A PROPOSAL FOR CURRICULUM REORIENTATION FOR TEACHING MATHEMATICS IN BASIC EDUCATION UNDER THE LIGHT OF ETHNOMATHEMATICS

UMA PROPOSTA DE ORIENTAÇÕES CURRICULARES PARA O ENSINO DE MATEMÁTICA NA EDUCAÇÃO BÁSICA SOB A LUZ DA ETNOMATEMÁTICA

Francisco de Assis Bandeira
fabandeira56@gmail.com

Universidade Federal de Rio Grande do Norte

ABSTRACT

This paper aims towards presenting thoughts in relation to a proposal of curriculum reorientation in mathematics education, in the light of conceptions of D'Ambrosio's ethnomathematics program. This article makes use of mathematical knowledge experienced by the students in their community, as a methodological subsidy in the teaching-learning process of school mathematics. To accomplish this proposal in the education area, the author searched the legal foundations in relation to the *Parâmetros Curriculares Nacionais - PCN* (National Curricular Parameters). This official document works as a reference to schools to organize curriculum proposals. In this regard, the author associated content blocs of the *Parâmetros Curriculares Nacionais do Ensino Fundamental de Matemática* (National Curriculum Parameters of Fundamental Mathematics Teaching) to the mathematical knowledge of a horticulturist community living in Natal, in the state of Rio Grande do Norte, Brazil.

Keywords: Culture; Mathematics; Ethnomathematics; Learning; Curriculum.

RESUMO

Este artigo tem como objetivo apresentar reflexões sobre uma proposta de reorientação curricular em educação matemática à luz das concepções do programa etnomatemática de D'Ambrosio. Este artigo utiliza o conhecimento matemático vivenciado pelos alunos em sua comunidade como um subsídio metodológico para o processo de ensino e aprendizagem da matemática escolar. Para a concretização dessa proposta no campo educacional, busquei fundamentos legais nos Parâmetros Curriculares Nacionais - PCN. Esse documento oficial funciona apenas como uma referência para que as escolas organizem suas propostas curriculares. Nesse sentido, associei os blocos de conteúdos dos Parâmetros Curriculares Nacionais do Ensino Fundamental da Matemática aos conhecimentos matemáticos de uma comunidade de horticultores da cidade de Natal, no estado do Rio Grande do Norte, Brazil.

Palavras-chave: Cultura; Matemática; Etnomatemática; Aprendizagem; Currículo.

1. Introduction

The reflections presented in this paper are a part of a proposal for curriculum reorientation in Mathematics Education in relation to Ethnomathematics conceptions as outlined by D'Ambrosio. This proposal aims at using the mathematical knowledge experienced by students in their community context as methodological subsidies for the teaching community as methodological subsidy in the teaching-learning process of school Mathematics. To accomplish this proposal in the educational area, I searched the legal foundations like the *Parâmetros Curriculares Nacionais - PCN* (National Curricular Parameters) (Brasil, 1998). This official document works as a reference to schools to empower them to organize curriculum activities. In this sense, I associated the content blocs of the PCN's for fundamental mathematics teaching to the mathematical knowledge of a horticulturist community living in Natal, in the state of Rio Grande do Norte, in Brazil.

The movements of curriculum reorientation in mathematics education are spreading worldwide, including in Brazil. In spite of it, and as in many locations worldwide, this wave is not capable of changing teaching practices and the elite character in the way teachers teach mathematics or can it improve its quality. In many Mathematics classes, pupils are trained to store (memorize) information and to develop proficiency in manipulating algorithms without any relation whatsoever to their out of school lives. This practice continues to be "marked by high retention rates, previous concept formalization, an excessive preoccupation with ability training and process mechanization without understanding" (Brasil, 1988, p. 19).

The consequences of this educational practice have led pupils to believe that the learning of mathematics occurs merely by accumulating formulae and algorithms, which is not a construction built by humanity; that it has nothing to do with their lives; that it compounds a body of true, static, and neutral concepts that nobody doubts or questions. For example, often teachers do not have the time to explain to their pupils the background or usage of certain mathematical formula or concepts.

It is due to this that many students start to feel mathematics as something full of senseless rules. In reality, they think that Mathematics is a set of rules to make things with symbols. These facts lead us to reflect on a recurring reality since decades ago, as Kamii and Declark (1991) remark, "those from us that obtained success in school, memorized a huge number of 'right' answers [in Mathematics] without understanding them nor worrying about that" (p. 77).

In the last years, in Brazil, discussions on curriculums have assumed a great importance, especially in reason of the varied changes that the official curriculum proposals try to bring to school. The first discussions on curriculums, in Brazil, date from 1920 (Moreira, 1990). Since then, until the 1980s, the instrumental transfer of theorists on the United States marked this field; this influence has prevailed because of bilateral agreements between Brazilian and United States governments in relation to aid programs throughout Latin America. Most import to the context of Brazil has been the agreement named *MEC/USAID* between the *Ministério de Educação e Cultura - MEC* (Ministry of Education and Culture) in Brazil and the *United States Agency for International Development – USAID* (SANTO, 2005). One notable example of this collaboration was the *Modern Mathematics Movement*, which is not relevant to the discussion in this paper.

It was not until the beginning of the 1990s, that curriculum studies assumed a sociological aspect, in counterpoint to the domain of psychological trends in North American curriculum. The works presenting this new approach interpreted curriculum in the context and part of power relations, as Moreira and Silva (2002) affirms that "curriculum for a long time ceased to be a mere technical area, devoted to questions relating to procedures, techniques, methods. One can speak now in a critical fashion in curriculum, guided by sociological, political and epistemological questions" (p. 7).

Mignoni (1994), studying ideological concepts of curriculum in the pedagogical training of Mathematics teachers in elementary school, took as a basis MacDonald's three paradigms: the one interested in control, the other interested in understanding and that interested in emancipation. However, Mignoni (1994) observed that José Luiz Domingues re-classified them, respectively, as Technical-Linear, Circular-Consensual and Dynamic-Dialogical paradigms, which have been adapted in this paper.

In the Technical-Linear Paradigm, the specialist dominates the process with the intention of guaranteeing the control and maximizing efficiency. This model is seen in the context of curriculum history, as a strategic field of social control, because it treats school with the same business vision as Taylorism[1] does (Rago & Moreira, 1993), that is, according to a technical division of functions: the planner, the specialist and the person that executes (the teacher). This paradigm highlights objectives, strategies, control and evaluation in the teaching-learning process.

The Circular-Consensual Paradigm demonstrates some control elements, but its interest is consensus and, as human activity dimension, language. The central approach of this circular model is on the learners and his/her experiences and necessities. In fact, in this model, learners themselves are involved in the teaching-learning process and the specialist's participation only occurs when it happens to be necessary or wished.

The Dynamic-Dialogical Paradigm takes as basis three basic premises: a) curriculum cannot be set apart from the social totality, it should be situated historically and be culturally determined; b) curriculum as an inevitable political act that aims at the emancipation of under classes, and c) crises afflicting the overall curriculum field is not conjunctural; it is deep and structural. Because content does not work in a neutral and objective way, curriculum cannot be a sequence of unarticulated contents that are disconnected from social, political and cultural aspects, but is an integrated element which often generates conflict, although problematized, that makes room at school for dialogue and contradictions.

[1]Taylorism is a kind of management system developed by the American engineer Frederick Taylor (1856-1915), who is considered the father of the scientific management and one of the pioneers in the systematization of company management as a scientific subject. What characterizes Taylorism is the emphasis on tasks with the purpose of growing efficiency in operational level. It became an important branch of the classical administration perspective. Taylor's ideas gained impulse since the beginning of the 20th century (Rago & Moreira, 1993).

Studies of the mathematics curriculum, as applied in the municipal education system of São Paulo, Oliveira (20002) classified curriculum in four dimensions: pragmatic, programmatic, cognitive and social-politic. The first dimension, the pragmatic, describes the functional dynamism of the school. The second dimension, the programmatic, concerns the need of establishing the education plan. The third dimension, the cognitive, stands out the role of school in the teaching-learning process. In addition to these four dimensions, the social-politic, reveals ways of conceiving the knowledge organized by human experiences in each society, related to a certain epoch, and to a certain social context.

Of all these curriculum dimensions referenced by Oliveira (2002), the one that is in harmony with the conceptions of a dynamic-dialogical curriculum paradigm is the social-politic dimension. This curricular dimension has come to influence the ways of conceiving the knowledge organized by human experiences in each society, in a certain societal context. In this regard, one could see school curriculum as a historically situated cultural and social construction that passes by a constant actualization process. As Mignoni (1994) says:

> Such a curriculum should reflect not only the institutionalized mathematics, but also the coming and going of an individual (and here we understand all components involved in the educational process, not only the students) through action, in pursuit of knowledge, of questioning, of the critical value of the reality that shelters the dream and the courage of wanting to disclose and change an inequality world[2] (p. 78).

I understand that a curriculum with these sociological conceptions can conceive knowledge as a historically situated cultural and social construction that needs constant and ongoing re-actualization. However, as Apple (2002) recalls, one should not be innocent, for curriculum is always part of a selective tradition, the result of someone's choice, product of the life of a certain group concerning what legitimate knowledge should be.

Ethnomathematics, besides other trends in mathematics education, also worries about important sociological conceptions of a curriculum. In fact, one can say that D'Ambrosio (1990) is one of the representatives of mathematics education to make use of these sociological conceptions about curriculum what has developed a new conception of mathematics preoccupied with cultural dynamism and not only with the rigorous science subsisting in its own world with its own codification system.

This paper, besides this Introduction, contains two more sections. The first, entitled *Toe Context*, shows a panorama of a Gramorezinho horticultural community and the participants in the research. The pedagogical process built in accordance with the mathematical knowledge of that community and in line with formal mathematics is in

[2]Esse currículo deve refletir não só a matemática institucionalizada, mas um ir e vir do indivíduo (e aqui entendemos todos os componentes envolvidos no processo educacional e não só os alunos) através da ação, na busca do entendimento, do conhecimento, do questionamento, do valor crítico da realidade que abriga o sonho e a coragem de querer desocultar e mudar um mundo de desigualdades (Mignoni, 1994, p. 78).

relation to the second section, entitled Pedagogical Actions. At last, in the Conclusions, some limitations and reflections are shared in the course of the pedagogical process experiences with the pupils of that community.

2. The Context

This pedagogical proposal emerged in the community school of Gramorezinho horticulturists, located in north coast of Natal/RN, 30 km from the capital. This school offers only elementary and middle school. In addition, the 5th grade in fundamental school deserves priority because at this turn pupils habitually present more problems in the teaching-learning process, especially in relation to mathematics. The community counts some 500 families living by producing and selling vegetables (lettuce, coriander, chives, pepper and others) to the restaurants, malls and district street markets in Natal and surrounding areas.

The vegetal production in this community comes from small farms employing three or four members of the same family. The farms are vegetable gardens irrigated with lagoon water available in the community and fertilized with manure acquired in aviaries, surrounding the capital and containing at most 90 furrows[3].

Most communal horticulturists have less than five years of formal education, while the oldest of them never entered a school at all. The youngest ones, whose parents are engaged in the vegetable production and selling, often give up school before concluding elementary school.

In the second semester of 2007, I was a teacher/researcher in the horticulturist's communal school, in Gramorezinho, specifically, in the fifth class of fundamental school with the purpose of working with those pupils on a proposal for curriculum reorientation in mathematical education as elaborated in accordance with formal mathematical knowledge (Bandeira, 2009).

During the development of this pedagogical proposal with the 24 students who participated in this intervention, three distinct realities were identified: a) there was a group of 6 (six) students and their parents who never worked with vegetables, but lived adjacent to the community, b) another group of 12 students who did not work with vegetables, but their families did, and c) a third group of 6 (six) students who helped their parents and worked daily with the production and the marketing of the vegetables.

Through the observations and analysis of the results, I considered only two groups of pupils: those who worked daily with vegetables and those who never did.

3. Pedagogical Actions

[3]A furrow, in the community context, means a rectangular lot of land two meters long and 20 meters wide and used to farm vegetables, especially coriander, lettuce, and green onions. The set of these furrows forms the vegetable gardens in this study.

Here it is important to mention the pedagogical process constructed that is based on the mathematical knowledge of the community. Actually, this pedagogical process had two objectives: to bring to the classroom traditional practices present in the community and, at the same time, to connect the learners to the community so they could witness and value these practices.

This pedagogical process made use of content blocs proposed by the PCN's: Numbers and Operations, Space and Form, Quantities and Measures, and Information Treatment. These are aligned with mathematical knowledge presented by the Gramorezinho horticulturist community, and were categorized in the following way: counting procedures, length and area measurements, volume measurements, time measurements, and procedures related to marketing and proportionality. Due to spatial constraint of this paper, I will share experience related to quantities of time, and information treatment and marketing procedures.

3.1. Quantities and Measures and Time Measurement

The PCN content bloc named *quantities and measures* indicates that fifth graders need to know how to value and estimate measures, read time in ordinary and digital clocks, identify coins and change a small amount of money, and make conversions of time measurements, mass and distance. The content of this bloc is present in almost all activities realized in our society and is characterized by its striking social relevance, with an important practical and utilitarian character. In this way, it plays an important and fundamental role in the mathematics curriculum of elementary school because it demonstrates the utility of the mathematical knowledge in daily life (Brasil, 1997).

Important examples of this form of pedagogical action are the conceptions of length, volume and time measurements as used by the Gramorezinho farming community. As previously mentioned, I will pay attention to the time measurements in this paper. For example, the fertilization control of the vegetables conducted by the farmers in Gramorezinho was done by watching the size and/or the color of the leaves of the vegetables. This observation procedure helped farmers place the necessary quantity of fertilizer in their gardens.

Another procedure used by the farmers during the harvest period, is that they did not record the date the vegetables should be harvested. For example, farmer Francisco shared that: "I do not record a date, I just observe. However, sometimes we can count from the time we planted to this epoch [harvest]. Is sums 45 or 30 and some days". When that farmer says that he does not record a strict vegetable planting date, he prefers rather, to *eyeball it*, he means that he knows the harvest time by just observing the size and the aspect of the vegetables crop. Here we can discern a notion of time intrinsically linked to the processes of nature. In consequence, the coming processes to quantify time such as germination, planting growth, and color of the leaves of the vegetables.

Amâncio (1990) conducted research about the Kaingang[4] counting system, and he identified that the indigenous community counts the age of their people by the flowering

[4]Traditionally, the Kaingang Indigenous people in Brazil occupied an immense geographical region from the Southeast to the Southern of Brazil. Currently, there are approximately 30.000 Kaingang people who occupy thirty reduced geographic areas that are distributed over its former territory in the states of São Paulo, Paraná, Santa Catarina, and Rio Grande do Sul (Silva & Laroque, 2012).

of *taquaraçu* or *taquara-brava*, in which each flowering time corresponds to a period of approximately thirty years. Other peoples count age with the aid of *taquara-mansa*, a plant that spends to each flowering half time required by taquaraçu. To count the months, they base their calculations on the phases of the Moon.

What were once thought of as *primitive* cosmologies were developed by human beings and incorporated sophisticated concepts of space and time and contained emotional or natural meaning. For example, time periodicity was associated to the rhythms and cycles of the collective life of a social group, and was strongly connected to the knowledge of the life cycle of plants and the migration time of the beasts of prey. However, only with the rise of agriculture, 10.000 years ago, and, consequently, with the growth of population and sedentary life, that people felt necessary to develop increasingly sophisticated instruments for planting and harvesting, storage of crops, land tenure, organizing production and work.

Because of that, people placed human and social observations and structures on a calendar. First they worked with symbolic constructions that were regulated by social behavior and by observing time. Worldwide today, there are some forty calendars in use. The most prevalent and internationally recognized one has been in force since 1582, and was proclaimed by Pope Gregorio XIII. D'Ambrosio (2001) states: "the construction of calendars, that is, the counting and registration of time, is an excellent example of ethnomathematics" (p. 21).

What does all this have to do with those fifth graders of the fundamental school in Gramorezinho? One of the first ideas to appear in the beginning of mathematical thinking were the different ways of counting time by linking it to the history of mathematics and to astronomy.

Today, the most important of all this is how the pupil understands time as one of the major survival tools of farmers in their community. Hopefully, they will come to understand why concepts of time are important. Time moves our behavior every day, for we have schedules, for example, the time for sleep, when to wake up, when to brush our teeth, when to go to school and/or work, among other routine activities. Besides that, time functions as an economic tool for calculating the salary of workers (per hour worked) to produce goods and services.

In accordance to Cipolla (2014), "Marx defines the value of a labor force as the working time necessary to the production of goods" (p. 388). The reduction of the time necessary to the production of certain objects does not mean that the rise or the reduction of the worker's salary, but the reduction of the time necessary to the production of that good, and the equivalent to the worker's salary at the end of the month. As a result, the entrepreneur gets a bigger amount of value added, that is, profit, when the worker produces the item in less time than planned. In other words, value added is the value that the worker produces beyond the value of his labor force.

Let us see now more clearly an example of time concept related with value added: suppose that in a clothing factory a dressmaker takes eight hours to sew six shirts. In a labor week, equivalent to forty-four hours in Brazil, this worker sews thirty-three shirts.

In this period, she sews what is necessary to pay all her salary at the end of the month. In the meantime, she stays more three weeks in the factory, producing more shirts to receive her monthly salary. If her monthly work time is 176 hours, it means that she sews 132 shirts. In brief, one concludes that this sewer works 99 hours without pay, or unpaid work time, reducing the shirt costs and increasing the entrepreneur's income. This extra value is appropriated by her employer and consists in what Marx (2006) calls "value added" (p. 325).

It is worth saying that this kind of situation generally occurs in typical mathematics textbooks. Therefore, mathematics has come to be associated with a process of domination and with the structure of this process. As D'Ambrosio (1990) observed, "although this question is not sufficiently studied, the analysis of ideological components of mathematical thought reveals a strong liaison with a certain socio-economic model" (p. 24).

Questions concerning time measurements worked pedagogically with the pupils in the Gramorezinho community were designed to help them connect the conception of time of the academic context, and be in line with the conception of time of the farm community. In this regard, I created a situation-problem based on the reality of those farmers that was related to how the control of the vegetable manure depended upon observing the size and the yellowish appearance of the vegetables. The same applies from the crop to the harvest, because horticulturists do not register dates; they just evaluate the size and appearance of the vegetables. A horticulturist explained to me: "I do not determine a term; it suffices to eyeball it. It takes some 45, 30 days". Among those farmers, there is a notion of time linked to the processes of nature: germination, plant growth, color of flowers.

After the reading and discussion of that situation-problem, pupils should be able to answer the following questions: Do all vegetables obey the same cycle from crop to harvest? What is the cycle of crop and harvest of lettuce? What is the cycle of crop and harvest of the green onion? What is the cycle of crop and harvest of coriander? Did you look at the calendar today? Can you say in what day, month and year we are having this class? What time is it? Do you have a pre-established hour to wake up? The same to meals, to sleep and to study? How many hours does a day have? How many minutes does an hour have? How many seconds does a minute have?

Before realizing this activity in class, pupils visited, under my supervision, a communal vegetable garden, and interviewed the horticulturists in order to know how the vegetable cycles occurred and might differ. Such an attitude was inspired from my class observations, because most pupils had no idea about the necessary time that vegetable cultivation required. They did not know how many days were necessary to germinate the vegetable seeds, especially coriander and lettuce seeds, and had no notion about the days needed to transfer vegetables from seedbed to furrows.

Then, to make them understand the concept of time measurements, firstly I referred to field researches realized in previous classes. I asked them what they had learned with horticulturists about the vegetable cycles (lettuce, green onions and coriander), if they had the same cycle, that is, if from crop to harvest. They had answered negatively, and explained that coriander demanded the longest cultivation time, while green onions, the shortest period. In addition, they added that to collect a green onion harvest it was necessary to wait more than 45 days, while coriander's required 30 days, and lettuce's, 35 days.

To solve the other questions before mentioned, I asked them if games, school and/or domestic tasks occurred at a scheduled time. Some answered yes, some no. Then, I said that if we had a scheduled task, it was necessary to look at the calendar and the watch. As an example, I mentioned our classes, programmed from August to December 2007.
To horticulturists, it was not necessary to register on the calendar a vegetable crop and harvest, because they knew already, thanks to their experience acquired in the daily activity. After this dialogue with the pupils, my observations in class and question analysis, I could note that they answered all my questions without any difficulty.

I then proposed these same questions to the six pupils busy with the vegetables their parents were handling. However, I remember that the procedures adopted varied from those applied with the other non-horticulturists pupils, because they worked in an environment separated from their classmates.

Let us see, then, how we acted with these pupils/horticulturists to help them in the solution of the four first questions referent to the vegetable cycle, that is, the number of days that were necessary for the cultivation of lettuce, coriander and green onion to grow between the crop and the harvest. Firstly, I asked if the number of days for planting to harvesting vegetables were the same. They answered no, but it was a tiny amount. Then I asked them to tell me each vegetable cycle cultivated in Gramorezinho community. One of them spoke that lettuce cycle lasted 30 days; another told it was 40 days. Concerning coriander, there was no agreement on that, too. Some told it lasted 20 days; others, 25 days. One of the pupils, named Carlos, said it lasted 30 days.

Then, to reach an agreement, I asked them to consult with their parents about the vegetable cycles. One pupil, Carlos, told us that it was unnecessary, because "coriander cycle lasted, with no doubt 30 days". Most pupils agreed that green onion cycle lasted longer, from 40 to 50 days. After these discussions, I scheduled the next class a visit to a vegetable garden located in the community to get more information about the vegetable cycles from the horticulturists.

In that visit, a farmer spoke that pupils were right, because the coriander cycle was the shortest, lasting in general 30 days from planting to harvesting; lettuce cycle lasted 40 days. He told us also that green onion cycle was the longest, lasting from 50 to 60 days. After talking with the farmer, we went out and sat under an enormous cashew tree, where the pupils solved questions concerning vegetable cycles, and were sheltered by the shade of that huge tree, with the agreeable smell of its fruit. Figure 1 shows fifth graders pupils visiting vegetables gardens.

Figure 1: Fifth graders pupils visiting vegetables gardens

In the following class, I reassumed the activities concerning time measurements. Before that, I asked the pupils/horticulturists what they usually did every day, besides studying from Monday to Friday at the community school. They told me that they woke up very early to irrigate the vegetable gardens. Thereafter, they had the breakfast. Then, they returned to vegetable gardens to clean the furrows and weed them. They used to land a hand at the transfer of lettuce seedlings from the seedbed to the furrows.

Most of the students worked in the vegetable gardens backing up their fathers from Monday to Friday, from six o'clock to 11 o'clock in the morning. On Saturdays, all day long. They did everything that an adult horticulturist did, except constructing furrows. In the afternoon, they went to school from Monday to Friday, studying until 17:15. When they had a break, they ran a kite or played football. They studied at home only when they had home tasks asked by the teacher. After these dialogues, they realized some collective tasks, sometimes in line with the teacher/researcher, when necessary or asked for.

Indeed, those pupils/horticulturists did not care about vegetables as much as their parents did. However, after these activities, they became more mindful and conscious about the importance of time in relation to contemporary society. However, they did not enjoy much leisure time, because some of them worked on Sundays in the free markets in Natal neighborhoods.

Regarding the non-horticulturist group of students (those that never worked, not even with vegetables), the objectives succeeded thanks to information conveyed by the farmers and in field class activities. I clarify this only from contextualized activities proposed by these pupils; many of them became fictitious, because they were strange to those pupils, even considering that the field tasks were in line with the class tasks. However, the positive side of the pedagogical process with these pupils was the motivation due to the field research and the interviews with the farmers concerning the knowledge that seemed distant from the reality of the classroom, but was actually quite near to them.

3.2. Information Treatment and Marketing Procedures

PCN's in the content bloc named *information treatment* stood out with a second grader of fundamental school and is not expected to develop a work based on formulae. However, he must be able to construct procedures to collect, organize, communicate and interpret data by means of tables, graphics and representations present in his daily life (Brasil, 1997).

It is important to point out that this content bloc is essential in the literary of any citizen; to be literate is the ability to read and interpret numerical data formally organized as, for example, in the mass media such as newspapers, magazines, television by those that use this form of language every day. However, to become a world citizen it is necessary that these pupils are able to decode and critically interpret information around them.

Many a time, the works inserted in this content bloc result in the production of tables and graphics, without connecting data to a given social context, and do not encourage students to criticize them. This is perhaps why fifth graders do not really understand information or graphics and neither the process or the recognition of parts of a totality in graphic representations, in accordance with research data from *Sistema de Avaliação da Educação* Básica - SAEB (Basic Education Evaluation System) (Brasil, 2003). To attenuate this situation in the communal context of the farmers in this study, I worked pedagogically on marketing procedures by means of information contained in tables and graphic representations with the aid of the mathematical knowledge of communal Gramorezinho farmers, and that was in harmony with formal mathematics. Before that, however, it was necessary to explain the conceptions of the horticulturists of that community relating to vegetables marketing procedures.

The marketing procedure for vegetables in the Gramorezinho community included accounting area, calculation of the costs of production, the selling price calculations, calculations in relation to profits made. The production cost of vegetables in this community is everything that one spends directly or indirectly to produce them, that is, it involves the labor force, that is, in general, the family, manure, seeds, electricity, work tools and others. The price estimate of vegetables: lettuce, red peppers, coriander and green onion depends on some variants, especially the market demand and/or the season of the year: winter or summer.

In this community, summer is more promising for cultivating vegetables, because this season provides a shorter cycle for harvest; consequently, it also demands less fertilization while the vegetable quality is better. In summertime, horticulturists sell vegetables cheaper than in winter. Another factor that influences and reflects the price is the vegetable supply coming from other regions to compete in the neighborhood markets in Natal.

In my opinion, the idea of profit means gain, advantage or benefit free from expanses obtained in the exploration of a formal or informal economic activity, or even any other activity. The horticulturists of Gramorezinho community see profit associated to the amount of vegetables commercialized. It seems that they do not account properly all their expanses.

In dialogues with some of these horticulturists, I noted that their greatest concern was with the cost related to manure and vegetable seeds. I could observe, still, along these dialogues, that profit was associated with the amount of vegetables sold and with the localization to the markets in Natal. However, the profit control was hard due to the precarious accounting of expanses, according to some horticulturists.

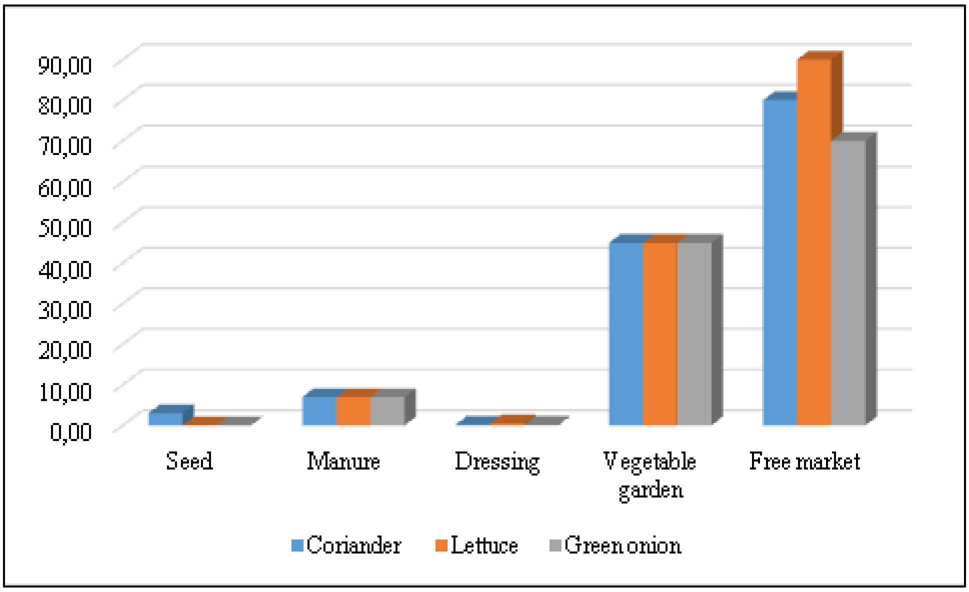
D'Ambrosio (2001) highlights that an important component of ethnomathematics is to provide a critical vision of reality using mathematical instruments. He recognizes the mathematical practices used by Gramorezinho horticulturists and underlines that daily actions like buying, selling, discounting, profiting and others as a way of teaching mathematics reveals practices existing off school, a real commerce ethnomathematics, as well as provide excellent pedagogical material.

Two were the pedagogically worked activities with the fifth graders: the first related to their conceptions in relation to proportionality; the second was related to the manure costs, and the sale and profit made. However, I will treat only the second activity, but I leave here an invitation to the reader to visit my doctorate thesis (Bandeira, 2009) which has complete data to all aspects of the mathematics I found in Gramorezinho.

The pedagogical questions concerned the second activity, where I worked with those pupils about input costs, such as seeds and manure to cultivate a vegetable garden, the sale of batches of vegetables in the neighborhood markets in Natal, as well as the sale of vegetables direct from their own vegetable garden. Finally, the profit made with the production and commercialization of a vegetable furrow both in the free market and in the vegetable garden. These questions are also presented in Table 1 and in Figure 1.

Furrow	Coriander	Lettuce	Green onion
Seed	3,00	0,00	0,00
Manure	7,00	7,00	7,0
Dressing	0,20	0,50	0,15
Vegetable garden	45,00	45,00	45,00
Free market	80,00	90,00	70,00

Table 1: Cost and sale of a vegetable furrow in Gramorezinho community Notice
Source: elaborated by the researcher



Graphic 1: Cost and sale of a vegetable furrow in Gramorezinho community
Source: elaborated by the researcher.

The situation-problems of the above mentioned activity required an analysis, with the aid of table and graphic, of the input costs, such as seeds and manure necessary for the cultivation of a vegetable furrow, the sale of vegetable batches in the markets in Natal, as well as the sale of vegetable from the vegetable gardens. Besides this, pupils could analyze the profits made with the production and commercialization of a vegetable furrow, not only in the markets, but also direct from the communal vegetable gardens of Gramorezinho.

Before starting this activity, I asked the pupils how their parents accounted for the input costs to produce vegetables. A pupil, Roberto, and who was producing vegetables and also sold his products in the markets in Natal, told me that his parents did not use to draw up a budget with the input costs of their furrow, because they were not accustomed to this kind of budget procedure. As well, this pupil told me that the shop that sold coriander seeds in kilograms, and a kilogram of seed cost R$ 24.00, an amount sufficient to cultivate eight furrows. Finally, I asked the pupils how much it cost to cultivate just one coriander furrow. Roberto also said that “it cost three *reais* because three times eight was 24”.

One becomes aware, reading the paragraph above, that the pupil first made the inverse operation of multiplication to affirm subsequently that three times eight equals 24. He also did not nourish any doubt about the operation, that is, “if the result would be less or more”, a situation observed in the beginning of the pedagogical process, when pupils often used to ask: “Is it more or less, teacher?”

By continuing with the questions, I asked pupils to analyze Table 1 and Graphic 1 and explain why there were just a column representing vegetable seeds. They answered that that column represented only coriander seeds because there were no costs with lettuce seeds and with onion threads, because they produced these things in their own vegetable gardens. Next, I asked them to analyze again using the table and the graphic, the cost fertilizer, the price of coriander, green onions or lettuce foot bunches, besides the price of the vegetable furrow in their own vegetable gardens. These questions, in fact, were very familiar to those pupils/horticulturists, and then they had no difficulty to answer them correctly and firmly.

In the issue regarding the profit made with a coriander furrow sold in the free market, at first these pupils did not view the costs in relation to the production of vegetables. Then I asked what was necessary to produce a coriander furrow. They told me that it demanded fertilizer, coriander seeds and energy, besides other inputs. However, I insisted only in those first items, because their costs were economically urgent and/or common preoccupation for the community farmers.

Proceeding with the dialogue, I asked the pupils how much it cost to produce a coriander furrow. All of them told me that it cost R$ 3,00 (spent in coriander seeds, and more R$ 7,00 spent with manure). Then again, I questioned if a coriander furrow has a bulk sale of R$ 80,00, what profit one makes? Firstly, they consulted Table 1. Then they answered correctly. See, for example, pupil Roberto’s commentaries 06/11/2007). “I spent ten [with seeds and manure], sold at 80 and I kept 70 [of profit]”.

One can observe in the conversation of the pupils that there were no doubts regarding the kind of operation in question, that is, if it concerned addition or other fundamental operations. In reality, he affirmed first cost, then product sale and, finally, profit, which was the target.

As to what concerns lettuce and green onion furrows, I followed the same procedures above: that is, I talked with the six pupils, with the aid of a text, table and graphic, along with the reality that was familiar to them. The questions concerning these vegetables (lettuce and green onion) were easily resolved, even those referring profit, and because the pupils had no doubt about how much was spent on manure for profit with the vegetables. It is true that, at first, the pupils had some difficulty in interpreting Graphic 1. However, along the pedagogical process they learned to apprehend their representations.

One can conclude, by evaluating activities realized by the students that worked daily with their parents in the production and commercialization of vegetables, that they knew exactly what they did. Activities that, indeed, originated at their mathematical conceptions, as expressed precisely by pupil Jean: “I learned much better how to calculate when you taught us to work more [mathematics], when we went to vegetable gardens”.

4. Final Considerations

In the light of conceptions of D’Ambrosio’s ethnomathematics, this paper aimed at presenting reflections on a proposal of curriculum reorientation in mathematics education by using the mathematical knowledge experienced by the pupils in their community as a methodological subside to the teaching-learning process of school Mathematics.

It is true that just one research project is not sufficient, sometimes, to solve all problems identified. However, it serves to point out errors and suggest new solutions. That is what I plan to do next, based on the results of my pedagogical proposal worked with fifth graders of fundamental school in the Gramorezinho community of horticulturists.

The meetings with the children occurred in August 2007, and were two days a-week, which was a time far too limited for my proposals, due to their poor reading and writing skills. Some could read a little, but could not express their thoughts well in writing. The biggest difficulty was to solve situation-problems involving the four fundamental operations, especially division.

Nevertheless, the pedagogical process showed those pupils how mathematics did not exist only in the classroom or in the textbook, but everywhere else; and that, if it was different, the cultures were different, too; for example the pupils who understand both mathematics: school mathematics and farming mathematics. However, the latter was better understood, because it was familiar to them.

In the beginning of the pedagogical processes, pupils seemed insecure concerning the situation-problems involving the four fundamental operations, always asking if concerned plus or minus sign and others. These doubts naturally disappeared during the pedagogical processes. The mathematics created an interest in the students, which allowed them to gradually learn to overcome their embarrassment and express their doubts without difficulty.

As to what regards those groups of pupils/farmers, although some were the *weakest* of the fifth graders of the fundamental school, many of them surprisingly performed better than many non-horticulturist ones. They also questioned situation-problems that did not align with their realities, unlike those pupils who had never worked, let alone in the farms.

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