Ethnomathematical Barters

Aldo Parra-Sanchez and Paola Valero
Aalborg University

An assumption embedded in characterizations of ethnomathematical research, that is widely held by both practitioners and critics of this academic field, is identified. This assumption concerns the relationship between mathematics and culture. We argue that many developments and theoretical conflicts within the field can be traced to that assumption. An alternative approach is proposed to explain ethnomathematical practice, trying to respond to some theoretical critiques and prompting new horizons for the academic field.

Now ethnomathematics….

Since its beginning, ethnomathematics has been trying to find a proper theorization and definition. Almost every researcher has attempted to give his/her personal comprehension about what the subfield is and intends. Although this is proper for a new and growing area of research, sometimes the diversity in methods and approaches is seen as a signal of disorganization, non-cohesion, or absence of a shared horizon. The practitioners declare the need to share the initial conception of ethnomathematics as a research program, but develop it in disparate directions. Even D'Ambrosio has been attempting over the last 15 years to propose a more holistic, transdisciplinary theorization of ethnomathematics, rewriting parts of his seminal statements, proposing not only to consider mathematics, but also knowledge in general (D'Ambrosio, 2001).

In the last five years, new attempts have been made to find a theorization. Miarka and Bicudo (2012) want to consider and to reflect upon the relation between mathematics and ethnomathematics through a phenomenological explanation for academic fieldwork. Rohrer and Schubring (2013) proposed a conceptualization of a theory, by claiming that this theory "needs to be regarded as an interdisciplinary discipline that covers theories from both the exact and social sciences" (p. 78).

Together with such theorizations, since its early attempts, parallel and periodically several critiques of ethnomathematics have been published, pointing to assumed meanings of terms like "culture" and "mathematics". Some of the critiques warn about the inconvenient uses of ethnomathematics in mathematics education (Dowling, 1993; Rowlands & Carson, 2002). Another group of critiques points to the effectiveness of achieving the intended political goals (Pais, 2011; Vithal & Skovsmose, 1997). The second group presents critiques in more constructive and proactive ways than the first one. Both share an external view, insofar as none of them carry out research in ethnomathematics. Only a few internal critiques have been made, for example by Alangui (2010), when he warns about the very old fashioned concept of culture that is commonly used. Knijnik, Wanderer, Giongo, and Duarte (2012) discussed assumptions on the importance of using students' reality for classroom activities.

…has an "intersection approach"…

Without wanting to reduce the diversity of approaches and purposes, the common feature of inner trends and external critiques is the intention of addressing the existence/absence of common things between mathematics and culture (despite the diverse definitions of those terms). By considering the particular culture of a group as one set and mathematics as another set, ethnomathematics as an academic field might be concerned to examine the *intersection* of those two sets. Such intersection can be called the ethnomathematics of that group, or even the mathematics of that group. Whatever the chosen name, and without repairing the possible methodological procedures to perform such examination, or the theoretical considerations that would make it impossible to compare those sets, the underlying assumption is that intersection matters.

It is not difficult to show the presence of that assumption in the growth of ethnomathematics as an academic field. To find how ethnomathematicians have considered such an intersection set as the main part (but not the only one) of their object of study, it is enough to read any PhD thesis that has made an historical account of the field, e.g. Alangui (2010), Miarka (2011) or Rohrer (2010).

It is very illustrative that the journal sponsored by the North

American Study Group on Ethnomathematics states: "The journal's contents examine the intersections between mathematics and culture in both western and non-western societies, and among both math professionals…and non-professionals." It is important to acknowledge that this journal has very broad definitions of culture and mathematics.

Also, in research articles it is common to find expressions like "Every culture has mathematics" (Selin & D'Ambrosio, 2001, p. xvii), "ethnomathematics seeks to revive mathematics *living* in different traditions and cultures, not by considering them to be exotic, but by including them in the new historiography of mathematics" (Rohrer & Schubring, 2013; emphasis added) or even in the dilemma pointed out by Bishop: "Is there one mathematics *appearing in* different manifestations and symbolizations, or *are there* different mathematics being practiced which have certain similarities?" (Bishop, 1994, p. 15; emphasis added). So, there is something in the intersection.

Even historically, we can find a continuity: from early approaches, like Marcia Ascher defining ethnomathematics as mathematical practices of non-literate people, through one reconceptualization of D'Ambrosio saying "Ethnomathematics *is* the mathematics *practiced* by cultural groups" (D'Ambrosio, 2001, p. 9; emphasis added), to contemporary works like Furuto (2014), assuming ethnomathematics defined as "the intersection of culture, historical traditions, sociocultural roots and mathematics" (p. 112). Bill Barton (1996, p. 213) explicitly pointed to the intersection in a diagram when he was trying to analyze the comprehension of the field by three representative researchers over time.

…problem…

There are different ways in which critics and followers of ethnomathematics position their arguments according to the "intersection dilemma", as well as to their personal alignment with the ethnomathematics program. In this section, possibilities and their consequences are considered.

The first possible situation is to subscribe to the ethnomathematical program and also claim that such intersection is not empty, therefore one will try to show within it cultural artifacts and practices as

some mathematical notion, skill, or concept that "lies therein". The ethnomathematician's duty becomes one of uncovering that presence and mathematical modeling appears as a natural complement. Therefore, there is a necessity to develop proper methodological tools to do that uncovering, as Ferreira (1994) and more recently Albertí Palmer (2007) intended. If ethnomathematics is theorized using these arguments, the paradox of Millroy quickly arises as problematic. This paradox points out that it is not possible to find any knowledge other than the academic, because researchers will be acting with their mathematical gaze. This is an echo of the anthropological "reflexivity problem" (Woolgar, 1988), resulting in considering ethnography as the proper methodology for ethnomathematics.

A second possibility is to agree with ethnomathematics as a program to investigate knowledge and education, but consider empty the mentioned intersection, due to nonexistence of the category "mathematics" in some cultures. This posture focuses on how knowledge is developed in different cultural groups, by recognizing how it affects and is affected by educational discourses, asking as Lizcano did, "what can we see if, instead of looking at popular practices through 'mathematics', we look at mathematics through popular practices?" (Lizcano, 2002). This positioning puts in doubt a pre-eminence of mathematics as a superior knowledge over the others. Conversely, efforts to embed holistic knowledge into the restricted boundaries of mathematical discipline are rejected. This position seems to be a subtle essentialist view of culture because it leaves unexplained why a culture that does not have a category of mathematics would not be able to understand the existence of such a category in other cultures, or at least to create an inner explanation about mathematics.

A third option presents similar reasons to consider the intersection empty, but differs from the second option because it does not follow ethnomathematics as a program to expand the social understanding of mathematics as part of culture. In this posture it is common to use an argument of authority: cultural practices are not mathematics because they are not developed within a scholarly context. They have not been legitimized by one particular institution (i.e., the academic community of teachers, mathematicians, universities, journals). And, because of that, they lack a "warranty" certificate. This attempt to create an essence for mathematical knowledge using the hegemony of one particular group, was summarized by Rômulo Lins with irony:

"mathematics is the thing made by mathematicians when they said that they are doing mathematics" (Lins, 2004). Although such a definition cannot be contested by its circularity, its self-sufficiency is at the same time its big weakness, as it implies an unacceptable omission: those institutions are cultural and historical. Lins reminds us how the professionalization of mathematics appears only in the 19th century and most things recognized as mathematics before that time hardly satisfy current standards.

The last possible position is less radical, as far as it recognizes that mathematics can be present in several cultures (i.e. non-empty intersections). This account of the development of the discipline is driven by a hierarchical model, believing that the world has adopted conventions of mathematics, "because they have been sifted and tested and refined within the crucible of practical experience, which yields neither to passion nor to ideological persuasion" (Rowlands & Carson, 2002, p. 86). In such a model, mathematical knowledge has been evolving constantly in a universal process of improvement that transcends civilizations. If such an approach is accepted, any strong review of the history and epistemology of mathematics is impossible and ethnomathematics has nothing worthy to do. Its duty would be, then, to fill in minor details of how the one and only possible rationality was improved across space and time until now, as an inevitable fate.

Whatever the case, either for or against an ethnomathematical program, for all four positions it is natural to operate in terms of intersections between mathematics and culture, because they refer mainly to what is (or has been) mathematical, instead of what could be.

We consider the intersection problem a mistaken dilemma, responsible for the criticism received and also for the growing "domestication" from which ethnomathematics has suffered in the last decade, as Pais (2012) attests.

…that can be changed…

We want to develop an alternative approach to theorize ethnomathematics that goes beyond the "intersection" problem, by taking into account several processes of multilingualism (Barton, 2008; Caicedo et al., 2009; Cauty, 2001; Meaney, Trinick, & Fairhall, 2011) like an impulse to reflect upon the possibilities of developing dialogic

processes within cultural groups around the very concept of mathematics, as well as its educational implications and political uses. We also consider the political views of Knijnik et al. (2012) and Alangui's methodological contribution about Mutual Interrogation (Alangui, 2010), because they give a central role to the interactions, despite not working directly with linguistic issues.

The task is not to discover or find elements within the intersection of mathematics and culture, but to create links between them. When the Māori Language Commission proposed terms to be used within schools (Meaney et al., 2011), by taking care of sensible features of the Māori language and their cultural heritage, they were creating a new knowledge that did not exist before. Those terms expanded boundaries in mathematics, culture, and language simultaneously.

Even if a more classic ethnomathematical work is considered, we can find in the work of Gerdes (2007) the same type of movement, when he proposed new mathematical ideas inspired by African cultural practices. Eglash recognizes it:

> Ethnomathematics of indigenous societies is not limited to direct translations of western forms, but rather can be open to any mathematical pattern discernable to the researcher. In fact, even that description might to be too restrictive: previous to Gerdes' study there was no western category of "recursively generated Eulerian paths"; it was only in the act of applying a western analysis to the Lusona that Gerdes (and the Tchokwe) created that hybrid. (Eglash, 2000, p. 17)

The basic idea is to provide an interpretation for the practice of ethnomathematical research, like intentional and deliberate processes, that generate connections between mathematics and culture, in a strongly non-essentialist understanding applied to both constructs.

This approach assumes a different role of the researcher, from one who *looks for* something hidden and pre-established, to one who *creates* representations and meanings. With such consideration researchers can be found on both sides, not only the academic one. In the same way that Chambers (1996) proposed in post-colonial studies and Cauty (2001) explored in ethnomathematics, practitioners and knowledge-holders become researchers as well, with their own agenda. As a consequence, the intended links are not only one way,

creating mathematical interpretations of cultural practices, but also providing culturally grounded explanations of mathematical practices. This last part puts forward a relationship between academic researcher and communities far from the realm of ethnography.

We will explain the idea of "creating links", using an example that Alexandre Pais proposed to criticize ethnomathematics. He imagined a group of indigenous people observing students in a mathematics classroom where the topic of the day was Pythagoras' theorem. After some time watching the students:

> They realise that what the students are doing while seated at tables with pens in their hands solving exercises on a sheet of paper *is actually* the construction of a house. Why does this sound absurd? Why is the direction of research always one of going to the local communities to recognize as mathematics what these people are doing? (Pais, 2013, p. 3 emphasis added)

As we argued, it is irrelevant if that mathematical practice "is actually" the construction of a house or not. Certainly, it could be less problematic if that group says something like "this exercise *looks like* the way that we build a house" to put it with Gelsa Knijnik´s proposal of the "family resemblances" metaphor of Wittgenstein (Knijnik, 2012). Nonetheless, the important thing is the act of the group claiming a connection between one system and the other. Pais found his story absurd because he maintains an unchanged colonial relationship on which ethnography relies. In his story, facts have no consequences and there are no interactions between people. He, like many followers and critics, does not conceive of ethnomathematics as a form of barter.

Let us imagine a continuation for the story, decreasing that colonial bias. Someone says that those equations on the chalkboard remind them of the building of an indigenous house. Another replies, "why?" A third says, "well, because we always try to guarantee that those pillars fit into…" and so on. A discussion starts involving different worldviews, with explanations from multiple sources. This conversation is a process requiring collaboration among agents. Contrasting, criticizing, and appropriating ideas about the practice observed, is a barter of insights. This interaction is in itself an educational process that does not intend to arrive at a happy shared end by destroying differences in a common unified knowledge.

This second part of the story does not sound absurd to us, for a simple reason: it already happens. Meaney et al. (2011) have related the challenging process of one Māori community in New Zealand trying to educate their children in a Māori-immersion school, highlighting how collaboration becomes central to confront the different challenges that arise in every stage. Gelsa Knijnik related how Brazilian farmers in a settlement discuss the different ways in which the land is measured, contrasting farmers' techniques with official ones used by banks and the state (Knijnik, 1996). Caicedo et al. (2009) reported the experience of an indigenous community in Colombia trying to appropriate mathematical knowledge for their political process of cultural resistance, applying their own idea of research collectively along the way.

Although this new story is very close to the idea of mutual interrogation proposed by Alangui (2010), we prefer to consider that the groups involved are building a relation that creates new knowledge. Coming back to the initial image of mathematics and culture as sets, instead of studying their intersection, it is possible to study the mappings between the sets. We only require knowers of those sets working together. It is important to notice that although such mappings do not belong to any of the previous sets, their existence affects them.

By adopting a posture towards interactions, the theoretical positions that criticize ethnomathematics paradoxically help to cast light on knowledge as a social and historical practice that is able to be changed. Indeed, the definition provided by Lins (2004) entails an invitation to challenge authoritarian efforts, as far as the uses that people give to mathematics cannot be controlled. Every particular appropriation of a concept expands its limits, transforming its meaning with the unavoidable presence of social facts. By using a non-colonial perspective, one that understands power and knowledge as imbricated things, we cannot be passive with arguments of authority.

It is fair to say that this idea is not completely new, since in his breakthrough paper D'Ambrosio (1985) stated:

> We are collecting examples and data on the practices of culturally differentiated groups which *are identifiable* as mathematical practices, hence ethnomathematics, *and trying to link* these practices into a pattern of reasoning, a mode of thought. (p. 47)

Also, Barton cited something similar, when he conceived of ethnomathematics as "a process of the social construction of knowledge at a cultural level" (Barton, 1996, p. 217) and claimed:

> Ethnomathematics does create a bridge between mathematics and the ideas (and concepts and practices) of other cultures. Part of an ethnomathematical study will elucidate why those other ideas are regarded as mathematical, and therefore why they might be of interest to mathematicians. Such a study creates the possibility both of mathematics providing a new perspective on the concepts or practices for those within the other culture, and of mathematicians gaining a new perspective on, (and possibly new material for), their own subject. (Barton, 1996, p. 216)

The difference stresses the central role that is proposed in the awareness and political intentionality in making such connections, the requirement to involve different voices to make possible the links, and also to notice that such processes can be considered educational beyond school or curricular boundaries.

…to a nicer problem!

The aim of expanding the social understanding of concepts like mathematics or knowledge becomes clearer, as far as the object of study of ethnomathematics is no longer the intersection, but the connection that can be built. Instead of previous and pre-established things to be uncovered, we might look upon the multiple and unexpected possibilities to be developed.

If, with this approach, ethnomathematics can solve the "reflexivity problem" posed by the Millroy paradox, then a "symmetry problem" arises, by considering that those negotiations and new meanings imply active participation of different stakeholders, within long term processes. How can such a thing be guaranteed? How can cultural groups be interested in establishing such processes? All the examples provided here are embedded in broad political projects of organized communities, pre-existing the particular research project. How can such dialogue processes be accomplished with non-organized groups? Can that happen in the limited space of a school system?

More considerations can be made around the features of such interactions. How much time does a process of dialogue require? What types of instances are demanded? By following the path of a mutual interrogation, how can the other research on its own terms? How are its questions actually from "it" without mimicking a traditional researcher? What kind of results can we expect? How can these be validated? Naturally, this demands a new role for ethnomathematicians. How could it be?

Many of these questions require an analysis that goes beyond the scope of this text (the approach presented is being developed in the doctoral thesis that Aldo is doing under the supervision of Paola), or cannot be answered directly. Nevertheless, they configure a promising landscape for the approach; as long as they emphasize a condition of inherent uncertainty for every ethnomathematical piece of research. This vision of ethnomathematics as a process could restore the seminal impulse to reveal the historical and cultural grounding of mathematics, as well as reinforce its critical positioning in the relationship between power and mathematical knowledge.

Conclusion

Ethnomathematics should not observe only the past, but look towards the future. It does not need to be concerned with how others build their knowledge, to better understand western knowledge, but to be engaged in changing the accepted body of knowledge. That "broader vision of knowledge", that D'Ambrosio claims, cannot be static, but dynamic.

This paper retakes an old idea that considers mathematical discipline as central to ethnomathematics. Certainly, we could have made more or less the same argument by substituting "mathematics" for "western/academic knowledge", but we preferred this way because it is precisely with mathematics that comparisons and links are more heretical. If mathematics is left out of the focus of debate, the ethnomathematical field is subsumed in a general discussion, losing its strong point of criticizing epistemology and the education of mathematics.

Ethnomathematics is not intended to empower people because their culture is now one step up, closer to the divine conventions of

mathematics. Instead, mathematics becomes demystified when it is moved one step down, closer to mundane affairs. For that reason ethnomathematics can change mathematics in an epistemological dimension.

This paper argued: *currently ethnomathematics has an "intersection approach" problem that can be changed to a nicer problem!* This content is a way to invite interplay with the dynamic condition of culture and mathematics, instead of merely watching it. Mathematics is the thing that our efforts sculpt. So this can clarify as much as possible, that the problem is not to perceive the difference, but what to do with it. How can we live with, and through, the difference?

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