v. 2, n. 15, 2022

International Journal of Human Sciences Research

DIALOGUE WITH THE PEDAGOGY STUDENTS OF PARFOR UFPA: THE ELEMENTARY MATHEMATICS TEACHER SMALLER CAN YOU BE CREATIVE?

Márcio Lima do Nascimento
Full Professor from the
Faculty of Mathematics
Federal University of Pará – PA – Brazil

Abstract: The article aims to analyze the experience of mathematics workshops for teachers of Basic Education in exercise without adequate training, course participants of the Degree in Pedagogy of the National Plan for Teacher Training at the Federal University of Pará. The motivations and characteristics of the workshops are discussed. In addition, a case study is presented, which included an interview with the participants. By analyzing the teachers' experience in the workshops and its consequences, the importance and need for actions that promote reflection on Brazil's place in elementary mathematics teaching in world indexes was evidenced.
Keywords: Creativity in mathematics, meaningful learning, PARFOR.

INTRODUCTION

In the mathematical community, only at the beginning of the last century, the difference between a mathematician and a Professor of Mathematics began to be discussed, even being mentioned in the famous book by the brilliant mathematician G. H. Hardy entitled "In Defense of a Mathematician". There is nothing that the mathematician is concerned with creating new theorems and subjects in the area of so-called "pure" mathematics. But the math teacher has a role to be a creative teacher in their teaching action and also discover which strategies will make their students be creative in the classroom. Therefore, the present work seeks to present the study with a geographic cut in the Amazon region, especially the state of Pará, where the results of the implantation/implementation of the innovative proposal of working with pedagogical workshops in the field of elementary mathematics will be presented as a contribution to training of PARFOR Pedagogy students. To develop this proposal, the study is divided into the following sections: the first presents the PARFOR-Pedagogy of UFPA, highlighting the breadth of the course, aspects of teacher training and the importance of mathematics for teachers working in the initial grades; then, it presents the contribution of pedagogical mathematics workshops for PARFOR-Pedagogy students. It is worth mentioning that PARFOR, in terms of Brazil, CAPES and the more than 100 HEIs, implemented until the end of 2016, 2,890 classes, in 509 municipalities, located in 24 units of the federation. During this period, PARFOR served teachers from 3,282 Brazilian municipalities and 28,925 schools. Until that year, the Program had 36,871 teachers taking a degree and 34,549 graduates. (MEC, 2017). It can be seen, in a very forceful way, that PARFOR is a program that has capillarity and is still urgent for Brazil.

MATHEMATICAL LANGUAGE AND THE CLASSROOM

Language is a communication process by which people interact with each other. It can be expressed verbally or non-verbally. The fundamental element of verbal language is the spoken or written word and the non-verbal language that is expressed in music, dance, mime, painting, photography, sculpture, among others. There are also mixed languages, such as comic books, cinema, theater and TV shows that can bring together different languages, such as drawing, words, costumes and music. And the most recent, the digital language, which combines numbers, allowing the storage and transmission of information in electronic media. (STADLER et al, 2012).

We will not get into the controversy over the definition of mathematics, but it is possible that everyone will agree that mathematics uses the mother tongue, orality and the meanings of words as a support for the exchange of information. Despite its scientific language characteristic, mathematics requires writing

as a basic communication resource. The utterances are read through the mother tongue, which allow comments to interpret what is heard or read in a precise or approximate way. On the other hand, "the mother tongue is partially applied in mathematical work, since the links of mathematical reasoning are supported by the language, in its syntactic organization and in its deductive power", he says. (SMOLE & DINIZ, 2001, p. 17). The teacher's task in relation to mathematical language is to guide students in the processes of writing and representation, in the elaboration of symbols, in the development of reasoning skills that begin with the support of oral language and evolve over time, incorporating the more elaborate texts and representations.

Lappan and Schram (1989) consider that any Mathematics class must incorporate "spaces" where the student can reason and communicate his ideas. They add that it is necessary for the teacher to listen to students and ask them to explain their thinking, giving students time to explore, formulate problems, develop strategies, make conjectures, reason about the validity of these conjectures, discuss, argue, predict and ask questions. This new vision of communication in the classroom presupposes another type of discourse. The teacher, as the main person responsible for organizing the class discourse, has another role in this, asking questions, providing situations that favor the connection of Mathematics to reality, stimulating discussion and the sharing of ideas. The teacher who teaches mathematics in lower elementary school (educated from pedagogy) becomes a facilitator of learning and this learning becomes significant the more time is taken for the student to think mathematically. It is obvious that these procedures are clear in several areas, but in mathematics classes, the traditional class is still predominant, as the teacher usually claims (sometimes with good reason) that he has a long content to fulfill and there is no time for the student to be heard. This is a complaint, which comes from the teacher of pedagogy in lower elementary school, through the math teacher of elementary and high school, to the teacher of calculus of the degree in mathematics. This is a constant challenge for those who teach mathematics, this relationship between content dosage and the student's authentic speech on the subject (we will see more details about the concept of authentic speech in the next section).

McCullough, D. and Findley, E. (1983), note that for more than 3 decades, highlights the obvious for a well-structured math class:

— Prepare some questions in advance;
— Ask clear and concise questions;
— Vary the level of difficulty, trying to involve the majority of students in the class;
— Provide a break time after questions;
— Ask the questions to the whole group and only then individualize them;
— Ask questions that provide the teacher with feedback on student learning.

These steps above, if adopted today by the teacher, as simple as they seem, run into enormous difficulties for the student of the 21st century. Without the authoritarianism and forced silence of before, how can the teacher get students' attention to start thinking mathematically, if he himself has not been well trained for this? How to change the vicious circle and transform teaching practice? We believe that an important step is to review certain pedagogical practices in the elaboration of key concepts in arithmetic, which generate more flexibility and sharpen children's creativity so that they do not get the impression that math problems are algorithms with a single solution, a only way to solve them.

The main reference that inspired the arithmetic workshops was the reading of the broad study developed by Liping Ma,

comparing the strategies of Chinese teachers with those of American teachers, where the author also weaves broad alternatives for changes in the forms of "Knowing and Teaching Elementary Mathematics", title of his book published in Portugal. LIPING MA (2009) states that the true mathematical thinking that takes place in a classroom, in fact, depends greatly on the teacher's understanding of mathematics. Another point is that changing the tradition of mathematics in a classroom may not be a *revolution* who simply throws out the old and adopts the new. Rather, it may be a process in which some new features develop from the previous tradition. In other words, the two traditions may not be absolutely antagonistic: on the contrary, the new tradition involves the old one. — just as a new paradigm in scientific inquiry does not completely exclude an old one and include it as a special case. Furthermore, this research suggests that teachers' knowledge of mathematics can contribute to and change a tradition of mathematics in the classroom. One « shared mathematical understanding» that marks a tradition cannot be dissociated from the mathematical knowledge of the people in the classroom, especially from the knowledge of the teacher who is in charge of the teaching process. If the teacher's own knowledge of mathematics taught in elementary school is limited to procedures, how can we expect his classroom to have a tradition of mathematical inquiry? The change we hope for will only occur if we work to change teachers' mathematical knowledge.

It was along these lines that we thought about the workshops of mathematics teachers teaching teachers with a degree in pedagogy, discussing and sharing elementary mathematics.

THE WORKSHOP AS A PROPOSAL

The workshop is, in general, considered as an environment for the development of skills and abilities, through diverse, creative activities, guided by qualified teachers, where important discussion vectors are available for the process of changes in teaching and learning, encouraging the individual performance areas. However, it is necessary to guide more specific aspects of our approach.

Focusing on the aspect of linking old strategies to new strategies, as mentioned by Liping Ma, math workshops can be structured with these connection vectors, where the teacher can perceive that their strategies can be improved, aiming at a meaningful learning, where the teacher is the facilitator of learning. As AMATUZZI (2016) would say, achieving the rescue of the authentic speech of the student, which can break the vicious circle:

> *Educating yourself is learning the expressiveness of the word that speaks (and is not just spoken). It is learning to speak (in the strong sense of the term). And so the relationship between education, learning, creativity and expressive speech becomes evident. (Amatuzzi, 2016).*

In the workshops that we proposed for the teacher-students of pedagogy, this challenge of giving voice to the student was thought of from the beginning of the discussions, but its execution and improvement are not trivial. Planting in the student the seed that mathematics can be challenging, alive and instigating demands a collective action of education professionals who visualize that creativity can exist in the classroom from the beginning of mathematical literacy.

When observing the content prepared for the workshops, aiming to work with teachers from the first to the fifth year of elementary school, one can get the impression that it is a traditional arithmetic course on the four

elementary operations of mathematics. There are addition and subtraction of whole numbers, multiplication, division and the study of fractions and proportions. However, all of these teachers trained in pedagogy have already studied these subjects in different traditional ways at some point in their lives and many are teaching the subjects with the plans of their schools and have diverse experiences. So, doing a "more of the same" arithmetic workshop didn't interest us. We wanted to highlight key points when addressing certain content, which can lead to changes aimed at children's creativity. We will see in the next section how the structure of these workshops was designed.

WORKSHOPS STRUCTURE

The workshops were planned with an initial structure, with the necessary adaptations throughout the process, following the schedule below:

- *Discussion trigger vector*: initial video of the most importante points in the discussion of each module – twenty minutes;
- Discussion of the workshop teacher with the class about the practice of each one, regarding the video;
- Activities that mix theoretical discussion if necessary, games, improvement dynamics and re-signification of theoretical content - new ways of learning and teaching;
- Hearing from teacher-students about "giving their students an opportunity with other views of mathematics that they did not have"

These four steps are repeated with each specific arithmetic topic on the schedule (in general, 3 arithmetic modules and their problems are discussed during 3 days of intensive activity).

The critical points mentioned above are elaborated by the organizers of the mathematics workshop, professors Marcio Lima do Nascimento and Marcos Monteiro Diniz, in the form of *Discussion Trigger Vectors*. These videos guide the discussion at each pole and the rest of the workshop is taught by tutors, who are graduates of the professional master's degree in mathematics. The main objective of the videos is to nudge, awaken and start the process of change in the resignification of concepts.

MATHEMATICS WORKSHOPS FOR PARFOR PEDAGOGIA STUDENTS

We prepared an initial report on the experience of mathematics teaching workshops for students of the PARFOR-UFPA Pedagogy Course, which aimed to analyze the repercussions of this activity on the pedagogical practice of teachers and as well as alert the academic community to the need to more initiatives like this, which we will mention in this session.

An analytical study with a qualitative approach was carried out during the workshops, using the case study as an investigation. As a priority instrument for data collection, interviews were carried out with tutor teachers who taught the workshops and with numerous teacher-students from municipal networks who participated in the workshops. The workshops were held in February 2017. It is important to note that the workshops are the result of an extension project entitled "Mathematics Workshops: theorizing and practicing with the student-teachers of the Pedagogy Course/PARFOR at UFPA" developed by the teachers of the Faculty of Mathematics of UFPA in partnership with PARFOR and were carried out in the period between stages (in the months of May/November of each academic

year), for three days. The project has been developing its actions since the end of 2015 and has held more than 27 workshops so far, as shown in the table below. The conformation of the workshops changed throughout the experiences. Initially, a base text was prepared with the author Márcio Lima do Nascimento and the tutors involved. Then, it was decided to change the strategies aiming to standardize the actions in the poles, trying not to avoid the main points to be discussed. That's why the inclusion of videos that trigger the discussions.

The realization of the workshops seeks to discuss the neuralgic points of the basic knowledge of mathematical content worked in the initial grades of the student-teachers, as well as to present them with new methodological alternatives that motivate the students' learning, and that effectively make mathematical knowledge accessible to all, through innovative methodologies that allow a significant learning in mathematics, and, mainly, re-elaborate the old alternatives, however, with a different look.

In this direction, when proposing a pedagogical work in the teaching of Mathematics through the realization of workshops, the study that gave rise to this article represents an initial step in proposing changes in the way of working the contents for the students, since the network teachers realized that mathematics this way not only stimulates the development of logical reasoning but, especially if well designed, it sharpens independent thinking, creativity, work autonomy and especially the ability to solve problems, which helps to reduce resistance that many students come to adopt for Mathematics.

The workshop is basically divided into the following stages: initially, with the reception and discussion of the topics proposed in the teachers/students workshop plan; followed by the presentation of texts/videos on certain topics of arithmetic; presentation of methodologies on how to teach differently;

2015		2016	
City	Number of workshops	City/Polo	Number of workshops
Abaetetuba	02	Cachoeira do Arari	01
Acará	01	Castanhal	02
Altamira	02	Colares	01
Breves	02	Concórdia do Pará	01
Cametá	01	Ipixuna	01
Colares	01	Nova Esperança do Piriá	01
Concórdia do Pará	01	Traquateua	02
Goianésia	01	São Caetano de Odivelas	02
Melgaço	02	-	-
Parauapebas	01	-	-
Soure	02	-	-
TOTAL	16	-	11

Table 01- MATHEMATICS WORKSHOPS.

Source: PARFOR/UFPA, 2017.

solving exercises in a playful way; and finally, a moment of reflection and evaluation with all participants.

In terms of content, the workshops are divided into 3 modules: Addition and subtraction; multiplication and division; study of fractions. As a working methodology, in this first phase, a small probing test was adopted to analyze the teacher's initial knowledge on the subject. After the test, the pre-set course follows. Always after each module, a diagnostic test is applied to assess the absorption of knowledge acquired by each participating teacher.

When evaluating the students' performance, it was verified through an interview with the teacher-teacher (PM), that during the classes, it was evident the perception that the students had in re-evaluating their practices, when the subject of multiplication and the multiplication table was discussed. where the question "to decorate or to learn? ". This change was noticeable when one of the participants said:

> *"I want more is for him to decorate himself!" and in the course of the process he changed his opinion and began to share the principle that it is more valuable for him to learn and know how to build the multiplication table, as we agree that it will be a more concrete and lasting learning experience. (PM 1).*

One of the course-professors (PC) highlights this difficulty that his students have in understanding the multiplication table. "*When students arrive, they have difficulty with the basic operations, multiplying, dividing, they can't understand the relationship, they can't do a division using multiplication and vice-versa*" (*P.C 1).* And we understand that the students' difficulty comes from a mechanical teaching method, where the construction of the multiplication table does not make sense, but the memorization itself. Memorization must come, for example, with the process of using the hands to have the multiplication table all playing with the fingers of the hands, in a playful and fun way, which gives meaning to the student. In addition, the gaps in teacher training will immediately reflect on student learning, and that we can observe this issue in the speech of the teacher-student. "*There are many things I didn't see during my training, I didn't see during my study period and that graduation doesn't teach everything, and when we go to the classroom we see the difficulty*" (*P.C 2).*

The speech of another teacher-course demonstrates the difficulty in teaching mathematics "*When we went to do the workshop, there were a lot of things that I said, 'Wow! And so!'. I could not have made my student's life so difficult, I could have simplified*" (*P.C 3).* We believe that this speech reflects a very common situation, which is the lack of knowledge of other teaching methodologies, considering that the vast majority of teachers end up teaching as they learned.

And this issue was also raised by the teaching professors, in which they point:

> *You must not teach your students the methods that were used in their training, they may be outdated. New discussions are necessary for children to innovate. Methods for understanding whole number subtraction and operations with fractions, for example, are fundamental to understanding basic mathematics. (P.M 2).*
>
> *The vast majority of teachers in China learn and teach subtraction by regrouping and in a variety of other ways. We from Brazil follow the American model of teaching subtraction by borrowing only. Ten out of ten Brazilian students only do subtraction by loan. This limits, oppresses creativity and throws mathematics into the "darkness of initiates and geniuses". (M.P. 3).*

And we believe that the workshops allowed the course-professors to rethink their postures, their practices, their teaching methodologies, since they raised salutary

doubts for all and brought reflection, as demonstrated by the speech of the course-professors:

> *This form that the teacher brought to us reminded me of difficulties in my childhood. How did I have a hard time learning this and now it's so easy?! The teacher always left a message for us: that not everyone learns in the same way, the student can have other paths (P.C 3).*

> *Today, you need to make the student want to learn to like mathematics, break this label as a difficult subject. We come from a traditional background and the workshop shed some light, it showed that mathematics is very present in the students' routine. (P.C 5).*

In this sense, when analyzing the speech of the teaching professors and the course participants, we understand that the holding of the workshops was extremely important to establish a dialogue between the participants for the development of a critical reflection that instigated the doubt as a starting point for the change. Where the error is one of the steps to improve to build valid and meaningful knowledge. Here's a reflection from a team member after the workshop planning meetings:

> *Why in circles of friends if someone says he hates math everyone laughs? Nobody is ashamed of it. I don't see people with the courage to say that they hate music or that they hate reading books, despite the fact that sometimes they don't read a book a year and enjoy music considered to be of poor quality. We have to change that (P.M 3).*

Lima (2008) observes that teacher training needs to be resized or the school runs the risk of entering a process of emptying the social function. It is essential that the teacher feels the need to reflect on himself – on his knowledge, his doing and his know-how; however, he needs not only this reflection, but also that it takes place in a collective space. In order to perform his function, the teacher increasingly needs knowledge about his work, about school work and about himself. See another testimonial from a teacher-course:

> *I've been teaching in this city for so long and I've never been told about mathematics this way, that it can be less inflexible, that I can talk about fractions at the same time I talk about division, at the same time about percentage and everything has to do with measuring on a ruler, so geometry is involved. I feel like tearing up the discipline schedule that was always strictly followed and the students hated. (P.C 5).*

The speech of this participant reflects in a way the core of the workshops: everything is related! And we, as teachers, must trace the path of knowledge that pleases us but also leaves the student more free to learn, having the opportunity to find his own path, which can be very different from ours. And that is why we must present alternative methodological tools in these training spaces, without the need for many technological and/or high-cost resources. And this shows us that the teacher always needs to stop, evaluate, debate and question, in order to increase the degree of participation of the subjects in the teaching and learning process.

FINAL CONSIDERATIONS

The study carried out here intended to collaborate with the discussions on teacher training, especially that of teachers who study pedagogy through the National Teacher Training Plan (PARFOR) and brought the experience of teaching mathematics through mathematics workshops, which sought to to highlight the need for these changes in pedagogical practice in search of creativity.

A remarkable fact was the experience that in all the classes in the different municipalities, the teachers and the vast majority reported that:

- Learned subtraction by borrowing only, not subtraction by regrouping. They understood that it is important to teach differently from what they learned in the classroom and that the method of regrouping in subtraction encourages the creativity of each student and each one makes their own strategy.
- The contents of fraction, division of fractions, equivalent fractions, percentage and decimal numbers are seen in isolation and the teachers themselves do not bother to relate the topics immediately, at the right and fun moments of learning fractions.
- The notions of area, perimeter and other geometry topics are also taught at a distance from arithmetic topics, when they must all be related, so that children's learning is a step forward in creativity.

In view of the data from PARFOR and Educacenso, in addition to the analysis of the recurrent speeches of teachers and course participants, we realize the great task that educational institutions have mainly in the state of Pará, where we observe the worst educational indices. It is a reflection of insufficient investments for the valorization and training of teachers in teaching degrees. And yet what to do with even the most basic mathematics, the one discussed in pedagogy curricula? Is it enough to study mathematics in these courses?

Therefore, we emphasize that initiatives such as these carried out through the extension project that reaches teachers on the school floor are of great value. The university-school partnership is one of the necessary ways to rethink teacher education and training strategies to improve this reality and make mathematics more attractive to students. Discussing mathematics with joy and fun is more interesting than discussing past failures in teaching mathematics in pedagogy courses.

We observed, therefore, that the need to review mathematics in the curricula of pedagogy courses is urgent, so that we can try to change the mechanistic view of teaching it. However, this discussion deserves greater research investment, since it implies thinking about the need to enter other theoretical perspectives to redefine new curricula, new pedagogical interventions. In this sense, we affirm the need and importance of researching on teacher training, its meanings and meanings, in order to unravel these multiple realities of PARFOR teachers, which have never been heard. To listen to these teachers and being able to help improve their practice was an immeasurable gain, as we know that this reverberates in the classroom.

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