

CERME 6 – WORKING GROUP 8

QUESTIONS AND THOUGHTS FOR RESEARCHING CULTURAL DIVERSITY AND MATHEMATICS EDUCATION

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UNDERSTANDING ETHNOMATHEMATICS FROM ITS CRITICISMS AND CONTRADICTIONS²

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We considered articles from six researchers on the field of mathematics education, in which we identified two categories of criticisms to ethnomathematics: epistemological, related with the way ethnomathematics positioned itself in terms of mathematical knowledge; and pedagogical, related to the way ethnomathematical ideas are implicated in formal education. From this analysis we conclude firstly that it is not easy to criticize a research field so diverse and internationalized as ethnomathematics. Those difficulties are related with the different contexts on which ethnomathematics is pedagogically implicated. Secondly ethnomathematics itself as a research field rejects any dogmatic position, and is aware of contradictions implicated in their pedagogical aims.

Key-words: ethnomathematics, criticisms, contradictions, school, education

THE RADICALITY OF ETHNOMATHEMATICS

To associate the prefix 'ethno' to something so well defined, exact and consensual as mathematics can cause strangeness. The idea of a science that is human-proof, as mathematics is in a platonist perspective, is splintered when we associate it with the prefix 'ethno'. 'Ethno' shifts mathematics from the places where it has been erected and glorified (university and schools), and spread it to the world of people, in their diverse cultures and everyday activities. Ethnomathematics as an approach sullies mathematics with the human factor. Not an abstract human, but a human situated in a space and a time that implies different knowledge and different practices to live. Ethnomathematics as a research program is less a complement to mathematics, than a critique to the knowledge that is valorised as being mathematical knowledge.

Ethnomathematics does not restrict its research to the mathematical knowledge of culturally distinct people, or people in their daily activities. The focus could be academic mathematics, through a social, historical, political and economical analysis of how mathematics has become what it is today. As mentioned by Greer (2006), it is

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part of ethnomathematical research to understand the historical development of mathematics as a scientific discipline, the understanding of that development as the intersection between knowledge from different cultures, and the way the validation of what is considered to be true mathematical knowledge is less related with issues of rationality, than with the social and political contexts.

According to D'Ambrosio (2002)³ academic mathematics is the basis of our modern world, upon which rests our faith in science and enlightenment ideas. So, if ethnomathematics aspired to be more than just the study of different mathematical ideas, but also the critical study of the social, political and anthropological aspects of academic mathematics, it assumes itself a critical stance on how mathematics is involved in the maintenance of our modern world. Ethnomathematics wishes to be an epistemological and educational alternative but, above all and this is not always given, a social and political alternative to our modern world.⁴

Given the radicalism of the ethnomathematical program (at least as it is put by D'Ambrosio (2002)), it is not surprising that its emergence has been the target of strong criticism. In our days research on ethnomathematics is numerous and scattered around the world.⁵ It's difficult to have an international perspective on how ethnomathematical research is being done. Hence, to criticize something with so different practices and discourses as ethnomathematical research could result in an unreal chimera, if we don't take into consideration the different contexts on which research is made. A way to surpass those difficulties requires criticizing ethnomathematics as a well defined research program, and by analysing the work of the most important ethnomathematical researchers. That was the path chosen by Rowlands and Carson (2002) and Horsthemke and Schäfer (2006), in the epistemological and educational critique made on ethnomathematics. This critique, we argue, although apparently pedagogical, is an epistemological critique that pretends to highlight academic mathematics as one of the biggest achievements of mankind. In what concerns the pedagogical critique made by the latest researchers, and also by Skovsmose and Vithal (1997), we will articulate the contradictions raised by ethnomathematical researchers. Even among these researchers there are contradictions in how they understand the pedagogical implications of ethnomathematics.

EPISTEMOLOGICAL CRITICISMS

In 2002 Rowlands and Carson wrote an article published in *Educational Studies in Mathematics*, where they make a critical review of ethnomathematics, by comparing the ethnomathematical program to the curriculum of school mathematics. This article was subsequently answered by Adam, Alanguai and Barton (2003), which Rowlands

³ But also to the philosopher Heidegger (1977) considered the most important of 20th century by Slavoj Žižek (2006).

⁴ At least, as D'Ambrosio (2002, 2003) put it.

⁵ All those references are present in the bigger version of the paper.

and Carson (2004) later responded to in turn. As raised above, this paper also draws on arguments by Horsthemke and Schäfer who wrote two articles presented at the International Congress on Ethnomathematics in 2006, where they follow most of the arguments presented by Rowland and Carson. Those two sources of criticism present themselves as an educational critique on ethnomathematics but, in the way we analysed the texts, they are above all an epistemological critique, especially the articles from Horsthemke and Schäfer.

Against a nominalist posture assumed by ethnomathematics, Rowlands & Carson (2002, 2004) and Horsthemke & Schäfer (2006) advocate an essentialist position, based on the idea that although knowledge is constructed by humans, remains beyond. This is to say, there is some kind of invariant (an essence) that is repeated in all mathematical knowledge, despite this knowledge being developed in a Mongolian tribe or in a European university, the mathematics involved is the same:

Mathematics is universal because, although aspects of culture do influence mathematics, nevertheless these cultural aspects do not determine the truth content of mathematics (Rowlands & Carson, 2002, p. 98).

The authors positioned themselves against the politicization of science: “mathematics is a science, and its laws, principles, functions and axioms have little to do with issues of social justice” (Horsthemke & Schäfer, 2006, p. 9). Or, as mentioned by Rowlands and Carson (2002) “rationality may be the preserve of an oppressive cultural system but that does not necessarily mean that rationality is in itself oppressive” (p. 82). Represented very strongly in this sentence is the idea that rationality exists *per se*, that is, as something disconnected from the social and political environment. In that sense, mathematics is taken by the authors as a piece of truth and neutral knowledge that could be used to the good and the evil, although mathematics itself is free from judgement: “the odious use of something does not make that something odious” (p. 98).

These authors embraced academic mathematics as a universal human good, shared by all people and considered to be one of the biggest achievements of mankind. This universal knowledge is presented as being the climax of a human evolution, and clearly more precious than others:

The reason we are attempting to ‘privilege’ modern, abstract, formalized mathematics is precisely because it is an unusual, stunning advance over the mathematical systems characteristic of any of our ancient traditional cultures. (Rowlands & Carson, 2004, p. 331)

Finally, the authors adopted an epistemological position in which the genesis and consolidation of knowledge must be understood by analysing the internal logic of that

knowledge and its pragmatic value, suggesting that social and political aspects have no influence in that genesis.⁶

modern conventions of mainstream mathematics have become ‘privileged’ (i.e. accepted by the world’s mathematical community and numerous secular societies) for reasons that have little if anything to do with the politics of nations or ethnic groups, but have much to do with their pragmatic value. (Rowlands & Carson, 2004, p. 339)

EDUCATIONAL CRITICISMS

The tone for the educational critique developed by Horsthemke and Schäfer is the way the application of ethnomathematical ideas into South African schools contributed not to the inclusion, but to the exclusion of children. Ten years before, Skovsmose and Vithal (1997) had developed the same critique, although in a more constructive way. They called our attention to the way ethnomathematical ideas are implicated in schools of countries suffering from ethnic and racial tensions. In the case of South Africa, we can see how those ideas contributed to the creation of a lighter mathematical curriculum (based on students’ backgrounds) to those students considered being ‘ethno’⁷. As a consequence of that politics, those students were systematically excluded from access to academic mathematics then aimed at the white student: “in South Africa bringing students’ background into the classroom could come to mean reproducing those inequalities on the classroom” (p. 146).

This critique on the way ethnomathematical ideas in school could overshadow the access to academic mathematics is also made by Rowlands and Carson. These authors emphasise the dangers involved in not considering formal mathematics as an important part of all students’ education. According to the authors, it is formal mathematics that gives access to a privileged world, and that all students should know how to appreciate that knowledge:

There is every danger that mathematics as an academic discipline will become accessible only to the most privileged in society and the rest learn multicultural arithmetic within problem solving as a life skill or merely venture into geometric aesthetics. (2002, p. 99)

In this sense, the authors defend a clear distinction between the local culture of a student, and the scientific and school culture:

To preserve American Indian cultures, African tribal cultures, traditional cultures of Asia and elsewhere, their uniqueness must be recognised, not collapsed into a dreary and illusory sameness with scientific culture. (2002, p. 91)

Rowlands and Carson are against the use of ethnomathematical knowledge in the classroom, arguing that there may be incommensurable ways of understanding and

⁶ As was done in mathematics during the so called crisis on the foundations of mathematics, where mathematicians like Frege, Hilbert, Russell tried without success to epistemologically understand mathematics by using mathematics. The Gödel results showed what a chimera such enterprise is.

⁷ Black students in the context of apartheid regime.

perceiving mathematics. It is that incommensurability that could make an artificial endeavour in trying to articulate ethnomathematical knowledge with school knowledge. They argue that people can master more than one culture, and school should be the place where people have contact with the more universalized culture, this is, the occidental culture.

Finally, Rowlands and Carson consider mathematics to be a foreign language to all students before they go to school. Contrary to the ethnomathematical stance which argues that students already have non-formalized mathematical knowledge before they start school, these authors argue that *protomathematical* knowledge is not important for learning school mathematics, because all students are equally positioned to learn a new knowledge:

We go to great lengths to point out that children of traditional cultural backgrounds are probably not at any significant disadvantage when it comes to learning mathematics, since it is a 'foreign language' to all novices, regardless their cultural background. (2004, p. 335)

Skovsmose & Vithal (1997) acknowledge the importance of ethnomathematical ideas on a critical mathematics education. They identified four trends in the ethnomathematical research, and stressed that it is in the confrontation with school mathematical curriculum that ethnomathematics finds its greatest challenge, and also the possibility of critique. Firstly, the authors stressed the fact that research in ethnomathematics does not usually specify much about the relation between culture and power. Secondly, they identified a problem with the definition of 'ethnomathematics', and make the question: how can someone educated in formal mathematics identify other mathematics? According to them, ethnomathematics only makes sense through the perspective of academic mathematics. Thirdly, the authors argue that ethnomathematics lacks a critique on how mathematics formatted reality (Skovsmose, 1994). Finally, as mentioned before, Skovsmose & Vithal (1997) think it necessary to *problematize* the idea of students' background, and think not just in terms of the actual culture of students, but also in the aspirations and desires that students have of emancipation, what they called the students' foreground:

Foreground may be described as the set of opportunities that the learner's social context makes accessible to the learner to perceive as his or her possibilities for the future. (p. 147)

According to Skovsmose (1994) all the importance given to students' background could inhibit them from emancipation, and more attention should be paid to the opportunities that the social, cultural and political context could bring to students. By emancipation Skovsmose means the access and participation in a world where mathematical knowledge is central.

SOME COMENTS ON EPISTEMOLOGICAL CRITICISMS

Before entering into a discussion on the epistemological criticisms made to ethnomathematics, we take the position that the interpretation of ethnomathematics carried out by Rowlands, Carson, Horsthemke and Schäfer is misleading. These authors understand ethnomathematics as an ethnic or indigenous mathematics. In fact, there is a vast diversity of studies in ethnomathematics, and part of them assume that ethnomathematics research consists of understanding, with the tools of academic mathematics, the mathematical ideas of culturally distinct people⁸. In that sense, ethnomathematics is indeed the study of an ‘ethnic’ mathematics:

the prefix *ethno* refers to ethnicity, this is, to a group of people belonging to a same culture, sharing the same language and rituals, in other words, cultural well delimited characteristics so we can characterize it as a specific group. (Ferreira, 2006, p. 70)

In this sense, the educational implications of ethnomathematics are focused on “how to bring ethnic knowledge to the classroom to allow for a meaningful education? How to establish the bridge between ethnic and institutional knowledge?” (Ferreira, 2006, p. 75). But there are other ways of addressing ethnomathematics. For instance, D’Ambrosio (2004) clearly says that “my view of ethnomathematics try to avoid the confusing with ethnic mathematics, as understood by many” (p. 286). That’s why D’Ambrosio prefers to talk about “ethnomathematics program”, as something more than the study of the ideas and uses of non-academic mathematics. We understand this program as a radical one, in the sense that it endeavours is to criticize, not just mathematics and mathematics education, but social orders and ideologies that feed our current world. As mentioned by D’Ambrosio (2004), “the ethnomathematical program focuses on the adventure of human species” (p. 286). Others like Knijnik (2006) and Powell & Frankenstein (1997) also criticize the idea of ethnomathematics as an ethnic mathematics and have developed investigations where the thematics of power and politics is taken seriously.

The epistemological discussion carried out by Rowlands, Carson, Horsthemke and Schäfer is an echo of a bigger philosophical discussion about the nature of knowledge that was intensively debated in the last decades under the label of “science wars”. As with any philosophical question, there are different ways of analysing it, and everyone has the right to choose the one that better fits its interests. We will not enter in such a discussion here. We just want to call attention to two points. First, in a philosophical line where we can include Nietzsche, Marx, Foucault, Durkheim, Weber, Wittgenstein, Freud, Lacan, Kuhn, Lakatos, Bloor, Restivo, Deleuze, Althusser, Zizek among others, knowledge is perceived from a nominalist perspective, that is, as something which creation, maintenance, valorisation or disqualification has nothing to do with its intrinsic or essentialist value, but with the way knowledge is exercised, whether it is in a language game (Wittgenstein, 2002),

⁸ See for instance the work of Sebastiani Ferreira, Paulus Gerdes and Marcia Ascher.

in the webs of discursive modalities involving power relations (Foucault, 2004), as an ideological discourse (Althusser, 1970), and so on. The meaning and the knowledge we have of something is always contingent, full of historicity, and involved on power relations. As mentioned by Amâncio (2006) the idea of knowledge as something universal, with an existence *per se*, is itself a very ideologically loaded position. Hence, the important aspect of this epistemological discussion is less a discussion on whether knowledge is itself universal or situated, but, as mentioned by Foucault (2004), what intentions, what politics, are behind the claiming that some knowledge (like academic mathematics) is universal?

Secondly, unlike Rowlands, Carson, Horsthemke and Schäfer, we don't think there is a lack of theoretical and philosophical basis for ethnomathematics. Although there is a very diverse and disperse field of research, and also a recent one, there are several studies where the focus is not the ethnomathematical knowledge of groups of people, but philosophy, sociology and political science. Most of those studies use the work of the philosophers mentioned above.⁹

The authors of the essentialist perspective positioned themselves as the guardians of academic mathematics that fuelled this modern world, seen as being superior to any existing society, "the beliefs and practices of other societies are epistemic and vertically inferior to our own" (Horsthemke & Schäfer, 2006, p. 12). From their perspective, we are living the climax of a human evolution, in which academic mathematics is the substrate of a society based on humanistic ideals. This universal society is however problematic. Part of the research on ethnomathematics has been concerned to understand how these universal images of society generate through history¹⁰. As mentioned by Fernández (2006), the idea of such a universal society was possible through "the development of a set of formalisms characteristic of a peculiar way that has a certain tribe, of European origin, to understand the world" (p. 126). That is, the universal society (capitalist society) based on universal knowledge (mathematics and science) suggested by Rowlands, Carson, Horsthemke and Schäfer is a very particular way of understanding time and space, of classifying and ordering the world, of understanding economical and social relations. In short, of conceiving what is possible and impossible to think and do.

CRITICISMS AND CONTRADICTIONS ON THE EDUCATIONAL IMPLICATIONS OF ETHNOMATHEMATICS

Ethnomathematics carries with it a critique on school.¹¹ D'Ambrosio (2003), for instance, compares current school with a factory, where people are components of big machinery that aims uniformity. In school, as mentioned by Rowlands and Carson

⁹ All those references are present in the bigger version of the paper.

¹⁰ See for instance the book edited by Powell & Frankenstein (1997), which collects a set of articles where these ideas are deconstructed.

¹¹ See for instance the work of Ubiratan D'Ambrosio, Gelsa Knijnik and Alexandrina Monteiro.

(2002, 2004), we are introduced to a certain society. And if we are delighted with our current society, as apparently is the case of Rowlands, Carson, Horsthemke and Schäfer, then we must prepare students the best we can to be full members of that society. But part of the studies in ethnomathematics does not share this optimistic view on current society.¹²

Society should be problematized, and not taken for granted, especially when we are aware of the economical politics based on market priorities, and all the ideologies that fuel our way of living (like the liberal view on mankind). What does it mean to educate people to be participative, active authors in a more and more merchandized society? Do we all want “schooling to serve the needs of industry and commerce?” (Rowlands & Carson, 2002, p. 85). Hence, a problematization of society, and the role of school in society is, in our opinion, a priority in a research program like ethnomathematics. But that is far from happening.

For instance, and to speak to one of the criticisms made by Rowlands, Carson, Horsthemke and Schäfer regarding the use of ethnomathematical knowledge in regular schools, we can identify a contradiction on how ethnomathematicians understand this pedagogical implications. On the one hand, as mentioned before, some researchers defend the idea of using students’ ethnomathematical knowledge to construct a bridge for the learning of formal mathematics. But, on the other hand, researchers like Knijnik (2006) clearly said that:

it’s not a matter of establish connections between school mathematics and mathematics as it is used by social groups, with the purpose of achieving a better learning of school mathematics. (p. 228)

Behind these two postures, is the way researchers understand the role of mathematics and school in our society. The problem with the first one, characterized by the “bridge metaphor”, is the reinforcement of the hegemony of school mathematics because the ‘other’ is valorised only as a way to achieve the true knowledge. Thus, it contradicts the critique that ethnomathematics makes to the hegemony of academic mathematics. The same problem identified by the critics regarding the valorisation of background instead of the foreground, is also raised by Knijnik (2006), Monteiro (2006) and Duarte (2006). These authors raise questions about the usually folkloric way ethnomathematical ideas appear in the curriculum. According to them, the use of local knowledge as a curiosity to start the learning of school mathematics could be the cause of social inequalities, as is mentioned by the critics.

But to truly contemplate ethnomathematical ideas in the curriculum is no less problematic. If we focus on a regular school, and take into account its role preparing students to a market orientated society, with all the pressure to learn the mathematics

¹² In Powell & Frankenstein (1997) we can find a set of articles that articulate a critique on mathematics with a critique on society. See also the most recent writings of Ubiratan D’Ambrosio where he developed a social critique, based on the idea of peace.

of the standard curriculum that will be essential to students' approval in the high stakes tests, we can ask ourselves if there is a place for ethnomathematical knowledge (or other local, non scholar knowledge)? Our opinion, according to our review on ethnomathematical research in Brazil, is that those educational implications of ethnomathematics (in a regular school) ended up being phagocytised by a school that, as Rowlands, Carson, Horsthemke and Schäfer would agree, is worried with the uniformization of knowledge. In that sense, we agree with them and also with Skovsmose and Vithal when they say that focussing the learning of mathematics in students' local knowledge could be a factor for social exclusion. But the problem is not just in ethnomathematics, but in school itself. Monteiro (2006), a very well renowned ethnomathematicians makes the definitive question: "Is it possible to developing ethnomathematical work in the current school model?" (p. 437).

Hence, it is not just the valorisation of students' background that should be dealt with care, but also the valorisation of students' foreground. Although we realise the importance of students having the opportunity for emancipation, and for full participation in a technological world (that is also a capitalist world based on a liberal idea of economy that stress the individual above the social), we should criticize naïve and ideologically loaded ideas about society. Preparing students to become participants in a society is also preparing them to assume critical points of view about society, different ways of thinking, acting and doing mathematics. Using the words of D'Ambrosio, we need to emancipate students by learning academic mathematics, but also by reinforcing its roots. If we analyse the role of school in modern societies, this is obviously a paradox.

Critical mathematics education and ethnomathematics, as mentioned by Skovsmose & Vithal (1997), have common concerns. Both developed a critique of the way mathematics is usually understood as one of the biggest achievements of mankind, and the intrinsic resonance (seen as something inherently good) that feeds its education. But in the struggle for a better mathematics education, they should take care when suggesting pedagogical proposals to be implemented in a problematic school. Taking school for granted is the best way to trivializing critical and ethnomathematical ideas.

REFERENCES

- Adam, S., Alangui, W. & Barton, B. (2003). A comment on: Rowlands and Carson "Where would formal, academic mathematics stand in a curriculum informed by Ethnomathematics? A critical review". *Educational Studies in Mathematics*, 56, 327-335.
- Althusser, L. (1970). Ideology and Ideological State Apparatuses. In *Lenin and Philosophy and other Essays* (1971), pp. 121-176.
- Amâncio, C. (2006). Da universalidade. In Knijnik, G, Wanderer, F, & Oliveira, C. [orgs], *Etnomatemática: currículo e formação de professores*, pp. 53-69. Santa Cruz do Sul: Edunisc.

- D'Ambrosio, U. (2002). *Etnomatemática: elo entre as tradições e a modernidade* (2ªed.). Belo Horizonte: Autêntica.
- D'Ambrosio, U. (2003). *Educação Matemática: da teoria à prática*. Campinas, SP: Papirus.
- D'Ambrosio, U. (2004). Posfácio. In Ribeiro, J., Domite, M & Ferreira, R. [orgs], *Etnomatemática: papel, valor e significado*. São Paulo: Zouk.
- Duarte, C. (2006). Implicações curriculares a partir de um olhar sobre o “mundo da construção civil”. In Knijnik, G, Wanderer, F, & Oliveira, C. [orgs], *Etnomatemática: currículo e formação de professores* (pp. 53-69). Santa Cruz do Sul: Edunisc.
- Foucault, M. (2004). *Microfísica do Poder* (20ª ed.). Rio de Janeiro: Edições Graal.
- Greer, B. (1996). Theories of mathematics education: The role of cognitive analyses. In L. P. Steffe, P. Nesher, P. Cobb, G. A. Goldin, & B. Greer (Eds.), *Theories of mathematical learning* (pp. 179-196). Mahwah, NJ: Lawrence Erlbaum
- Heidegger, M. (1977). *Basic Writings*. Edited by David Farrell Krell. New York: Harper & Row.
- Horsthemke, K. & Schäfer, M. (2006). Does ‘African’ mathematics facilitate Access to mathematics? Towards an ongoing critical analysis of ethnomathematics in a South African Context. *Third International Conference on Ethnomathematics: Cultural Connections and Mathematical Manipulations*. New Zealand.
- Knijnik, G. (2006). Etnomatemática e educação no Movimento Sem Terra. In Knijnik, G, Wanderer, F, & Oliveira, C. [orgs], *Etnomatemática: currículo e formação de professores*, pp. 53-69. Santa Cruz do Sul: Edunisc.
- Lizcano Fernández, E. (2006). As matemáticas da tribo europeia: um estudo de caso. In Knijnik, G, Wanderer, F, & Oliveira, C. [orgs], *Etnomatemática: currículo e formação de professores* (pp. 124-138). Santa Cruz do Sul: Edunisc.
- Monteiro, A. (2006). A etnomatemática em cenários de escolarização: alguns elementos de reflexão. In Knijnik, G, Wanderer, F, & Oliveira, C. [orgs], *Etnomatemática: currículo e formação de professores* (pp. 432-446). Santa Cruz do Sul: Edunisc.
- Powell, A. & Frankenstein, M. (1997). *Ethnomathematics: challenging eurocentrism in mathematics education*. State University of New York Press.
- Rowlands, S. & Carson, R. (2002). Where Would Formal, Academic Mathematics Stand in a Curriculum Informed by Ethnomathematics? A Critical Review of Ethnomathematics. *Educational Studies in Mathematics*, 50, 79-102.
- Rowlands, S. & Carson, R. (2004). Our response to Adam, Alanguí and Barton’s “a comment on Rowlands & Carson ‘Where would formal, academic mathematics

stand in a curriculum informed by ethnomathematics?”. *Educational Studies in Mathematics*, 56, 329-342.

Sebastiani Ferreira, E. (2006). Os índios Waimir-Atroari e a etnomatemática. In Knijnik, G, Wanderer, F, & Oliveira, C. [orgs], *Etnomatemática: currículo e formação de professores* (pp. 70-87). Santa Cruz do Sul: Edunisc.

Skovsmose, O. (1994). *Towards a Philosophy of Critical Mathematics Education*. Dordrecht: Kluwer Academic Publishers.

Skovsmose, O. & Vithal, R. (1997). The end of innocence: a critique of ‘ethnomathematics’. *Educational Studies in Mathematics*, 34, 131- 158.

Wittgenstein. L. (2002). *Investigações filosóficas* (3^a ed.). Fundação Calouste Gulbenkian.

Zizek, S. (2006). *The Parallax View*. MIT Press.