An Ethnomathematical Approach in Mathematical Education: a Matter of Political Power

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This article explains and discusses the author's work in a rural school in the southernmost Brazilian state. This school is linked with organized rural movements, mainly the MST (Movimento dos Sem-Terra: landless people's movement). Two specific practices of the people are presented. Using an ethnomathematical approach, the author developed some educational work which deals with the interrelations between erudite and popular mathematical knowledge in the context of the struggle for the land. Without glorifying popular knowledge, the paper discusses the contributions this kind of pedagogical work can give to the process of social change

The research took place in the rural area of the State of Rio Grande do Sul, in Brazil. The country's total area is approximately 8.5 million km², corresponding to almost 50% of South America's total area and more than 20% of the American continent. Nowadays, Brazil has about 146 million inhabitants, with a demographic density of 16 people per km²

One of the biggest economic problems in Brazil, which is also a social and political problem, is its land structure with its very dense concentration. Rural properties of less than 25 acres—which represent 53% of all Brazilian rural properties—occupy only 3% of the country's total area. However, rural properties with more than 2,500 acres—which represent only 1% of all Brazilian rural properties—occupy 44% of the country's total area.

The author's fieldwork was developed in the rural area of Braga, a small district of Rio Grande do Sul, about 370 miles away from the State capital, with about 5,000 inhabitants (15% less than its population in 1980). With 73% of its population living in the rural areas, it is essentially an agricultural district.

The DER/FUNDEP rural school [1], located in Braga, where the author developed her research, was founded in 1989, as a response to organized rural movements, mainly the MST. The school aims at implementing a form of popular education, understood as a methodological approach which should contribute to social changes. Today, the school has to work, as a priority, with the organized rural workers themselves because, as they say, "there is a historic urgency in the need to educate the main agents involved in the social change process".

The school has different types of formal and non-formal courses. The author's research was more directly linked with one of these courses, which aims at preparing and giving a certificate to elementary school teachers. Almost all the students were, in fact, teaching, even before getting the required degree. They are called "lay teachers". In Brazilian rural areas where teachers are scarce and, sometimes, there are no schools, a community member who has a more advanced level of study holds the teacher's position, helping children and also adults in the learning process. In this situation, it is absolutely necessary to provide better conditions for those people involved with education. Usually the schools in those very distant communities have only one class for children in all the grades. The teachers work part-time teaching and part-time farming.

These "lay teachers" go to the DER/FUNDEP rural school, as students, for four periods during their school vacations. This represents six months of all-day study at the school and "long-distance study" while they are teaching in their communities. After these four periods there is a probation semester, when they teach in the communities, supervised by DER/FUNDEP teachers.

Today, the MST is one of the most important rural movements in Brazil. The slogan of the Movement—"occupying, resisting, producing"—describes the struggle for land reform in order to avoid a rural exodus, giving inland people better conditions of life through the redistribution of the country's wealth.

When MST members occupy a piece of land, they live on precarious campsites, in very rudimentary plastic tents. This is the time when they organize themselves into groups and start discussions about political, economic and social issues. they learn how to resist police violence. They also plan how to produce and market goods in the settlements as well as how to manage the land they are supposed to receive from the government. At present (October, 1992), there are about 110,000 people in the settlements and more than 12,000 in the camps linked to MST, spread over 19 out of the 26 States of Brazil.

It is clear to the Landless People's Movement that education is a strategic issue for the land reform; the Brazilian peasants have always been deprived of academic knowledge and in this situation it is hard to live and produce goods successfully in the rural areas. The Movement is aware that it is absolutely necessary to have academic and therefore technological, knowledge when organizing, administering, and planning production.

An ethnomathematical approach

The author's research—taking for granted that pedagogical practice in mathematical education is fundamentally a political issue—tries to establish concrete links between

broad questions of emancipatory popular education in the Third World and the processes of learning and teaching mathematics It deals with the interrelations between academic and popular mathematical knowledge in the context of the struggle for land; it is also inserted in the broader educational movement called Ethnomathematics. The expression *ethnomathematics* was coined by the Brazilian Professor Ubiratan D'Ambrósio in the mid-70s Since then he has made important theoretical contributions as well as laid down outstanding research guidelines in ethnomathematics.

I use the expression *ethnomathematical approach* to designate

> *research* into the conceptions, traditions, and mathematical practices of a specific subordinated social group and *pedagogical work* involved in making the group members realize that:
> 1. they do have knowledge;
> 2. they can codify and interpret their knowledge;
> 3. they are capable of acquiring academic knowledge;
> 4. they are capable of establishing comparisons between these two different types of knowledge in order to choose the more suitable one when they have real problems to solve.

This approach assumes that mathematics is cultural knowledge and that its birth and development are linked to human needs. It implies placing the ethnomathematical approach, from an epistemological point of view, in the confluence of mathematics and cultural anthropology [2] The author would like to introduce into this confluence pedagogical and sociological knowledge as well.

A theoretical analysis of the present fieldwork emphasizes the sociological dimension of the ethnomathematical approach. The object of the research refers to two social practices involved in the productive activities of the inland people where mathematical knowledge is absolutely necessary. The investigation discusses the interrelations between popular and academic knowledge in the context of two specific practices of the group concerning mathematical knowledge: *cubaçao de terra* (estimating the area of a piece of land) and *cubagem da madeira* (estimating the volume of a tree trunk).

These two rural social practices are not exclusive to the southernmost countryside of Brazil In the northeast region of Brazil, the researcher Guida Abreu has also looked into them. Her study investigated the mathematics used by sugar cane farmers in activities related to farming [3]. What is relevant, from the author's point of view, is that the students who, before coming to DER/FUNDEP, knew the popular methods were those who taught them to the group, during the maths classes. They were "teachers" as well as "students". In one of the student's own words: "Before our maths class I knew the counts, now I know the mathematics." This sentence can be understood as saying

that the student was aware that in the maths classes he was able to decode and understand the mathematics involved in his social practices. Furthermore, with the given pedagogical approach, he also gained academic knowledge—"book mathematics", as the group called it. It is important to emphasize that popular knowledge was taken into account in the pedagogical work without any intention of "exalting" it.

Two social practices

Here I present the mathematical practices which were the object of the investigation, starting with those referring to land area measurement They consist of two different methods, which were called by the group "Jorge's Method" and "Adao's Method". The students Jorge and Adão themselves taught the group the specific way of "measuring the land" in their communities. In estimating the volume of a tree trunk, "Roseli's Method" will be shown below; she also taught it herself to the group. Other students were familiar with other methods of figuring out the volume of a tree trunk, but Roseli's was the method most used in the southern Brazilian countryside.

JORGE'S METHOD OF ESTIMATING AREA

PEASANT'S WORDS	ACADEMIC'S WORDS
Here is a piece of land with four walls.	This is a convex quadrilateral
First, we add all the walls.	First, we find the perimeter of this convex quadrilateral.
Second, we divide the sum by four.	Second, we divide the perimeter by four.
Third, we multiply the obtained number by itself	Third, we find the area of the square whose side is given by dividing the perimeter by four.
This is the 'Cubação" this land	This is the area of the square obtained from the perimeter of the convex quadrilateral.

ADÃO'S METHOD OF ESTIMATING AREA

PEASANT'S WORDS	ACADEMIC'S WORDS
This is a piece of land with four walls.	This is a convex quadrilateral
First, we add two of the opposite walls and divide them by two.	First, we find the average of two opposite sides.
Second, we add the other two walls and also divide them by two.	Second, we find the average of the other two opposite sides.
Third, we multiply the first obtained number by the second one.	Third, we find the product of the two averages reached before.
This is the 'cubação' of the land	This is the area of the rectangle whose sides are the averages of the two pairs of opposite sides of the convex quadrilateral.

PEASANT'S WORDS	ACADEMIC'S WORDS
This is a trunk of a tree.	This is a frustrum of a cone.
First, we select the medium section of the trunk of a tree.	First, we transform the frustrum of a cone into a cylinder.
Second, we take a rope. Then put it around the middle section. Then, we find the rope length and divide it by four.	Second, we find the base perimeter of the cylinder. Then, we find its fourth part
Third, we multiply the obtained number by itself.	Third, we find the area of a square whose side is the fourth part of the base perimeter of the cylinder.
Fourth, we multiply the obtained number by the length of the stem of the tree.	Fourth, we multiply the area of the square by the height of the cylinder.
This is the "cubagem da madeira."	This is the volume of a prism the side of whose base is one-fourth the length of the circumference. This circumference is the circumference of the base of the cylinder. The cylinder was obtained by transforming the frustrum of a cone.

It is not difficult to show, using elementary mathematics, that in the case of a convex quadrilateral area, Jorge's result always exceeds Adão's, which itself overestimates the measure of the "land" obtained by academic calculations. When Jorge and Adão were explaining their methods to the group, the students decodified and understood what the methods meant in terms of academic mathematics. This represented the passage from the first to the second column in the above tables.

Final comments

The final part of this article emphasizes some theoretical aspects of the current research. It is important to note that the work tries to avoid "glorifying" popular knowledge; on the contrary, it aims at understanding how popular mathematical practices—the product of a relation of social inequality—represent a limitation, a disadvantage. It is necessary to understand that the mere perpetuation of this popular mathematical knowledge involved mechanisms which reinforce social subordination. It is clear to the MST that grasping and appropriating academic and technological knowledge is a strategic issue in the concretization of land reform. Without this specific knowledge it would be hard to organize, to administer, to plan, and to commercialize production. Taking into account these arguments, it is important to reaffirm that merely glorifying popular

knowledge does not contribute to the process of social change. When a specific subordinate group becomes conscious of the economic, social, and political disadvantages which its scarce knowledge brings about, and tries to learn erudite knowledge, this type of consciousness may contribute to the process of social change.

Pierre Bourdieu [4] gives support to this view, when he says: "If in order to resist I have no better argument than to claim the right to hold to precisely that which makes me dominated, is this resistance? [...] When, on the contrary, dominated people endeavor to lose what makes them "vulgar" and endeavor to appropriate those things in relation to which they seem "vulgar", is this submission?[...]" Bourdieu finishes the paragraph saying: "Resistance may become alienation and submission may become liberation".

The second point is the pedagogical work which is part of what the author has called the *ethnomathematical approach*. To start with, it tries to probe into and rescue popular mathematics. This mathematics is not legitimated by the dominant culture and has survived only through a process of oral transmission; it tends to disappear, without any "synthesis-knowledge" occupying its place. Nevertheless this pedagogical work does not simply try to rescue popular knowledge. It also tries to decodify and understand it, giving the students the opportunity to become aware of the limitations of their methods and the reason why these methods, even without being exact, are utilized by subordinate rural groups. Furthermore, the process of *cultural awareness*, in Paulus Gerdes' words [5], allows the birth of a "synthesis-knowledge", which is constructed taking popular knowledge as its starting point but which, however, transcends it.

Acknowledgements

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