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LEARNING OBJECT IN SERVICE OF MATHEMATICS TEACHERS: MEDIATION STRATEGIES

Prof. Dr. Arilise Moraes de Almeida LOPES
Fluminense Federal Institute
Center for Education Technology
and Distance Education - NTEAD
Campos dos Goytacazes
RJ- BRAZIL

Renata Nogueira CARDOSO
Fluminense Federal Institute
Center for Education Technology
and Distance Education - NTEAD
Campos dos Goytacazes
RJ- BRAZIL

ABSTRACT

Facing the Information and Communication Technologies (ICT) in society, the importance of researches to the pedagogical use of digital Learning Objects (LO) in Flash devoted to the teaching and learning of mathematical contents are highlighted. Making use of these LO is to try to promote a rapprochement between educational practices and the digital reality in which young people are included and require appropriate methodologies geared up for the processes of teaching and learning. This study aims to analyze the processes of building pedagogical practices developed by mathematics teacher in the classroom, with the use of LO, relating concepts of Exponential Function and Arithmetic Progression, applied on a high school students group. It promotes a discussion resulting from participant observation discoursing about the mediation strategies as they occurred, and the potential difficulties in interacting teacher-student-LO. It is concluded that the actions were developed not to allow any passive and unilateral discussions.

Key Words: Mediation strategies, learning objects, mathematics.

INTRODUCTION

The performance of Brazilian students in mathematics, according to the PISA (Programme for International Student Assessment), SAEB (Evaluation System of Basic Education) and ENEM (National High School Exam), has not been satisfactory (ROSISTOLATO; VIANA, 2014). This may be evaluated by an increasing decline in student interest in how the mathematical concepts are presented in the classroom (LUCAS et al., 2014).

What causes the student to lose interest in the classroom during the teaching and learning of mathematical content?

According Lorenzato (2007), the success or failure of students depends on the mathematical content of an established between them and these relationship issues. To succeed in the process of teaching and learning mathematics, it is necessary to link the mathematical content to the reality in which the student is placed.

Pedagogical practices traditionally known are giving way to new forms of teaching and learning through the meaningful integration of Information and Communication Technologies (ICT) and processes of teaching and learning in the classroom has become a potentially innovative challenge (NUNES, 2009, p.3).

Silva, Fagundes and Basso (2008) emphasize that only have access to the use of ICT is not enough that there is a quality education system. New ways of experiencing learning supported by the use of ICT should be adopted in order to adequately address the wants and desires for a quality education.

Based on these considerations, and in order to contribute to the improvement of the teaching and building knowledge of mathematical content of the student's high school, this study aims to examine the processes of construction of teaching practice for teacher, relating concepts and Geometric Progression Exponential function with the use of a Learning Object (OA).

EXPONENTIAL FUNCTION AND GEOMETRIC PROGRESSION

The way mathematics is taught in the classroom reflects several difficulties presented by students during their study. Meier (2012), Oliveira and Lopes (2012) report that they have difficulties in: (i) establish connections between mathematical content and its interaction with the world; (ii) promote inter-relationships between arithmetic and algebraic equations; (iii) interpret the codes of mathematical content in natural language and mathematics own language, among others.

In some kinds of content, eg, exponential function, Brucki (2011) reports that there is student interest in studying it. This is because they have access to practical applications involving the subject, nor do they establish relationships between Exponential Function and other mathematical content.

Also in relation to the exponential function, as authors Brucki (2011) and Angiolin (2009) emphasize that students present during the study, difficulties in conversions of algebraic record for the chart record; manipulation of equations; operations with rational and negative exponents and interpretation of the meaning of empowerment and their properties.

Regarding the study of Geometric Progression, Sousa (2010) states that during the resolution of problem situations, students did not achieve much success when they needed to understand the logic proposed for its resolution. Ie, they could not succeed during utterance interpretation. Moreover, had difficulty expressing mathematically thinking, using the nomenclature improperly and not showing accurate understanding of mathematical concepts.

In fact, according Bellemain and Siqueira (2011), the teaching of mathematical functions by some teachers adheres to the passage of the equation for your graph with the construction point to point and forget that the reverse transition brings problems. For these authors, the types of records are explained separately by the teacher during the teaching of mathematics. But joints between them are considered as a natural consequence of mathematical knowledge. So that the student knows articulate records, teachers should aim to make them mathematical objects.

Given the difficulties described, involving the learning of some topics of Exponential Function and Geometric Progression, Moura (2004) suggests strategies for the interdisciplinary study of these issues, aiming to overcome some of the difficulties experienced. The author argues that in establishing contextualized situations relating such content, promotes the construction of algebraic concepts significantly to the student, allowing them to establish connections between algebraic concepts and the relationships between them are exploited to the full.

LEARNING OBJECTS AND THEIR APPLICATION IN THE AREA OF MATHEMATICS

The concept of OA emerged in the 90s, having studied literature in various settings, and the proposal by (WILEY, 2000) is the most quoted. The author defines OA as any digital resource that can be reused to assist learning.

In this article, we adopt the definition of Lopes (2012) which considers OA digital or non-digital resource to be used in actions of teaching and learning processes composed of knowledge mediation between subject-subject, when in use, to to allow new knowledge.

According to Lopes (2012), if the object does not allow teaching and learning strategies that can support different teaching practices, is not characterized as an OA to support the construction of knowledge.

In the context of this work involving the field of mathematics, Sampaio and Almeida (2010) and Castro Filho et al. (2011) applied OA on mathematical content in the computerized classroom and reported some advantages in its use.

Sampaio and Almeida (2010) applied an OA on parity of numbers. The objective of the research was to analyze how the use of an object, the mediating role of instrument teaching and learning process may influence the students' learning. As a result of this analysis highlighted that the use of OA served as a tool that encourages potential and might modify the forms of teaching and learning, enabling and challenging learning by dynamic and playful manner with which he presents the knowledge.

Castro-Filho et al. (2011) applied an OA which aimed to analyze what the contributions of its use for solving activities that contemplated the construction and interpretation of graphs. The authors point out that, during the analysis, it was observed that there were significant advantages in the use of OA in the role of mediating tools of learning, in that it resulted in a better understanding of graphics and visualization elements necessary for teaching math concepts. They also reported that one of these advantages is related to the fact that students can understand the concepts, using a simple graphical way to work, questionnaires and tables supported by the object.

SOCIO-HISTORICAL THEORY: MEDIATION AND ZONE OF PROXIMAL DEVELOPMENT

This section presents two concepts of socio-historical theory: mediation and zone of proximal development that underlie this work.

Vygotsky (2007) defines mediation as a feature of human cognition which refers to the internalization of activities and socio-historical and cultural behaviors, including the use of tools and signs in man's interaction with the social space in which it operates. This mediating action that develops the social interaction between individuals from the use of instruments (signs) mediation aims at the development of the subject (PASSERINO, 2005).

The contribution of socio historical theory possible to understand how mediation occurs in the teaching and learning process, it has a fundamental role both by the facilitator (teacher who encourages students), through reflections, offering help, as for its importance for student autonomy and ownership of knowledge (PASSERINO et al., 2008).

Vygotsky (2007) discusses the relationship between the development process and the appropriation of knowledge occur within the Zone of Proximal Development, which establishes two levels of development. A level that is called real development and another potential development. The first deals with the actions and processes that the learner can do without help. Second, the actions that the student is able to accomplish with the help of a more experienced person. So is the Zone of Proximal Development (ZPD) that transposition occurs between the actual developmental level of the student and their potential development (VYGOTSKY, 2007).

The concept of mediation, this work has the intention of intervention, interference of a subject or between subjects or groups, with the aim of achieving goals, occurring in the educational environment, in the context of a discussion between the student, the teacher in the role the mediator and the OA.

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CASE STUDY: STRATEGIES FOR MEDIATION IN THE RELATIONSHIP BETWEEN EXPONENTIAL FUNCTION AND GEOMETRIC PROGRESSION

In the second half of 2013, in a classroom course of the second year of high school in a Federal Education Institution, it was proposed to apply a OA developed by a research group composed of teachers in the area of mathematics and scientific initiation scholarship of the institution.

This proposal came from the initiative of the research group that in researching mathematical content that addressed the relationship between Exponential Function and Geometric Progression through a digital OA, OA did not find any that did this relationship and talking to a professor of mathematics secondary education institution, this demonstrated interest in the application of OA.

For exploration of the contents of Exponential Function and Geometric Progression, a survey was conducted in textbooks of high school and on the Web in scientific publications. Selected surveys conducted between texts discoursed about concepts, addressing the content of Exponential Function and Geometric Progression and the use of ICT.

OA Digital to present the relationship between these contents in scientific journals in the area of Mathematics and OA repositories were also surveyed. How not found one that relates the two OA content has motivated the construction of a by addressing the relationship between these contents to support the work of the teacher.

This work was conducted through a case study with direct observation, analyzing and describing the records of mediation between the teacher-student-OA. The study took place in the computerized classroom, we had available twenty-one computers and duration of two hours and thirty minutes. Forty-two students participated and the study was done in pairs. The record of the lecture was recorded and filmed.

The teacher had access prior to its application in the computerized classroom to OA and observation it became clear that developed some teaching strategies such as: (i) the activities of OA were developed in pairs in order to enable and encourage social interactions between subjects, (ii) discussion of two contents (Exponential Function and Geometric Progression) and the relationships between them, and (iii) mediation of the teacher with students, seeking that the student was the agent of their learning process.

At the end of the previous lesson the application object, the teacher, who was not a teacher of the class in the first year, applied a questionnaire with three questions, to investigate whether students had already studied the contents of Exponential Function and Geometrical Progression in first year of high school, basic to the application of OA prerequisites. In analyzing the responses, we found that all forty-two students had already studied such content. As for seeing the relationship between them, 25.64% of students responded affirmatively. When asked what was the relationship between these contents, 50% responded that a Geometric Progression "becomes" one exponential function, 20% answered that they both have potentiation, 20% said they both "have exponent", and 10% did not know or did not reminded of the relationship.

Can conclude that, although some students have already seen the relationship between the two contents, they did not know how the content is related. This can be seen among those who have seen the relationship between content, only 50% knew that a Geometric Progression was a restricted case of exponential function.

In the next lesson, presenting the object to teachers, the teacher warned that while answering the questions in the OA, they could consult with other classmates and the teacher herself. This interaction teacher-students and students-students aimed to develop a mediation in which, through these interactions, we attempted to observe a link between students and the OA used for resolving the questions posed.

It was also advised that they could use a sheet of paper to facilitate calculations for the resolution of issues. This sheet was used appropriately named and associated with the computer on which would be recorded in .txt

during application of OA response. This request was intended to supplement the data analysis, monitoring student mathematical reasoning since the resolution of the issues to put your final answer in OA. This is because students would be faced with new and challenging situations, and often the skills acquired would prove insufficient to meet them. By using their previous knowledge, the student modifies them, rejects them, complete them, or resets them discover new contexts of use.

The OA was applied at room consists of screens that had five questions in context with items to be answered, in which each question was described by an image representing the context of the situation described.

During application, the teacher was circling the room, observing how students interact with their peers and with OA. It was observed that, before consulting the teacher, they sought to discuss the issue with colleagues proposed themselves (student-student interaction).

In extracts of dialogues analyzed, while mediation process between teacher and student, used the legend: A = students, P = teacher and A (n, n) = double.

ANALYSIS OF THE RESULTS OF THE APPLICATION OF OA WITH HIGH SCHOOL STUDENTS IN THE COMPUTERIZED CLASSROOM

It brings this result to analyze certain items of some of the questions posed in OA, considering the relevance observed in mediations occurred.
The first issue described in Figure 1 was stated as: "Everyone has two parents, four grandparents, eight great grandparents, sixteen great, great grandparents, etc. Every generation that kicked, we double the ancestors "and goals: to interpret the statement to organize the data in the table; to correlate the rate of sequence number generation; manipulate the properties of powers; interpretation of the chart to reach its generalization; relate the data table with the result and to reflect on the common function found and the sequence formed features.

Figure 1: Statement of question
Source: own authorship

The item (a) asked to complete the table according to the genealogy of each student and in item (b) ordain that the numbers presented in the table in the form of sequence. At this time of the application, seven doubles the 21 requested the help of the teacher. Realizing that the difficulty lay in completing the sequence, the teacher suggested that they desenhassem your own family tree on notebook sheet, taking as an example the image of the proposed situation. This suggestion was made because of the error of the double was in place, as the first

term of the sequence, the zero element. With the proposed design, the pairs who asked for help realized that there was no generation of a family with zero person.

It was noticed that the seven teams who did the design requested by the teacher failed to solve the items (a) and (b) correctly. It is believed that the figurative element, in this case the design of the students encouraged to reflect on the terms of the sequence. The seven double responded in part (a) that the first generation: 2, second generation: 4, 3rd generation: 8 and 4th generation: 16 and part (b) 2, 4, 8, 16, 32.

Another item that was possible to observe a mediation strategy was the item (f), which sought that students associate the common characteristics between the function found in part (e) and the sequence formed in part (b) as shown in Figure 2.

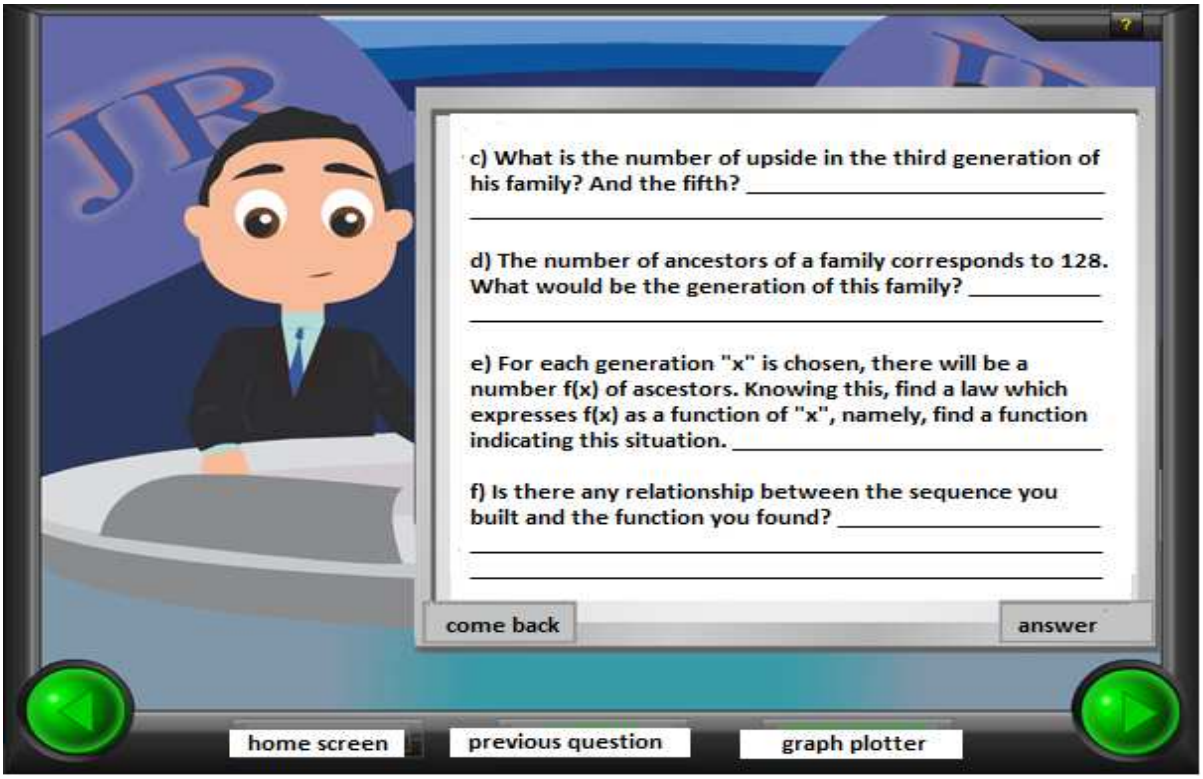

Figure 2: OA screem with topic (f) of the first question
Source: own authorship

A teacher who does not intervened in the knowledge construction process of students was asked by them to her to explain about what is asked in the question. The mediation between the teacher and the students it happened this way. She went to the front of the room and toward the contextualized image of the projection issue, began a strategy of dialogue-exhibition:
<P>: Let's read the wording of the question together.
<P>: Is there any relationship between the sequence that you created with the function you found? What did you notice what happens to the numbers in the sequence?
<A>: Each term of the sequence, the successor is twice the previous term.
<P>: OK! And what did you understand the function of the law found? Write table data in powers of the same base.
<A>: The law exponent of the function is the number of generation!
<P>: Done! Therein lies the answer to the question. Very nice!

With the mediation of the teacher with students during the resolution of this item, it was noticed that all the students were able to describe properly, natural language, the analysis found between the function and the

sequence formed. Additionally, recorded their responses in OA correctly, two examples of pairs <A3.4> and <A11.12> these responses, respectively, can be observed after mediation with the teacher: "Yes, because every generation the number of people increases, this being elevated to the corresponding generation "and" number Yes, because with this function you can calculate any number of sequence ".

At that moment, it was inferred that the students who were in the ZPD had a level of real development before the mediation took place.

In another question (third), part (a) and (b) shown in Figure 3 were aimed at the interpretation of a type graph f (x) = 3^x, as well as the organization of graph data in a table. From this table built, came to the correlation of the function with the index of the term of the proposed variable Geometric Progression.

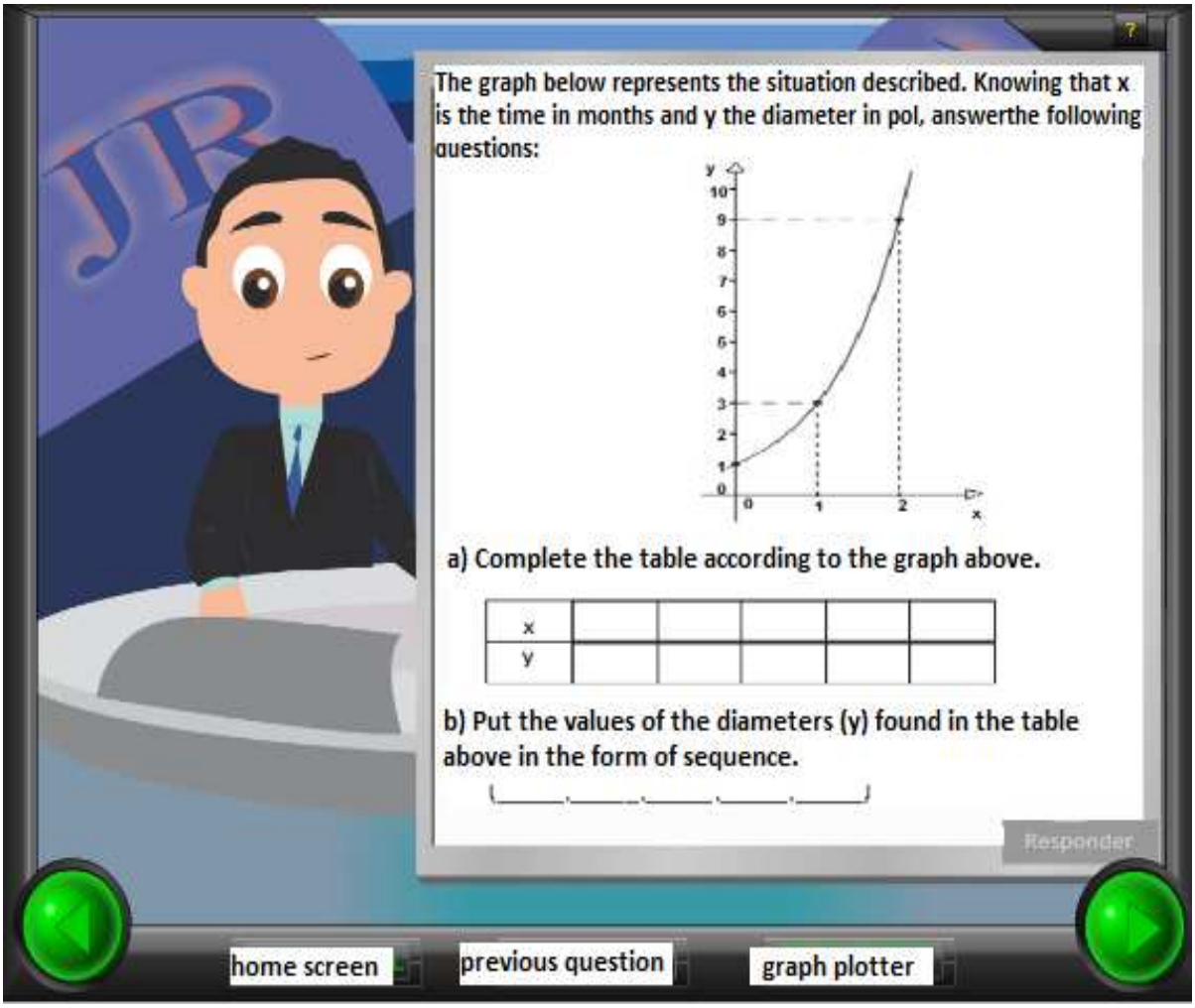

Figure 3: Screen with the topics (a) e (b) of the third issue
Source: own authorship

The teacher noticed that some pairs had difficulty recognizing the point that was on the Y axis, and led the students to reflect, developing a strategy of dialogic lecture that aimed at achieving the goal we wanted to reach through the process of student learning . The teacher made the students to participate actively, in which prior knowledge was exploited and taken as a starting point. The teacher went to the projection of OA within the room and began the following dialogue-exhibition:

<P> Let us recall some concepts. If point is at the intersection of the axes, what point is that?
<A5>: Zero!
<P> Well done! And we represent a point? Only one value, two values?

<A6> (double student A5) ordered pair? Two points? Is (0.0)?
<P> Exactly! So in the situation you are seeing, the point is on the axis OY, what value of x and y?
<A> Y is one and x is zero.
<P> So, the first point on the graph is ...?
<A>: The point (0,1)
<P>: Very good!

Double that requested the help of the teacher to resolve the issue, from her mediation, able to correctly complete the table and the sequence, ie, able to convert the log plot for the table and the table for the sequence requested. The teacher once again gave no reply. Took students to reflection through mediation.

Upon resolution of the part (f), the teacher was asked by some double, to help them in terms of the generalization sequence. The teacher asked the double return on the screen that had the sequence, suggesting that they formed to write the following, from an understanding of the context of the question, with the data written as a power of the same base. This suggestion aimed to help them visually relate to the exponent power formed the index term of the sequence. One realizes that the teacher has used a strategy of problem solving, in which coping with a new situation requires the development of reflective, critical and creative thinking on data described in the formulation of the problem. Demand the application of principles, or laws that can not be expressed in mathematical formulas. In issue three, the strategy of mediation occurred as follows:
<P>: Go back to the screen where it has the design of a biologist and analyze the sequence formed. Write this sequence, with numbers in the form of power and show the same basic representation of the position.
<P>: Were you able to observe something?
<A>: The leaf is 1 centimeter in diameter initially. The exponent of the power generated is one less than the index of the term of the sequence.
<Q>: And then? How to write for this one months x, any?
<A>: 3^{x-1}

It was noticed that during the suggestion proposed by the teacher, the students viewed the relationship between the index of the end of the sequence and the exponent of the power base 3. Students wrote: $a_1 = 1 \Rightarrow 3^0$, $a_2 = 3 \Rightarrow 3^1$, $a_3 = 9 \Rightarrow 3^2$.

During the analysis of the responses of the students, it was observed that the double hit that this item had registered on the sheet of paper which the teacher asked them to do.

The teacher, to circulate among the pairs around the room, he noticed that some students were struggling to understand what the statement asked. He decided to interfere with the application, providing a mediation with students, as described below:
<P>: Go back to the table and the following screen. What happens to the data table?
<A>: Passing The diameter triples each month.
<P>: OK! Now analyze what happens with the terms of the sequence.
<A>: Each successor term is triple the previous.
<P>: If the triples over the following months diameter, and the terms of the sequence too, so ...?
<A>: The Geometric Progression formed is an exponential function!

After mediation by the teacher with the students, they returned the question to answer it. During the analysis of the answers given by the double, it was found that all students were able to write in natural language, a Geometric Progression is an exponential function.

At the conclusion of the data analysis, we conclude that the students mastered without the mediation of the teacher, the use of OA as ICT, on the other hand, does not dominate alone observed and analyzed some items that require abstract / reflective thinking.

CONCLUDING REMARKS

Five issues were proposed in the OA for the purpose of discussing relations between Exponential Function and Geometric progress, but it was not possible to bring all of these discussions on the limited space in this paper. However it can be concluded that the application of an OA by the teacher while teaching strategy, addressing relations between the concepts of Geometric Progressions and Exponential Functions, brought the possibility of the student experience everyday questions that refer to these relationships, allowing us to understand the study of these concepts, widening his field of knowledge at the time that can make this relationship.

The mediation occurred, mainly the "Talk aloud," allowed to infer that this is a suitable means to formalize mathematical concepts, leading students to understand and internalize these concepts, through actions that are designed so as not to allow passive and unilateral discussion.

The study by the use of the object, while the construct of learning, also helped to promote student reflection on the content being, using interactions with the object and mediations occurring between teacher-students-OA, a fact quite evident in the dialogues described in this research.

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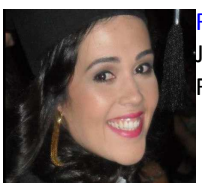
BIODATA AND CONTACT ADDRESSES OF AUTHORS

Arilise Moraes de Almeida LOPES is teacher at Instituto Federal Fluminense, Rio de Janeiro, Brazil. LOPES has graduated in Mathematics, at the Faculdade de Filosofia de Campos. Master in Educational Technology by University Federal do Rio de Janeiro - UFRJ, in 2004. Ph.D. in Information Technology in Education from the University Federal do Rio Grande do Sul - UFRGS, Brazil, in 2012. Her research interest is digital technologies applied to Education and Virtual Learning Environments.

Prof. Dr. Arilise Moraes de Almeida LOPES
Dr. Siqueira Street, 273,
Parque Dom Bosco, 28030-130.
Campos dos Goytacazes, Rio de Janeiro- BRAZIL
E. Mail: arilise@iff.edu.b



Renata Nogueira CARDOSO is teacher at Secretaria de Estadual de Educação do Rio de Janeiro, Rio de Janeiro, Brazil. CARDOSO has graduated in Mathematics, at the Instituto Federal Fluminense.

Prof. Renata Nogueira CARDOSO
Oswaldo Tavares,100, apto 102
Turf-Club, 28015-190.
Campos dos Goytacazes, Rio de Janeiro- BRAZIL
E. Mail: bnxrenata@gmail.com

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