Ethnomathematics and Cooperativism

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Abstract

Ethnomathematics is generally concerned with the resolution of practical problems and thus it is natural to investigate how this new science can be combined with cooperativism in order to foster sustained economic development. It is maintained that one way of developing this kind of investigation would include some business mathematics, informal logic and practical ethics. A project, implemented in a rural area of the Brazilian Northeast, is described in terms of both research into the community's ethnomathematical knowledge as well as pedagogical situations in which this knowledge and academic knowledge are taken into account.

Resumo

A etnomatemática geralmente se interessa com a resolução de problemas práticos e, assim, é natural investigar como essa nova ciência pode se juntar com o cooperativismo para promover o desenvolvimento econômico. Argumenta-se que uma maneira em que o referido tipo de investigação pode ser feito incluiria matemática financeira, lógica informal e ética prática. Descreve-se um projeto, implementado numa região rural do Nordeste do Brasil, em termos da pesquisa do conhecimento etnomatemático da comunidade, bem como em termos de situações pedagógicas em que tanto o mencionado conhecimento quanto o conhecimento acadêmico é contemplado.

The present article describes the conjunction of two erstwhile separate areas of knowledge: ethnomathematics and cooperativism. The conjunction of these two areas, which was originally idealized by the present author and implemented, for the most part, by my students João Ferreira dos Santos and Rosana Ananias Silva da Costa, is both a research project about aspects of the ethnomathematical knowledge of two rural communities and an instrument for promoting sustainable economic growth in the communities investigated. Before laying out the theoretical framework and describing its implementation, however, I would like to set the stage by briefly outlining my conception of the nature of ethnomathematics.

Ethnomathematics

Although mathematicians have been, on the whole, slow to catch on, cultural anthropologists have long been interested in various aspects of what is usually seen as parts of

mathematics. This is especially true of the study of primitive (and not so primitive) number systems.[1] A new level of awareness of what would soon become ethnomathematics was foreshadowed by Raymond Wilder[2] in 1950. It seems to be only in the late 1970's and early 1980's, however, that the field began to attract much attention, but by the time that Ubiratan D'Ambrosio coined the term "ethnomathematics", in 1985, its importance both for the history and the pedagogy of mathematics had become apparent to an ever widening group of researchers.

Right from the beginning, however, there seems to have been some uncertainty about just how ethnomathematics should be characterized, as is evident in some of the early issues of the *ISGEm Newsletter*. Perhaps this is not surprising, given that the emergence of a new field is usually predicated more on a vision than on a definition. In any case, it seems that any fruitful characterization of ethnomathematics would have to be parasitic on a characterization of mathematics. This is indeed the case of the well known characterizations made by, for example, D'Ambrosio (1993), Bishop (1988) and, more recently, Barton (2004). Most of these thinkers, however, define mathematics so broadly that it is difficult to conceive of any human activity that would not be subsumed under the term "mathematics" according to these definitions.[3]

I am quite aware that, at least in the case of D'Ambrosio, there is a deliberate attempt to define ethnomathematics in a very broad fashion so as not to exclude any of the many researchers who have been attracted to the field. This is partially due to the desire to consolidate a new area of research in the face of hostile responses by many professional mathematicians and partially a genuine attempt to conceive of ethnomathematics as a multifaceted enterprise that must encompass disparate viewpoints in order to be true to its mission. This attitude has certainly had beneficial results for the growth of ethnomathematics as a field of study, but it has also led to a rather non-critical appraisal of some of what passes for ethnomathematical research. In particular, some researchers seem to be imposing their own mathematical structures on the basically non-mathematical activities that they are investigating[4] and this, in turn, creates a pedagogical danger in that it tends to validate watered down mathematical programs for the disadvantaged by replacing mathematics education by non-mathematical activities (see Fossa, 2000 and 1998). I hasten to add that these results are certainly not intended by any of the researchers involved in ethnomathematics.

Although I think that a mature reflection on the nature of mathematics is due, I can here do little more than state clearly my own position (for more details, see Fossa, 2004) and try to show how that position has influenced my understanding of ethnomathematics and its relation to cooperativism. Thus, I characterize mathematics as those activities that use deductive reasoning – which basically turns out to be axiomatics – as the methodological principle for validating its

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[1] The existence of multifarious relations between mathematics and other culture areas is, of course, an ill-kept secret. Erickson and Fossa (2005), for example, show that all of Western metaphysics has been structured by the mathematical doctrine of Plato's Divided Line and reactions to it.

[2] In "The Cultural Bases of Mathematics", an address given at the International Conference of Mathematicians in Cambridge, MA.

[3] For other conceptions of ethnomathematics, see Powell and Frankenstein (1997).

[4] It is interesting to observe that a similar phenomenon occurs in the history of mathematics, when investigators do not think through the historical material on its own terms. See further Sabetai Unguru (1975).

statements. This means that much of what we ordinarily call mathematics is not really mathematics at all.[5] In fact, there is a large amount of human endeavor that revolves about, basically (but not only), number and operations with number that I call proto-mathematical activities. These activities are extremely important, as is witnessed by the fact that we spend at least twelve to fourteen years in our school systems teaching this material to our children. The complex of proto-mathematical activities is both the matrix from which mathematics emerged and the "practical mathematics" that most people use in their everyday lives and, thus, is of both historical and continued import. As a matter of historical fact, different cultural groups have gone about their pursuit of these activities in sometimes quite disparate ways. Thus, I characterize ethnomathematics, in the first instance[6], as the investigation of the different ways that different cultural groups practice proto-mathematical activities.

The Ethnomathematics-Cooperativism Connection

There seem to be cases in which proto-mathematical activities are carried out in order to obtain new knowledge about, for example, the way numbers work. Practitioners that undertake such theoretical investigations are rather like amateur scientists and they may contribute to the advancement of mathematical knowledge. Thus we see, once again, the importance of proto-mathematical activities. In other cases, proto-mathematical activities are engaged in for the fun of it. Nonetheless, it seems to be that the vast majority of proto-mathematical activities, at least those taking place outside an educational or training context, are undertaken to solve practical problems. In consequence, most practitioners of proto-mathematical activities are employing some type of modeling[7], either implicitly or explicitly, to reason about problems that arise in their daily life. Naturally, most of these problems arise in relation to the production and control of commodities, the obtaining of shelter, the making of long-term predictions and other economic activities.

Since proto-mathematical activities are so closely related to economic undertakings, it is not surprising that ethnomathematics can be readily linked with cooperativism. What is necessary is to identify cooperativism as a viable way of promoting sustainable economic growth in otherwise moribund communities and then to analyze how ethnomathematics can make a difference (Fossa, 2002) in setting up and maintaining a cooperative in a setting long dominated by paternalistic politics. My answer, admittedly incipient and in need of further development, was threefold: "mathematics", logic and ethics. A cooperative is a business and, as such, some knowledge of business mathematics would clearly be of help in the running of such an

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[5] The term "mathematics" may be extended to cover these proto-mathematical activities in ordinary discourse. It is only in the context of foundational thought that more care is required.

[6] There are, of course, many subtleties that cannot be belabored here. To mention only two of these, we may observe, first, that the term "ethnomathematics" is often used to refer to the activities studied, as well as to the study of these activities. This does not seem, in general, to be problematical. Besides describing the aforementioned activities, many researchers try to analyze the role that these activities, or the role of mathematics itself, in a given culture. I usually signal this second aspect of ethnomathematics by writing Ethnomathematics.

[7] Pedro Paulo Scandiuzzi (2002) argues that modeling and ethnomathematics are incompatible. D'Ambrosio (2000) argues that they are complementary. The former is pretty much correct in regard to the two areas conceived of as part of current educational practices; the latter is correct in regard to their educational potential. The controversy, however, glosses over the more important point that proto-mathematical activities almost always involve modeling and thus provide the basic framework of virtually all of applied mathematics. See Fossa (2005) for more details.

establishment. Further, most social projects are complex ventures in which decisions must be made, ofttimes before all the evidence is in and in the presence of conflicting values. Logic, in the form of an informal, though critical and reflective appreciation of the "strength" of arguments would thus also be instrumental. Finally, no cooperative would be likely to be successful if its members were selfish and deceitful, so it would also be useful to have a full discussion of ethical norms applied to appropriate concrete situations.

The project also has two separate strands: research and pedagogy. The research strand investigates the community members' knowledge relating to each of the three aspects detailed in the previous paragraph. Thus, we want to describe the proto-mathematical activities that have evolved in the community, identify habitual patterns of reasoning and determine the basic ethical values and general outlook on life in the community. The pedagogical strand is an introduction to appropriate concepts and techniques from academic business mathematics, (informal) logic and practical ethics. The teaching methodology employed rejects the traditional approach of the transmission of knowledge from the professor to the student; rather, we attempt to create a true dialogue that takes the participants' prior (ethnomathematical) knowledge as the starting point and attempts to foster greater metacognitive awareness on the part of the participants. Hopefully, this approach will validate the participants' own knowledge as a valuable resource, while also opening new possibilities for intellectual growth. The intended result is a fruitful dialogue between the ethnomathematics of the community and appropriate parts of academic mathematics, much in the style of that described by Gelsa Knijnik (1996).

The Communities

The first community in which we started to work is Baixinha dos França, a district in the municipality of São Miguel do Gostoso, located about 140 km to the northwest of Natal, capital of the State of Rio Grande do Norte in the Brazilian Northeast. The Northeast of Brazil is one of the poorest and economically underdeveloped parts of the country. Most of the economic gains in this region have been limited to the state capitals; outside these cities, the region is predominately rural and traditionally organized into large estates that are not particularly profitable. Most of the area is semi-arid and subject to recurring draughts. The community of Baixinha dos França is about 36 km from São Miguel and is connected to it by a one lane dirt road that is impassable during rainy weather. Until recently there was no running water, telephone or electrical lines to the community. The survival of its approximately 450 inhabitants was dependent on subsistence agriculture, export of tropical fruits (sold to middlemen for almost nothing) and government handouts.

The other community in which we have recently begun to work is Umburana, another district in the same town of São Miguel, similarly situated, with much the same problems. These problems are, however, exacerbated by the presence of very influential fundamentalist religious leaders that have an enormous resistance to change.

Overview of Results Obtained

Since, as mentioned above, we have just begun our work in Umburana, the discussion here will be limited to the results obtained in Baixinha dos França. More details can be found in dos Santos (2003).

In reference to the arithmetical procedures used by most of the members of the community, as far as we have been able to determine, the standard school algorithms are in use, although they are not always performed correctly, especially when larger numbers are involved. These algorithms are applied to local units of measurement. A variant of *cubação*, a well documented method for measuring the area of fields, is performed in the community. It is limited to two practitioners, neither of whom realize that it is an approximation. Neither do they have what Richard Skemp (1976) calls "relational understanding" of the procedure and, thus, they perform it as a rote process. The younger children, however, show a remarkable level of creativity in solving numerical problems (applied to concrete situations) for which they have yet to learn algorithms and we hope to be able to incorporate this into the educational milieu. We are currently trying to investigate how mathematical thought is applied to issues of home economics and at the two commercial establishments in the community, a small store and a bar. The high level of adult analphabetism, however, seems to be a limiting factor here, as most housewives seem to have an approximate and instinctual knowledge of how much they can spend/use each week. Most of the housewives are very reticent about discussing these matters and time is needed to develop more trusting relationships with them.

The analysis regarding habitual patterns of inference has yet to be done. We have, however, obtained very interesting results regarding values and attitudes and how these have changed as a result of our presence in the community. I will make some general comments here; for some individual profiles, see dos Santos (2003). The members of the community used to see themselves as victims of an unjust social system, against which they were powerless. The only way open to marginal alleviation of their situation was to somehow take advantage of their neighbors or obtain preferment from local politicians. In contrast to both government agencies and non-governmental organizations (NGOs), we strictly abstained from telling the community members what they should do. Rather, we tried to help them to identify their problems, set priorities and come up with their own solutions. How much we may have unwittingly pushed our own agenda – and the legitimacy or not of doing so – will have to be a matter for serious scrutiny. Nevertheless, as a direct result of our posture in the community, including both the seriousness with which we undertook to dialogue with community members as equal partners in the discussion and the sincere desire that we had to learn from them, the prevailing sense of apathy was overcome. A newfound sense of community development began to emerge and various steps were taken to obtain immediate material benefits for the whole community. As we began to probe their personal and family histories, they began to take a new pride in who they are and what their community has to offer. Besides these more immediate steps, a cooperative has been chartered with the express purpose of both marketing local produce and serving as an incubator for new projects.

Conclusion

Our experience in the rural districts of São Miguel do Gostoso has further strengthened our conviction that the conjunction of ethnomathematics and cooperativism is a fruitful way to approach many pedagogical and social problems that we face in this, our still largely unjust, world. We do not pretend to have worked miracles in the communities where we have implemented our model, but we have begun to foster slow, but steady, change in those communities. It is still an open question, however, whether the community will be able to stay the course in our absence. In this regard, the preliminary results are disappointing. Despite our

insistence that decision making is their responsibility, they still seem to need us to validate their decisions and to provoke more critical attitudes towards their own problems and proposed solutions. Thus, when we absent ourselves from the community for any more or less prolonged period, things tend to come to a standstill. Hopefully this problem will be overcome with the emergence of new community leaders that will have a vision for the whole community and that can impart a sense of community to the next generation. Finally, as we mentioned above, the theoretical underpinnings of the proposed conjunction is in need of further development. We are thus aware that much more work, both theoretical and practical, needs to be done.

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