

**O pedagogo e o ensino da matemática**  
**The pedagogue and the teaching of mathematics**  
**El pedagogo y la enseñanza de las matemáticas**

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**Resumo**

No cenário de discussões sobre os obstáculos didáticos e epistemológicos que 'assombram' os processos de ensino e aprendizagem dos conteúdos de Matemática no Ensino Fundamental nos primeiros anos, encontramos entre outros teóricos Santos (2007; 2014; 2015; 2017). Neste estudo, objetivamos apresentar a importância de desafiar o graduado em Pedagogia a deixar sua 'zona de conforto', onde ele reproduz os conteúdos/modelos matemáticos e o provoca a desconstruir/reconstruir/descobrir os conceitos matemáticos, em detrimento de uma reprodução parálitica e, assim, contribuimos para o pensamento/questionamento a partir de situações desafiadoras. Essa prática também contribuiu para a percepção do pedagogo de que seu conhecimento deve exceder o do aluno; e, acima de tudo, possibilitou ao pedagogo refletir mais sobre sua práxis, a fim de se constituir no processo como sujeito epistêmico, proporcionando a ele uma reflexão de sua ação e uma visão do que é ensinar. As ações nos

despertaram para a necessidade de uma formação pedagógica mais inovadora que supere desafios e dificuldades no exercício do ensino com excelência.

**Palavras-chave:** pt

### **Abstract**

In the scenario of discussions about the didactic and epistemological obstacles that 'haunt' the teaching and learning processes of Mathematics content in Elementary School in the early years, we find among other Santos theorists (2007; 2014; 2015; 2017). In this study, we aim to present the importance of challenging the Pedagogy graduate to leave his 'comfort zone', where he reproduces the mathematical contents/models, and provoke him to deconstruct/reconstruct/discover the mathematical concepts, to the detriment of a paralytic reproduction, and thus, we contribute to the thinking/questioning, from challenging situations. This practice has also contributed to the pedagogist's perception that his knowledge must exceed that of the student; and, above all, it has made it possible for the pedagogist to reflect more on his praxis, in order to constitute himself within the process as an epistemic subject, providing him with a rethinking of his action in a vision of what it is to teach. The actions have awakened us to the need for a more innovative teaching formation that overcomes challenges and difficulties in the exercise of teaching with excellence.

**Keywords:** Pedagogue; Mathematics; Training; Teaching and learning.

### **Resumen**

En el escenario de las discusiones sobre los obstáculos didácticos y epistemológicos que “rondan” los procesos de enseñanza y aprendizaje del contenido de Matemáticas en la Escuela Primaria en los primeros años, encontramos entre otros teóricos de Santos (2007; 2014; 2015; 2017). En este estudio, nuestro objetivo es presentar la importancia de desafiar al graduado de Pedagogía para que abandone su 'zona de confort', donde reproduce los contenidos/modelos matemáticos, y le provoca que deconstruya/reconstruya/descubra los conceptos matemáticos, en detrimento de un reproducción parálitica, y por lo tanto, contribuimos al pensamiento/cuestionamiento, desde situaciones desafiantes. Esta práctica también ha contribuido a la percepción del pedagogo de que su conocimiento debe exceder el del estudiante; y, sobre todo, ha hecho posible que el pedagogo reflexione más sobre su praxis, para constituirse dentro del proceso como un sujeto epistémico, proporcionándole un replanteamiento de su acción en una visión de lo que es enseñar. Las acciones nos han despertado a la necesidad de una formación docente más innovadora que supere los desafíos y dificultades en el ejercicio de la enseñanza con excelencia.

**Palabras clave:** Pedagogo; Matemáticas; Formación; Enseñando y aprendiendo.

## 1. Introduction

In the scenario of discussions about the obstacles that 'haunt' the teaching and learning processes of Mathematics content in Early Childhood Education and Elementary School, we find, among other theorists, Curi (2008), Nacarato (2005), Santos (2007; 2014; 2015; 2017), Lima (2007), Borges Neto and Santos (2006), Toledo and Toledo (2010).

The teacher of mathematics in the initial years of 1st to 5th grade is the pedagogue, so research, in general, according to Lima (2007) directs criticism to the mathematical thought of this professional, being always taken as a professional who 'flees' from mathematics.

Based on the problems presented, we seek to assist the initial formation of the pedagogue, which is based on the challenges and difficulties faced by these subjects. Thus, we carried out a study based on pedagogical practices supported by the trends in Mathematics Education, and actions were carried out that would contribute substantially to the training of these professionals.

Because he is pointed out as the main responsible for the failure of students in external evaluations, the pedagogue is submitted to think that he does not know and is not able to teach mathematical content, because he does not overcome arithmetic<sup>1</sup> thinking, he cannot overcome empirical abstraction for reflective abstraction, especially because he is not a graduate in mathematics.

The rates of external evaluations in mathematics of students in the early years of elementary school are low, and this overloads the pedagogue as responsible. For this indicator, it is necessary to think about actions to minimize the difficulties faced by students in Pedagogy in relation to mathematical knowledge.

It is common to find Pedagogy students teaching, even though they are not yet legally qualified to be in the classroom, but regardless of this situation, it is also common in other degree courses. In the case of the pedagogue, he still lacks the basis to understand the teaching about: a) number and operations; b) space and form; c) numbering system; d) quantities and measures; and, e) statistics etc.

In addition to teaching, we know that the pedagogue can act in other functions, such as in the organization and management of teaching systems; school and non-school units and

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<sup>1</sup>It is understood here as arithmetic thinking, the most elementary thinking for the construction of mathematical concepts and development of mathematical thinking.

projects; production and dissemination of scientific and technological knowledge in the educational field; and in emerging areas of the educational field.

Among the various functions that the pedagogue can perform, if the curriculum is not well elaborated, the focus on teaching may be in second place, which further compromises his development as a teacher and consequently, as we approach in this work, the pedagogue as a Mathematics teacher in the early years of elementary school (Santos, Lima & Borges Neto, 2006).

It was our purpose to challenge the Pedagogy graduate to leave his 'comfort zone', where he reproduced the mathematical contents/models, and to provoke him to deconstruct/reconstruct/discover the mathematical concepts, to the detriment of a paralytic reproduction, and thus, we want to contribute to the thinking/questioning.

In general, we aim to guide the [re]construction of basic mathematical concepts based on didactic resources (analog and digital), promoting the intellectual, professional, cognitive and affective development of the students of Pedagogy, evaluating the didactic-theoric contributions of the trends in Mathematical Education, focusing on the [re]elaboration of mathematical concepts, now cited in the item.

With this same purpose, we present the specific objectives, which among some changes, effectively aim at improving the initial formation of the pedagogue and suggest: to plan theoretical and practical activities aiming at the formation of the graduate in Pedagogy for the teaching of mathematics in the initial years of Elementary School; to guide the graduate to a reflexive look about his self-training, contributing for this subject to identify his greatest difficulties and cognitive possibilities, providing the student protagonism; To analyze the conceptual, procedural and attitudinal contents that involve Early Childhood Education and Elementary School in the early years, considering the work with materials (analogical and digital), following the evolution and renewal of mathematical concepts in Mathematical Education; and, finally, to relate Mathematics with the other (specific) disciplines of the course, aiming at interdisciplinarity through practical activities, in order to expose (disseminate) the results achieved through a blogger<sup>2</sup> so that the actions are known by other professionals in the field of education.

On this threshold, after some reflections, we built some questions that guided our practice, among them: i)What is the importance of a mathematical education for the pedagogue? ii)What contributions to the practical activities in the classroom have brought to

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<sup>2</sup> Source: <http://lavemgtercoa.blogspot.com/>

the training of the graduate? iv)What pedagogical challenges most bother this professional? and finally, v)The graduate in Pedagogy is also a teacher of Mathematics?

To contemplate these questions, this qualitative study was developed in four phases, detailed ahead. We also carried out a study based on the selection of readings that contemplated the subject, we also sought theoretical-methodological input in the National Curricular Parameters of Mathematics -PCNM (Brasil, 1997).

Below we detail the actions.

### **1.1 Context of the project**

This research is the result of observations made during six semesters, ( 2013.1, 2013.2, 2014.1, 2014.2, 2015.1 and 2015.2), but here we detail the actions carried out in the semester of 2013.1 because it is the pilot project, and because we have encountered a lot of resistance from the subjects regarding the confrontation of the theme - mathematics.

We present a summary of the activities carried out (in the classroom and on the TelEduc online platform) with the 37 students regularly enrolled in the subject of Teaching Mathematics, in the Pedagogy evening course, at a public university in Fortaleza-Ceará.

The activities are always redesigned every semester, as they are the fruit of a monitoring project called Initiation to Teaching-PID. The title of the project is: Subsidizing the mathematical formation of the pedagogue. This project has been systematically developed together with the monitors of the discipline, as well as the special participation of graduate students, at master's and doctorate levels, and is justified in the testimony of the students of the discipline. Let's see the student's statement on TelEduc<sup>3</sup>.

I see a great deficiency in the formation of the pedagogue to act in the teaching of mathematics, today we have one or at most two subjects in the curriculum of the course that, does not completely prepare this professional, being the same to seek a continuous education to develop this competence and act in the classroom with more property. (Student 9, 2013.1, Forum 1)

We understand that an appropriate approach to mathematical content contributes to a better reflection of the licensee on the question of the role of content in his practice.

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<sup>3</sup> Source: [http://teleduc4.multimeios.ufc.br/pagina\\_inicial/autenticacao\\_cadastro.php?cod\\_curso=108](http://teleduc4.multimeios.ufc.br/pagina_inicial/autenticacao_cadastro.php?cod_curso=108).

## 1.2 Curriculum content covered

The contents include the Law of Guidelines and Bases of National Education (LDBEN), Law No. 9,394/96, as well as the blocks of content based on the PCNM (Brasil, 1997), which make up the program of the discipline, and teaching methodologies and resources as educational objects, such as: The Farm, interactive scale, Tangram, ruler of fractions, Geoplan, Abacus, online graphics, etc.. The required contents (blocks of contents suggested in the PCNM) are to minimally form the Pedagogy graduate to teach Mathematics in the early years of elementary school (Brasil, 1997).

Regarding the number, in a very simple way, it can be said that it is an indicator of quantity (cardinal aspect), which allows to evoke it mentally without it being physically present. It is also a position indicator (ordinal aspect), which makes it possible to store the place occupied by an object, person or event in a list, without having to memorize this list entirely (Brasil, 1997).

The numbers were worked as a code, which does not necessarily have a direct connection with the cardinal aspect, nor with the ordinal aspect (for example, telephone number, license plate number, etc).

It is worth noting that according to Kamii (1990) the construction of the concept of number is done through the three types of knowledge the physical, social/cultural and logical-mathematical. The physical knowledge comes from the contact, the interaction of the subject with the environment, the action of this subject on the object, the physical and empirical experience, a factor that allows the cognitive development. Logical-mathematical knowledge is the relationship that the subject establishes among the objects he manipulates, involving relationships also with the objects that are in the mind.

According to Piaget (1978) we infer that social knowledge is the same cultural knowledge (numeral - name). Physical knowledge (numeral-symbol) needs to relate to logical-mathematical thinking (number - idea) and attitudes consist of social knowledge. Piaget also states that the construction of knowledge takes place through external and internal sources. While physical knowledge and social knowledge are processed outside the subject, logical-mathematical knowledge takes place inside the individual, that is, in the mind (Kamii, 1990).

These distinctions needed to be formally presented, and were quickly identified in the various situations of social/cultural use, to which the teacher/trainer drew attention. Starting from everyday situations to construct hypotheses about the meaning of numbers, knowledge

about numerical writing began to be elaborated in a similar way and the written language was sought.

The numerical writings were presented, in order to understand the construction of the Systems of Numeration-SN, providing the decomposition in orders and classes (units, tens and hundreds), in which the characteristics of SN were worked, mainly through the analysis of numerical representations and calculation procedures, by means of problem situations. It is worth noting that most of the problems inside and outside Mathematics were solved through fundamental operations, by means of problem situations.

Some of the meanings of the operations (direct, indirect, inverse, reversible, irreversible) were explored, highlighting the addition and subtraction, according to the characteristics relatively more necessary to understand the subjects. Throughout the proposed activities, the students built the operations (calculations with two terms, smaller than ten and larger than ten), constituting a repertoire in order to support the mental and written calculation.

In the same sense, the activities with geometry were performed to stimulate the students to progress in the ability to establish reference points in their surroundings, to situate themselves in space, to move in it, giving and receiving instructions, understanding terms such as left, right, distance, displacement, above, below, to the side, in front, back, close, to describe the position, building itineraries. Besides important discussions about similarities and differences between two-dimensional and three-dimensional forms, flat and non-flat figures, as well as situations with which they promoted knowledge about analytical, topological and projective geometries.

We also worked on the formalization of measurement systems, the use of some instruments, such as scales, measuring tapes and containers of frequent use, and educational objects. Besides the concept of time, temperature indicators, from a work with hand clocks, digital clocks and thermometers.

Before the French Revolution we did not have standardized units of measurement, in 1790 the Paris Academy of Sciences instituted a commission also composed of mathematicians in order to solve the problem, it was from there that the meter appeared, whose origin of the word comes from the Greek metron which means that it measures.

In this understanding, the central point of the work with measures was the learning of the standardized measures, although the discussion also understood the non-standardized measures. However, much of the time devoted to measurements was to develop a work with the transformations of units, because we considered these activities of transformations of

measures as possibilities to develop more qualitatively the logical-mathematical thought, as well as to provide the overcoming of the arithmetical thought of these subjects.

We also emphasize the importance of non-standardized measures throughout history, they are: the inch, the yard, the palm, the fist, the foot, the step. Man had to create his own measures and for a long time each country, each region, had its own system of measures. For example, the ulna, which was a unit, was a unit of the same size.

Used by the Egyptian, Sumerian, Assyrian peoples for long years, and it consisted of the distance from the elbow to the tip of the pharaoh's middle finger, and respectively measured 52.4 cm, 49.5 cm or 54.9 cm. As each people had its measure, this generated many problems, which is why the historical rescue was important to substantiate the importance of the system of standardized measures for humanity in contemporary times.

In the continuation of the activities, we finally present the block of contents that involved the Treatment of Information (Statistical Education). In this perspective, we worked with tools that developed the investigative spirit of the students in Pedagogy. We proposed activities that encouraged students to develop attitudes of organization, investigation, perseverance, seeking a posture that would lead them to justify and validate the knowledge acquired.

We propose two activities to the subjects, being initially an analogical activity, in which the subjects took on the role of researchers, chose a theme and left the classroom to collect the data, then prepared their charts and exposed them to the class with the results found. After this activity, at another time in the same class, the subjects were sent to the Informatics Laboratory - LIE, and there they were guided to use a Learning Object - OA of sector graphs to present the results of their previous research. The subjects were presented with a Learning Object - OA that aimed to familiarize them with the content and also with the possibility of building concepts through an interface. From the use of OA pie chart it was possible to observe what they knew in relation to the construction of graphs, as well as, what didactic possibilities they could perceive for their formation.

We can infer that the contents were thought in an interdisciplinary way with focus on the formation of a critical and autonomous pedagogue.

## **2. Didactic Procedures of Practice**

The theoretical and practical activities developed were planned in phases:

**Phase 1:** Elaboration of a teaching plan by the instructor and the monitors - in the planning of the monitoring activities for the subject Mathematics Teaching, the mathematical contents proposed in the subject menu were highlighted, including the objectives of the training project. This planning aimed at fomenting the initial formation of the pedagogue, leading them to reflect on their difficulties and possibilities of reconstructing the 'poorly elaborated' mathematical concepts caused by the 'epistemological fraud'<sup>4</sup>.

**In phase 2:** Empirical experimentation of the elaborated planning: action of the monitors - in possession of didactic resources, we executed the planning of the activities to subsidize the formation of the pedagogues, specifically, the students of the subject of Teaching Mathematics. They participated in actions that enabled them to change their attitude towards the (re)construction of mathematical concepts. The monitors participated effectively in this phase, contributing directly to the classes of the discipline.

**In phase 3:** Evaluation of the process: report of practices - for the understanding of the weaknesses and strengths of the actions/mediations, the evaluation was carried out with the students of the discipline, and these students were able to evaluate the participation of the monitors and the teacher. The evaluations were carried out by means of a questionnaire and a discussion forum (Teleduc platform), during and at the end of the activities.

**In phase 4:** Systematization of pedagogical guidelines based on the training process - this phase was dedicated to systematizing the strategies that were experienced and approved during the actions, thus preparing recommendations, didactic guidelines, as well as the publication of papers at academic events (local, regional, national, international). We highlight that the planning and practical meetings were face-to-face, and at a distance with the help of the TelEduc platform.

## 2.1 Methodological background

Mathematics is a science that studies the possible quali/quantitative relationships and interdependencies between magnitudes, behaving as a vast field of theories, models and procedures of methodological analysis, proper of a research and of the forms of data collection and interpretation (Brasil, 1997).

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<sup>4</sup> When the teacher induces the student to think he knows a certain algorithm, but that student potentially does not.

In this understanding, we relied on methodologies that prioritized the creation of strategies, proof, justification, argumentation, critical spirit, and favored creativity, collective work, personal initiative and autonomy derived from the development of trust in one's own capacity to know and face challenges.

We chose a methodology that presented mathematics in a way that favoured the reasoning and expressive capacity of the students, as well as the aesthetic sensibility and imagination. In this sense, the methodology of teaching Fedathi<sup>5</sup> Sequence was the one that was learned by the students.

## **2.2 TelEduc as a pedagogical data collection tool**

The monitoring of the evaluation of practical activities was carried out during the planning/implementation of the work plan in person, as well as by technological means, supported by the TelEduc platform, allowing greater contact and possibilities for broader and more effective guidance.

Students were evaluated in the discussion forums, portfolio, and in the classroom activities, when they were instigated to present results of problem situations, analysis of mathematical software, as well as their conceptions about the proposed activities.

Thus, one student points out that

it is necessary here that the educator breaks with the barriers imposed by the contents and creates conditions and possibilities for the student to be placed in the position of researcher and subject constructor of knowledge. Be it in the elaboration of more contextualized and interdisciplinary contents as well as in the way activities are arranged and built along the teaching/learning processes (Student 5, 2013.1, Forum 1).

In this course, 16 forums were held on the themes related to the contents of the classes in person, which made it possible to democratize the participation of all students even if they did not feel like expressing themselves in person. About this dynamic developed in the subject of Mathematics Teaching, and also about the practice of monitors, one student highlights that

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<sup>5</sup> Source: Methodology developed in the Multimedia Research Laboratory under the guidance of Professor Hermínio Borges Neto, since 1994. To know more: <http://www.multimeios.ufc.br>. (Souza, 2013).

(...) your proposal is very good (...) it was very good to know that I could count on you for clarifications, which are many doubts (...) but I found a great differential of the other disciplines and an excellent means of interaction of monitoring with us students of the discipline. I hope you continue, because it is very important (...) (Student 3, 2013.1, Forum 1).

However, we also found testimonies that highlighted concern about the mathematical training model the pedagogue goes through

(...) Most educators work with the traditional methodology and do not make students think mathematics in a way that interferes with their logical and mental reasoning. The work is done with formulas and content to memorize. This makes discipline a terror for most students who feel difficulty and do not like it. (...) in pedagogy the teaching of mathematics is insufficient for a real quality education. The challenge is that within these limitations educators find effective ways to improve the teaching of mathematics (Student 2, 2013.1, Forum 1).

The activities developed and experienced in the subject of Teaching Mathematics in the semester of 2013.1, with the workload of 96 class hours, were always focused on the relationship between theory and practice and overcoming the paradigm that the pedagogue "does not know and does not learn enough mathematics to teach in the early years of elementary school. We also remember that the final objective of this proposal was to contribute to the development of educational projects aimed at improving the math training of the graduate in Pedagogy.

### **3 Final Considerations**

For the theoretician Caraça (2002) the knowledge involving mathematics must be freed from all fear generated by the lack of knowledge, for this it is necessary that the future pedagogue passes through a liberating training that is recognized as a mathematics teacher. We emphasize the need to resize this practice, so that the graduate assumes a new attitude within the classroom, when dealing with the basic concepts of mathematical content.

The student of Pedagogy, when confronted with the subject of Teaching Mathematics, starts to behave differently from the others, because he reveals "prejudices" arising from Basic Education, and in his statements some reveal their anguish, barriers. One student points out "(...) Mathematics was never my favorite subject or among the subjects I had most affinity with at the time of basic education" (Student 2, 2013.1, Forum 1).

In general terms, we aimed at a transformative and innovative approach to teacher training, seeking to overcome challenges and difficulties that prevented the pedagogue from exercising his science with mastery. Thus, we realized that the activities collaborated so that this professional future would overcome its difficulties in relation to the basic concepts of mathematics, and would make possible in a more conscious way the methodological practices in the classroom, enabling its teaching action by working with mathematical games (analogical and digital), as well as consolidating its mathematical knowledge.

This practice also contributed to the pedagogue's perception that his knowledge must exceed that of the student; and, above all, made it possible for the pedagogue to reflect more on his praxis, in order to constitute himself within the process as an epistemic subject, providing him with a rethinking of his action in an inter and transdisciplinary vision.

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**Percentage of contribution of each author in the manuscript**

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