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## What field school teachers say about the teaching of mathematics: A study in the Northeast of Brazil\*

### O que professores de escolas rurais dizem sobre o ensino de matemática: Um estudo no Nordeste do Brasil

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#### Abstract

The majority of research in mathematics education in Brazil focuses on aspects related to urban schools. Although there has been a discussion for decades about the need for a curriculum in schools located in rural areas that considers the importance of the local culture and the concept of context-based knowledge, there is still precarious teaching of mathematics in these schools. This paper discusses research data that addresses the teaching of mathematics in rural schools located in Pernambuco, Brazil. The method used is a qualitative research method based on interviews and discourse analysis. We focus on the discourse of teachers who participated in the empirical study by analyzing their views on rural education, the conceptualization of resources, and on their performance in mathematics teaching. Although most teachers positively evaluate their performance when they teach mathematics, they do not identify differences between teaching in the city and in rural areas. Generally, the teachers were unaware of the field schools' specificities. The results lead us to reflect on the possibilities of teaching mathematics to empower rural communities.

**Keywords:** Field Education; Teaching of Mathematics; Rural Schools; Teacher Discourse.

#### Resumo

A maior parte da pesquisa em educação matemática no Brasil concentra-se em aspectos relacionados com as escolas urbanas. Embora tenha havido uma discussão de décadas sobre a necessidade de um currículo em escolas rurais, que considere a importância da cultura local e do conceito de conhecimento baseado em contexto, ainda é precário o ensino de matemática nessas escolas. Este artigo discute os dados da pesquisa que aborda o ensino de matemática em escolas rurais localizadas em Pernambuco, Brasil. O método utilizado é o da pesquisa qualitativa, baseada em entrevistas e análise do discurso. Nós nos concentramos no discurso dos professores que participaram do estudo empírico através da análise de seus pontos de vista sobre a educação do campo, sobre o uso de recursos e o seu desempenho no ensino da matemática. Embora a maioria dos professores avalie positivamente suas performances quando eles ensinam matemática, eles não identificam diferenças entre ensinar na cidade e no meio rural. Em geral, os professores não tinham conhecimento das especificidades das escolas do campo. Os resultados nos levam a refletir sobre as possibilidades de ensinar matemática para capacitar as comunidades rurais.

**Palavras-chave:** Educação do Campo; Ensino de Matemática; Escolas Rurais; Discurso dos professores.

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## INTRODUCTION

In Brazil, the school education of people living in rural areas has a specific historical trajectory that is different in comparison to other countries. In this sense, the processes of teaching and learning of mathematics in which Brazilian rural population is engaged are part of a wider scenario that has a history of educational policies for these specific educational realities.

Historically, the organization of schooling for the rural population in Brazil did not consider the particularities of these contexts. Educational policies were not concerned with schooling that considered the rural reality. In this sense, the curricular content, teaching methodologies and pedagogical proposals of the urban schools were transported to the rural ones. This led to schooling that ignored the potential for better development of rural citizens and did not guarantee their right to this development (Monteiro, Leitão & Asseker, 2009).

According to Souza (2006), the origin and organization of Brazilian schools is connected with the social and political bases of the unequal distribution of land and with slavery. It was only during the 1880s that the government started to develop formal education for rural areas. However, Souza states that the first Brazilian rural education system began in the 1920s. This initiative was called “patronato”, with the aim of domesticating rural workers. This initiative was intended to improve agricultural production and to prevent overpopulation of cities. The “patronato” is characterized by transferring knowledge and practice from urban schools to rural schools, without any consideration of the diversity, the specific experiences and the knowledge associated with rural life.

From the 1980s, several social organizations and movements demanded more attention to the education developed for rural inhabitants and a curriculum that considered problems and possibilities of rural education. Veiga (2002), Wanderley (2001) and Arroyo, Caldart and Molina (2004) are examples of authors who discuss the changes that field population has experienced with regard to the emergence of different forms of organization and new social actors. In this perspective, the rural should not be considered only as a place of agricultural production, but must be understood as a "field" of possibilities, such as defining the Operational Guidelines for Field Education (Brasil, 2002).

These changes were motivated by social pressure that rural workers movements made for the preparation and approval of operational guidelines for the basic education of this population

(Brasil, 2002). This governmental document proposed what is called by Field Education (Educação do Campo) that values the population that resides in rural areas, its existence, its forms of production and who perceive the “field” as a living space and cultural production (Arroyo, Caldart & Molina, 2004). From this document linked the struggle of the field population, ‘rural education’ has gained a new perspective, conceiving the field population as a producer of knowledge and life goals themselves.

This curriculum should give value to the different knowledge and needs of education in rural areas (Arroyo, Caldart, & Molina, 2004). Therefore, the consideration of environmental and contextual aspects is the base of a perspective of education in which learners have active roles and bring in his or her previous knowledge and creative way of thinking into the learning process (Pinxten & François, 2012).

Giving value to the different knowledge and needs of education in rural areas is most important for Brazil since this country has continental dimensions and many different contexts of rural areas. According to the 2010 Census (Brasil, 2012), 16% of the population of Brazil lives in rural areas (30.501.231 rural inhabitants), and 23% of this rural population are illiterate, while in urban areas this ratio tends to be lower, at about 7%.

The contemporary field schools need to seek an intensive dialogue between the various actors involved in the learning process. The teacher needs to realize that no group is homogeneous and that there are specificities related to each student involved in the educational process. For example, he/she needs to respect students’ skills and values.

We consider that field schools have a particular role in society, because they are situated in rural communities where people have unique culturally constituted experiences, and where the means of production are linked to local reality, and yet at the same time are part of global reality.

In this paper we reflect on the teaching of mathematics in rural schools by making a link with socio-historical aspects of Field Education. We analyse data from a research study developed with teachers of rural schools which belong to a municipality school network in the Agreste, region of Pernambuco State, and discuss what these teachers say about the socio-cultural reality of field contexts and uses of resources in teaching mathematics.

## **THE TEACHING OF MATHEMATICS IN RURAL SCHOOLS**

Most research on mathematics education in Brazil focuses on schooling in urban areas. Therefore, this paper presents a discussion that is fairly rare among Brazilian academic studies.

Generally speaking, in Brazil, there is a common perception that rural schools are institutions without resources to provide good teaching, and therefore do not provide the elements to guarantee students' learning processes. In fact, statistics (Brasil, 2005) indicate that in Brazil many state primary schools (including those located in rural areas) do not have basic infrastructural equipment (approximately 22 000 schools do not have toilets and 27 000 do not have electricity). However, this aspect cannot be the only factor which influences the students' performance, because in the last few years the government has implemented important projects which are changing the infrastructure of many state schools, but the level of achievement remains very low. Therefore it seems that the effective teaching of mathematics is a complex issue, and the increase in quantity of resources available is not a factor that will solve this issue.

Knijnik (2004) argues that mathematical knowledge has been linked to the economic power of dominant social classes. The contents of mathematics and practices of teaching and learning mathematics in school would be linked to the values and interests of the dominant class. Under these conditions, schools would be presenting only a limited mathematical knowledge, denying the importance of knowledge and practices related to specific contexts, such as those developed in rural areas. Knijnik (2004) emphasizes that mathematics curricula should make knowledge accessible to students of all classes and social contexts. Thus, diverse populations, regardless of their social position, should have access to the relationship between the practices of everyday life and schooling.

Knijnik has investigated these practices in an environment of social movements, such as the Landless' Movement and rural communities (Knijnik, 1996, 1998, 2004). She highlights that students should be led to think and rethink mathematical situations from their realities, especially those professional activities which include local mathematical practices.

Garnica and Martins (2006) argue that stereotypes about rural schools are linked to historical aspects of mathematics teaching. These authors analyzed interviews of rural school inspectors, teachers and students in 1950 and 1970. In the interviews respondents were asked to report their experiences with the teaching and learning of mathematics. The analyses of the responses

suggested that they reduced the teaching of mathematics to the instruction of methods of calculating (addition, subtraction, multiplication and division), and memorizing multiplication tables.

Adler (2001) emphasises that to understand social practices that are developed in schools, it is necessary to analyse the access to certain resources. Adler (1999) argues that resources for teaching, can be analysed from the human, material and cultural dimensions. According to this author the most important is not to classify the resources, but to analyse the effective use of them. Thus, the use of resource as a word involves two meanings: noun and verb, as both object and action (Adler, 2000).

Adler also discusses that the teaching and learning of mathematics can be reflected through effective relationship between these three dimensions of resources (human, material and cultural) that can be used in a visible or not. Thus one of the central aspects of this reflection is that the difficulties in the process of teaching and learning of mathematics cannot be associated only with the lack of resources, but the way these are used in the school context. Adler (2000) investigated different school contexts and stated in whatever the material conditions of schools have always existed teachers explaining educational difficulties blaming their lack of resources, without however reflect on what is a resource in teaching Mathematics.

Mathematics educators need to develop a wider conceptualization of resources in the teaching of mathematics which embraces material objects as well as activities and processes which constitute and emerge from diverse educational practices related to the teaching of mathematics. Adler (2000) argues that general descriptions of resources in teacher education (pre-service and in-service) seem to be ineffective. Instead, teacher education programmes should work with teachers in order to help them to learn how to conceptualise and approach different resources. Teachers should understand resources as mediators which can amplify the possibilities of their teaching.

Melo, Leitão and Alves (2007) discuss some aspects of teacher education in the reality of rural education in Pernambuco. They report that among rural school teachers who participated their study, 25% had completed only a middle-level teaching qualification (corresponding to professionalizing course at high school level). Therefore those teachers did not graduate with an education certificate from faculty or university. These authors reported that participants said that

the lack of resources and teacher education affecting rural schools contributes to students' failure in mathematics.

Asseker and Monteiro (2008) argue that it is important to change teachers' perspectives on teaching mathematics and to make them value the local culture as providing fundamental resources for the teaching and learning of mathematics.

## **METHODOLOGY**

In this paper we discuss data from semi-structured interviews conducted with 12 teachers from 4 rural schools situated in the Pernambuco state of Brazil. These schools belong to a network consisting of 90 rural schools. Interviews were conducted from May 2007 until June 2007 and each took about 1 hour and 30 minutes to complete.

The main criteria used to include the 4 schools and the 12 teachers in the data collection were: 1) the teacher's availability and 2) the school's accessibility. The rural schools where the interviews were carried out have only two classrooms and each teacher works with a class group comprised of students in up to four different school years and hence with a large range of ages.

The local education authorities have developed an educational program for this type of class group. It is called *Escola Ativa* (Active School) and was suggested by the Ministry of Education of the Federal Government. The aim of this program is to improve the quality of teaching in primary schools in the poorest rural regions, and to reduce the gap between children's age and the school year they are attending. According to Piza and Sena (2001), the *Escola Ativa* combines different experiential strategies with the aim of stimulating the learning, collaboration and the participation of the students.

The aim of the analysis of the interviews was to investigate the participants' discourse, including their opinions about rural education and their own practice as mathematics teacher. Each teacher was interviewed individually. All interviews were recorded on a digital audio player and then transcribed into protocols. Significant passages were selected, based on a content analysis approach.

We do not want to make explicit the main topic of the interview at the beginning of conversation with the participants. Therefore, we organized the script in which the first questions were about general teachers' opinions. Some examples, of those questions were:

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- Why do you think your students come to school?
- What contributions can bring their work to the student?
- Which knowledge do you consider essential to work with your students?
- What is education for you?

Gradually, we asked more specific questions about rural education, teaching, and resources, such as:

- What is rural education for you?
- Do you consider this school as Rural School? Why?
- What do you expect of your students?
- What the objectives that rural education has or would have, in order to educate your student?
- What is resource? Exemplify the use of those resources.

## **RESULTS**

All participants were female, with an age ranging from 22 to 53 years (mean age: 35 years). Eleven of them have a higher education certificate; 9 in Pedagogy, 1 in Portuguese Language, and 1 in Accountancy. They have a professional experience ranging from 4 to 25 years (mean: 13 years of experience). One participant has a middle teaching level qualification called *Magistério* which is a special course for elementary school teachers, corresponding to high school level (Marcondes, 1999).

Generally, the teachers seem to have a conception of rural education associated with the students' realities. However, they conceptualize rural realities as restricted and inferior compared to the students who live in urban areas. Within the scope of this paper we cannot report all relevant extracts we transcribed from the 12 interviews. The following interview extracts, from 4 different teachers, Zilda, Nadia, Julia and Claudia, exemplify the participants' conceptualisation of field education.



Interviewer: What is rural education to you?

Zilda: (...) Because you work... You can work with the children the concrete. In the rural area there is the concrete to work with them, you work with animals, plants, water... all these things in a rural area, in a rural school. In town you do not work in concrete... it is very difficult. So, to me rural is all this, because of that, the environment, because of the difference of environment.

Interviewer: Do you consider this school as a rural school?

Zilda: Well, although the school is located in rural area, my students... I do not consider them as students from rural area.

Interviewer: No?

Zilda: No, not because they have, they have access, so they have knowledge... town boy has, today they have. The same knowledge that a town boy has... not before, when I first came here, they did not have, twenty years ago it was very difficult, isn't it? There was not electricity here, today he has knowledge... the boys around here they already participate in the city things, today they have more live in the city, the local boys go to the mall, go... So they have much access to the city; the only difference is because they live far from the city centre.

(Zilda is 53 years old, graduated in Pedagogy, 25 years of teaching experience)

Zilda's point of view about rural school is heavily linked with the idea of agriculture. In this sense, her opinion deviates from what is discussed by official contemporary documents and by social movements.

In the interviews, the participants told us that the local government education secretary provides in-service education for mathematics teaching. However the participants considered that this support does not adequately prepare them to teach this school subject.

Interviewer: How about the teaching of mathematics, have you received orientation?

Nadia: I have received a different methodology to innovate, isn't it? This is because day-by-day children need to increasingly have to follow the changes, isn't it? Playing games, developing everyday situations, that's what we have been working since the beginning of the *active school* which work on it, there must be change, cannot be that traditional.

Interviewer: Specifically in mathematics?

Nadia: Especially in mathematics. It is what they most beat up, right? Lots of games, lots of logical situations that we have to work out, to escape from the sameness, isn't it? More elaborations of problem situations which do not have to be those traditional algorithms, after

they catch those systems, we can develop only problem situations, isn't it? With the four basic operations... and so on with a fraction... and so on.

Interviewer: Do you think the guidelines that the secretary gives are enough?

Nadia: No. My experience is also taken into account. I seek a little bit of my experience because it counts. Especially because, not everything that is discussed in the meetings is the reality that we find in the classroom, right? So we have to adjust, sometimes is the issue that I told you, we prepare all different, isn't it? Those instructions we received... However, sometimes we escape from those instructions a little bit to reach the student, the student's knowledge, isn't it? I fit myself into his situation, into his need, right? I think this is education, isn't it? We cannot say that it has to be to that side and the child does not understand, that does not work, right? I have to see what is the best way to bring knowledge to them, that's how I do in those 20 years, isn't it?

(Nadia is 48 years old, graduated in Pedagogy, 20 years of teaching experience)

As we can see in the extract from Nadia's interview, she considers the educational secretary's guidelines as not linked to rural classrooms. In order to deal with this limitation, she recognizes the need to adjust the instructions that she receives. Therefore, when she does the adjustment she clearly is mobilising a kind of resource to teach mathematics.

Another example of the use of resources in teaching mathematics in the context of rural schools is provided in Julia's interview.

What are resources do you have access to help in mathematics classes?

I use ingredients of school meals, show them bean seeds, and then, I ask: How many kilos? What is its expire date? How long to expire? How much do I need to make snack for everyone? Anyway, I spend the whole morning asking things, but nothing in the notebooks [She refers to the activities in the notebooks that students cannot answer].

(Julia is 38 years old, middle teaching level qualification, 15 years of teaching experience)

In this extract from her interview, we could infer that she generally emphasises the idea of resource as only including material objects. However, she does not explain how use these objects as part of the processes of teaching mathematics. In another moment in her interview, Julia complements her conceptualization of resources that seems to encompass non-material and procedural dimensions:

Interviewer: What do you think is necessary to teach mathematics?

Julia: It is your creativity. You can take the best resource, the best material and then place it in a classroom, but if you do not have creativity it does not make any difference... I achieve many things in my classroom playing with them. I put them at the playground and start playing, playing... Sometimes I want to teach one thing, but then many other things emerge and then I embrace these things and teach even things that were not planned.

Julia makes explicit her unplanned strategies to use resources in her teaching of mathematics. The extract above suggests that she also considers the nonmaterial dimension of resources. For example, she emphasises creativity as a resource and mentioned that the process involved in the use of a resource is more important than the resource itself.

Selva (2003) argues that the use of manipulative materials and creativity itself is not a guarantee to teach and learn mathematics in a better way. According to this author, the purpose of resource use have to be explained, and students should understand that relationships should be established and what knowledge they should construct. This requires the use of human and cultural resources, such as participation and intervention of the teacher, and clear language, accessible and involving the student at the time of class (Adler, 2000). Julia did not mention this wider perspective of resources and their uses.

The analyses of the interviews showed that 7 teachers positively evaluated their performances when they teach mathematics, as the extract below exemplifies.

Interviewer: Yes, your performance as a teacher of mathematics. How would you describe your way of acting as a mathematics teacher?

Claudia: Look, Mathematics for everybody, that's how we usually speak, is a "big deal" [literal translation: monster with seven heads]. I do not like math, you know? But whenever I go to math class we have to search, you have to study and you also work with the resource that you have on hand, but I'm not in love with mathematics don't you see? [Laughs]

Interviewer: Hum-hum.

Claudia: No... Well, I study mathematics more when I'm teaching, or studying for a competition, so now I have no FEAR, FEAR [said with emphasis]. The mathematics is not what you say, it is not a big deal, a bogeyman, and sometimes the mathematics becomes a thing simple for us, only we do not know how to use it not so? Because, so, mathematics is always part of people's life. When you wake up, you already have a timetable to get up, get ready for ... then it is math, right?

(Claudia is 41 years old, graduated in Accountancy, 10 years of teaching experience)

It seems that Claudia is conscious about her role as a resource to teach mathematics. When Claudia stresses the need to search for and study new and different ways to teach, she recognises that this attitude can overcome restricted ideas about mathematics.

Another aspect observed in the speech of teachers is the lack of knowledge of the specific reality of the countryside that is different from that of urban areas. The teachers tended to regard the countryside as they would an urban area, and thus reproduce in multi-grade classrooms in rural areas the knowledge, methodologies, mathematical content and goals that are specific to the reality of cities. This perspective can be seen in the words of teacher Julia when she assigns to students a lack of interest in learning.

Interviewer: Do you think there is a difference between teaching in rural and the urban area?

Julia: It has a lot of difference. I think teaching in the city is easier, students learn faster, parents encourage the children and students have access to TV, newspapers, DVD's, magazines, shopping lists that her mother makes... , here there are none of these things. Look. Even homework, they do not do... They do not want to learn because they think they already know what they need to do what parents do: work in the field.

(Julia is 38 years old, middle teaching level qualification, 15 years of teaching experience)

Julia explains the field school students' lack of motivation based on preconceptions: field people are ignorant and they do not want to learn because they already know what they need to know. Julia depreciates the field people's knowledge and practices, she ignores that teaching could be based on many resources related to field people. In fact, we could infer that the lack of motivation of students to engage with scholarly knowledge is because the curriculum does not reflect the mathematical content of the reality of the field.

The analysis of the teachers' interviews also suggested an aggravating aspect related to such this narrow perspective about resources: All teachers reported that they did not identify a difference between teaching in the countryside and the city.

The teachers who participated on this study seem to overlook the principles of Field Education and they characterize rural by lack of resources. In this regard, they do not see the need to differentiate the teaching approaches in field area schools from those located in urban areas. Even though those field schools have multiseriante organization, they seem to reproduce teaching

approaches similar to those developed in urban conventional schools. This is presumably because the initial training received by the teachers did not offer enough support specific to teaching in rural areas.

It is essential to address issues related to the conceptualization of resources as an extension of the teacher in the practices associated with teaching mathematics at school, especially given the rural reality, so that students can construct meaningful mathematical knowledge. Arroyo, Caldart & Molina (2004) argue that field education needs to be thought differently. This must be an alternative that contributes to the formation of the identity of those who constitute themselves as citizens and who seek a humanity fuller and happy.

### **FINAL REMARKS**

The characteristics of the current Brazilian rural schools are a result of socio-historical processes. They include an unequal social stratification that attributes less value to the rural population. Only in recent years, rural education has begun to have a particular approach which tries to build an identity that consider and respect the field realities.

Our data analysis indicates that the pedagogical organisation of field schools does not yet consider the particularities of rural education. Generally speaking, the teaching of mathematics has a peripheral status within their pedagogical planning because less time is spent in class on this subject than on other school subjects. On the other hand, the teachers' conceptualisation and use of resources to teach mathematics is diverse. They emphasised material resources, but also saw their attitudes to overcome resistances and limitations in this school subject as a resource.

However, the discussion about a wider conceptualization of resources in the teaching of mathematics (Adler, 2000) involves the consideration of different types of resources, such as material, process, human, socio-cultural, etc. Therefore, in order to approach the concept and use of resources it is necessary to analyse the social practices which teachers develop in classrooms as well as understand the macro-cultural context.

Our study suggests that the conceptualisation and the use of resources should be a crucial topic in teacher education (pre-service and in-service). The teacher education program needs to provide situations in which teachers can learn about the elements and processes related to the types and uses of resources in the teaching of mathematics, considering the socio-cultural context in which the schooling processes are developed.

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Specifically, in order to develop a field education from the perspective of field people, it is crucial a process of change in the attitude of all teachers involved in field schools, both those that are linked to social movements such as those belonging to governmental education networks.

Therefore, change involves overcoming prejudices, and gives the value to field people's knowledge and practices as a resource to construct new and different knowledge. However, we do not argue that field people become restrict to the use of their specific human, material and cultural resources. The field people's resources need to be articulated to school knowledge and the use of technological resources, especially for the development of mathematical knowledge.

## NOTES

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