ciência como Cultura.* Colóquio promovido pelo Presidente da República, pp. 17-26 Lisboa: Imprensa Nacional-Casa da Moeda

Mimica, J (1988) *Intimations of Infinity. The Cultural Meanings of the Iqwaye Counting System and Number*. Oxford: Berg Publications

Moreira, D. (2007a) Filling the gap between Global and local mathematics. Em *Proceedings of the Fifth International Conference of the European Research Association on Mathematics Education (CERME5)*

Pires; G & Moreira, D (2005) Cálculo mental: estratégias de "escape" dos alunos ciganos ao uso dos algoritmos escolares. Em, Brocardo, J., Mendes, F e Boavida, A (Org.) *XVI SIEM Actas* pp. 253- 272. Lisboa: Associação de Professores de Matemática.

Stafford, C (2003) Langage et apprentissage des nombres en Chine et á Taiwan. In, *Terrain*, 40, pp. 65-80

Sturtevant, W. C. (1964) Studies in Ethnoscience. *American Anthropologist* Vol. 66, nº 3 pp. 99- 131

Urton, G. (1997) *The Social Life of Numbers. A Quechua Ontology of Numbers and Philosophy of Arithmetic*. Austin: University of Texas Press.

Verran, H. (2001) *Science and an African Logic*. Chicago: The University of Chicago Press