USING ETHNO-MATHEMATICS IN THE GRADUATION OF THE INDIAN TEACHER

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Abstract

Enabling the Indian Teacher/Resercher to deal with ethno-mathematics as to make him the ethnographer of his own culture and link between this knowledge and the occidental mathematics, in order to offer students an educational process that has criteria, has been for over twenty years, the main focus of my work. And is also the objective of the Ethno-mathematics Research Program, which was created by Ubiratan D'Ambrósio.

Some of the mathematical knowledge of the Waimiri-Atroari Indians, form the north of the Amazonas — with whom I have been working for ten years enabling the teacher researcher of the village — and, most importantly, how some of their field researches have been successfully used in the village classes as mathematical activities are presented on this paper.

THE MATHEMATICAL EDUCATION OF THE WAIMIRI-ATROARI

The Waimiri-Atroari tribe belongs the the Karib linguistic trunk. Their territory embraces part of the states of Amazonas and Roraima, to the north of Manaus and their population is estimated to be that of about six hundred Indians, in twelve villages. The building of the Balbina Hidroeletric Plant, in 1998, caused part of this territory to flood and, as a consequence, Eletronorte and Fuani signed a covenant to provide assistance in several areas, one of which is an educational program. This program aims to capacitating the Indian teacher, who is always chosen by the community itself, as well as building and maintaining the village schools. In the program, I am responsible for the mathematics area and have been working with the teachers for six years. Not only their mathematics graduation but most importantly their being the field researchers of their own ethnic knowledge, be it based in institutional mathematics or simply categorized in mathematical, is my main concern. As the result of this work, there is already some evidence of linguistic evolution both in their numeric system and also in the names of certain geometrical shapes and topologic concepts, all which are social characteristics, reflecting the cultural dynamism of the tribe. That is proof of the building of mathematical concepts as the result of social aspects, also conveying that there are historically placed meanings.

THE WAIMIRI-ATROARI SCHOOL SYSTEM

There has always been schooling in a more ethnic sense in the Waimiri-Atroari tribe, for their ethnic knowledge has always been passed on but, on a more occidental sense, schooling as the teaching of occidental knowledge has had several moments. The first one, as far as it is known, started in 1968 with a couple of missionaries from the Indigenous Missionary Council (Conselho Missionário Indígena — CMI), but not for long; in the same yeas another couple, now from the Evangelical Mission of Amazonas, resumes this educational process and carries it on until 1987. Although both the couples were missionaries they had a rather different idea for the village school, where catechesis was not part of the curriculum but curricular disciplines, such as mathematics, were teacher based. A second moment happened when Marcio Silva, an anthropologist, was asked by the Indians to take over the school in 1987, while he was doing some ethnographic research. The third and final moment took place in 1988, when the Waimiri-Atroari program, sponsored by Eletronorte to reimburse the lands which had been flooded, started and developed the educational sub-program. It was only then that the 12 school villages were implemented.

The first positions of teachers were given to white, inexperienced teachers that were little by little substituted by Indian teacher who have been being prepared for the positions. They receive continuous orientation, given by the academic team, that periodically visit the sites providing teachers with pedagogical grounds and accompanying the curricular development of the schools. Another point of importance in their formation are the annual meetings with specialists in the curricular areas where they discuss pedagogical methodologies. During such meetings the specialists attempt to link the teachers academic knowledge with the best methodologies, which may be based on the teachers' own didactic experiences as well as their knowledge of the communities' lifestyles. The school village is, therefore, differentiated from the urban of even rural school. Besides the teachers' backgrounds being different, their school calendar respects traditional Indian festivities, the panting of the crop, the hunting and the collective fishing. Likewise, they start learning how to read and write in their mother tongue and only later are they made literate in Portuguese and then continue their learning process in both languages. The sciences are taught cross-disciplinary, both are taught in conjunction as often as it is possible, and the ethnic knowledge is as part of the program as institutional science.

Approximately four hundred students attend classes at the schools nowadays, being one hundred and forty five children, two hundred and thirty three adults under fifty and twenty two over fifty years of age.

THE WAIMIRI-ATROARI MATHEMATICS

The first time I came across any reference to the Waimiri-Atroari number system was in the book "Pacificação dos Crichamas" by João Barbosa Rodrigues (page 49), where he quotes some sentences said by the Indians. The sentences "Tuparé ainam naemé?" and "Tupanican anamei" are respectively translated as "How many nations are there in this river?" and "There is only one, ours".

In the same page the author describes a conversation where he asks the guide how many 'malocas' (Indian houses) there were in the village, for which question he answers "anciá ean", showing all fingers from both hands, and the author translates it as 'ten'.

In the end of the book he transcribes the Waimiri-Atroari numeration:

$01 - ext{tuim}$	06 - turincaboná	$20-{ m tiuimtemongonon}$
$02 - \mathrm{sananobur}$ ú	$07 - { m saquene}$	30 - m sarcicamongen
$03 - \mathrm{sarenu\acute{a}}$	$08 - \mathrm{seranor\acute{e}neabunan}$	$40 - \mathrm{iepor\acute{e}}$
04 - saqueroba	$09 - { m saqueror{\acute{e}}meabanan}$	50 - tuparémonongonon
05 - tupaique	$10 - \mathrm{taparenon}$	100 - soroparetuparo

All of the indians with whom I have worked are not familiar with such terms and do not believe they belong to the Waimiri-Atroari language. The asked the elders from their villages and none of them knew those numbers. The interpret the author referred to was probably from another tribe and told him the numbers as they were used in his own language. Such numbers are, however, not known by any Brazilian tribe.

What we know nowadays are the three first numbers: *awenini* (one), *typytyna* (two) and *takynynapa* (three). Above three they use *wapy*, which means *many*, or *warenpa*, that means *big quantity*. The elders even use such terms as *akynmy* and *pitymy* to refer to *one* although they are no longer in use. The words also mean *alone* and *single*, respectively.

The geometrical shapes which were brought to my knowledge were itaktyhy as square and mixop itaktyhy as rectangle — mixop means long, therefore being a long square it is a rectangle. The lozenge is very specifically named as *maia pankaha waty*, whick menas 'like the tip of the arrow', and the circle is *avermyhy*, which in fact means round. The perimeter is called *asapanpankwaha*, which could be translated as 'along the verge', diagonal is epakytyhy and even for angle they could find *asa panta panwaha*, that is, 'folded tip verge'.

Some other terms of relevance I came to know are:

kawy - tall/high	$\operatorname{Mixop}-\operatorname{long}$
m kyby-short/low	Takwa – short (the opposite of long)
aha-big	natéme ou $natahme - front$
bahnja - small	agytyhy ou apytylmy - back
mie - far	${ m djapma\ najapy-right}$
kypy - near/close	$\mathrm{makma}\;\mathrm{najapy}-\mathrm{left}$
tydapra or taha - thick	${ m eixyknaka-on/above}$
bakinja - thin	m kytany - under/bellow

In our first meeting, when we put together the maths primer for the school, they decided to name the numbers from four to nine using addition. Four, for example, became *takynynapa awenini* (three and one), five was named *takynynapa typytyna* (three and two) and nine was then called *takynynapa takynynapa takynynapa* (three, three and three). When this idea was taken to the villages, the young thought it was funny and mediataly accepted the concept. The elders, on the other hand, didn't accept it and strongly opposed to the concept, with the idea that the language shouldn't be played with.

My work with mathematics consultancy

Every year, since 1994, I spend one week working eight hour a day with the Waimiri-Atroari teachers. In the mornings I usually focus on their mathematical formation, the concepts are, then, taught using examples that relate to their own realities. Some of the things we have already worked with are the four basic operations, fractions, the rule of three, interest and percentage, perimeter and the area of certain geometrical shapes they are more familiar with and angle measures.

In the afternoons we have different themes for each year. The planning of the building of the maloca-school, the using of the calculator, interviews for mathematical modeling and the benefit of using games with pedagogical purposes are just some of the themes discussed. The night period is when they study and revise by doing the homework, which consists of problems and exercises that further develop the concepts seen in the classroom.

Every time I visit the village, it is necessary to review some of the concepts, for it is very difficult for them to study. Nevertheless I have observed great growth in the acquisition of the studied concepts and the work has proved to be efficient so much as in to enable the Indian teacher to be the expert on the concepts they later teach. Another matter is their formation as field researchers, ethnographers. With my yearly requirement of a field research

paper, they already reasonably dominate the process of ethnography, which is generally quite difficult for an inexperienced non-indian teacher. They also started their own pedagogical project, as the result of the field researches. Proficient in their ethnic knowledge. they are the best people to develop such project. They know and live the indian lifestyle, the important cultural values that should be taught at school, and, with academic mathematics, are more able than others to interpret their reality. Besides that, they are also apt to understand the urban, non-indian, world and the role of mathematics in this world. They can read, analyze and criticize news articles that require mathematical knowledge as a tool to understanding.

There is still a long path to be walked until these Indian teachers are completely enabled, the moment when they are alone able to perform their role of educators, valuing their own knowledge but also understanding and criticizing the non-indian culture. It is my desire to continue contributing to their education.

Some results

The educational program has the objective of enabling the Indian teacher to work in the village schools. My work, with Ethnomathematics, is that of enabling them as researchers of this science in their own culture besides teaching them the basics of occidental mathematics. There are annual meetings with the Indian teachers and also visits to the school villages done by pedagogical counselors during the school year. Nowadays these counselors are also Indian leaders that have finished their educational graduation.

My goal is to prepare them for the field research in Ethnomathematics and show them how to model, when possible, in this academic mathematics so that the Indian teachers are later capable of using their ethnic knowledge to build, with their students, the occidental mathematical knowledge.

Some examples of researched themes in the Waimiri-Atroari culture

Here are some examples of field researches done by the Indian teachers that were later used in their classes, as methodological resources, to teach occidental mathematical concepts:

The building of the Maloca	The nembers
The building o the Jamaxi	Oars construction
Canoe construction	Maryba
The arrows	Katyba

These topics, researched within the Waimiri-Atroari culture, were used in the annual meetings for the elaboration of educational activities to be developed in the village schools. The Mathematical Modeling worked was a tool for the creation of these activities and even the introduction of occidental mathematical concepts.

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