

# Mathematics Club and Teacher Training for Elementary Education I: weaving possibilities<sup>1</sup>

## O Clube de Matemática e a Formação Docente para o Ensino Fundamental I: tecendo possibilidades

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### ABSTRACT

The continued training of the pedagogue to teach Mathematics in the grades that comprise Elementary School I was the focus of the research that supported this article, whose objective is to investigate the actions of teachers in training at the Mathematics Club that indicates an understanding of this context as a training space. In connection with this objective, it was intended to find answers to the following question: How do teachers in training at the Mathematics Club appropriate a way of organizing the teaching and learning of Mathematics for the final grades of Elementary School I? In the search for answers about how this appropriation occurred, a training experiment was organized with twenty-five teachers, which lasted the entire academic year of 2022 and 2023. This experiment is presented here as a methodological path for the research. Data analysis has the following structure: unit, episode and flashes. The results provide evidence that the teachers understand the Club as a training environment in which the teaching and learning of the object of knowledge (represented by the contents) can be organized based on the structure of the

### RESUMO

A formação continuada do pedagogo para atuar no ensino de Matemática nas séries que compreendem o Ensino Fundamental I foi o foco da pesquisa que subsidiou esse artigo, cujo objetivo é investigar as ações de professoras em formação no Clube de Matemática que indiquem entendimento desse contexto como um espaço formativo. Conexo a esse objetivo, pretende-se encontrar respostas à seguinte questão: Como as professoras em formação no Clube de Matemática se apropriam de um modo de organização para o ensino e a aprendizagem da Matemática para séries finais do Ensino Fundamental I? Na busca por respostas de como essa apropriação ocorreu, foi organizado um experimento formativo com vinte e cinco professoras, o qual perdurou todo o ano letivo de 2022 e 2023. Tal experimento é posto aqui como caminho metodológico da pesquisa. A análise de dados possui como estrutura: unidade, episódio e flashes. Os resultados dão indícios de que as professoras compreendem o Clube como um ambiente formativo no qual o ensino e a aprendizagem do objeto do conhecimento podem ser organizados a partir da estrutura da Atividade Orientadora de Ensino, por meio

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Teaching Guiding Activity, through the valorization of logical-historical movement of concepts that will be learned and subsequently taught to students.

da valorização do movimento lógico-histórico dos conceitos.

**Keywords:** Teaching Guiding Activity; Logical-historical Movement; Continuing training; Teacher who teaches Mathematics.

**Palavras-chave:** Atividade Orientadora de Ensino; Movimento Lógico-histórico; Formação continuada; Professor que ensina matemática.

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## 1 Introduction

The expansion of vacancies in Brazilian public schools, with regard to the first stage of Elementary Education (the period from the 1st to the 5th year), has brought to the fore among many elements the pressing need for more teachers for this level of schooling, a fact that, itself, makes discussion and research on teacher training in this period of school education urgent.

The proposal for the National Curriculum Reference for Early Childhood Education (Brasil, 1998), which subsidizes teacher training in Pedagogy courses, is to develop different skills for teaching, which, certainly, demands extensive training. Therefore, the teacher, at the end of the course, must be able to teach specific content from different areas of knowledge, including Mathematics, in a way that suits the needs.

Such teaching aptitude is interconnected to the act of educating, understood as a dynamic process and linked to historical-cultural contexts. Therefore, to achieve this, the action of all subjects involved in the process is necessary, be they teachers, students, parents or institutions. In this sense, the training process of these teachers must, then, organize the establishment of a “school education that presents itself as the particularity that best allows, in our current society, the realization of the subject-human gender relationship” (Araujo; Moraes, 2017, p. 52).

Among the studies on the training of teachers who teach Mathematics for the years that comprise Elementary School I, there are researchers such as: Nacarato *et al.* (2023); Moretti *et al.* (2023); Gaio and Duarte (2003); Curi (2004, 2005); Carzola and Santana (2005); Cunha (2010), among others. Thus, Curi (2004) highlights a worrying situation regarding the methodologies frequently used in Brazilian

Pedagogy courses, in which they are materialized as expository classes and this option is in line with the indications presented in research on training of these teachers. Curi (2005) also highlights that the training of these teachers must have, among its objectives, the selection and the choice of content, the organization of training times and spaces, the methodological approach and evaluation.

The importance of research arising from the area of Mathematics Education aimed exclusively at the training of Elementary School I teachers, added to the increasing need to have training spaces that allow teaching learning, specifically focused on the teaching of Mathematics, justifies the primordially of projects such as the Mathematics Club<sup>4</sup>. In this situation, researchers such as Cedro (2008); Lopes (2004); Moura (2000; 2021); Moretti (2014), among others, show the possibility of overcoming the theoretical discourse about the formative difficulties of this teacher who teaches Mathematics.

Overcoming such challenges is possible, based on the demands established by MathClub, which allow teachers in training who participate in it to understand other conditions for planning and developing pedagogical activity, generating new learning, through understanding the importance of the participation of teachers during their training, whether initial or continued, in spaces marked by the assumption that “learning is a social process in which the interaction between those who carry out the pedagogical activity sets in motion the learning of those who carry it out: the teacher [...]; and the student” (Moura, 2021, p. 18).

In meeting the need and the possibility of a space capable of solving it, the objective is to investigate the actions of teachers in training at the Mathematics Club that indicate an understanding of this context as a training space. In connection with this objective, it is intended to find answers to the following problematic question: How do teachers in training at the Mathematics Club appropriate a way of organizing the teaching and learning of Mathematics for the final grades of Elementary School I?

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<sup>4</sup> Throughout the text, different nomenclatures were used to refer to this space, namely: MathClub and Mathematics Club. This diversity occurs in order to provide better textual fluidity.

However, in order to understand the actions that preceded the elaboration of this article, so that the objective was achieved and answers were found, initially, it was sought to understand how training aimed at teaching Mathematics for teachers of Fundamental I Education has been carried out. Subsequently, the assumptions on which the Mathematics Club's training proposal is based will be explained.

Next, the formative experiment is presented as a methodological option for developing actions. Afterwards, data analysis will be discussed, based on a structure that privileges the movement of the phenomenon and to this end, the following will be used: unity, episodes and flashes. Finally, some considerations about the research carried out.

## **2 The training of teachers who teach mathematics in Elementary School I**

Research on teacher training in Brazil has focused on understanding how and if learning to teach Mathematics in the years of schooling (1st to 5th) that comprise Elementary School I has occurred in Pedagogy courses (Nacarato *et al.*, 2023; Gatti; Nunes, 2009).

These authors emphasize, in their studies, that in the vast majority of these degrees approaches to specific Mathematics concepts are superficial. According to such research, this fact is correlated with the reduction in the workload allocated to subjects that address mathematical knowledge, leaving little space, which ends up in an overvaluation of some concepts (numbers and the four operations) and a neglect of others (Quantities and Measurements, Space and Shape, Information Processing). This ends up causing a deficit in knowledge 'of and about Mathematics'.

In an analysis of the types of knowledge necessary for teaching Mathematics in Elementary School I, Cunha (2010) explains that the main ones would be content-specific and methodological-pedagogical knowledge. The author argues that there must be a unity between the two, so that they are interrelated, as the experience that students will have during this school period will certainly influence the way that these students, in the future, will view and relate mathematical knowledge with other types of human knowledge.

Gaio and Duarte (2003) complete these understandings, conjecturing that the biggest mistake in the training of Elementary School I teachers is neglecting basic Mathematics, because the mathematical knowledge of this educational stage is evaluated as so simple that it does not require preparation for it.

In line with this discussion, Nacarato *et al.* (2023, p. 32-33) point out that the “generalist training and reduced workload allocated to the field of mathematics education” in Pedagogy courses are points that make it difficult for mathematics content to be worked on “in conjunction with discussions of assumptions of teaching and learning for children”, making it difficult to “adequately train multipurpose teachers for teaching mathematics” (Nacarato *et al.*, 2023, p. 88).

Along this path, they emphasize the perception that stands out among these teachers that Mathematics is a science that is already ready, which only studies numbers and shapes, ignoring other parts of it, as well as having little knowledge of the History of Mathematics.

As a result, teachers who attended these degrees probably finish their initial training without appropriate contact with the contents they will teach - specific knowledge of mathematics -, both with regard to how they will organize their teaching, methodological-pedagogical knowledge, as if “[...] the multipurpose teacher did not need to know mathematics [...]” (Curi, 2005, p. 71).

In the wake of the discussions presented, Gatti and Nunes (2009, p. 22) emphasize that the majority of institutions holding the courses that train these teachers simply see “[...] the study of teaching contents associated with methodologies in a panoramic and in-depth way”, materializing a deficient way and allowing there to be no “more systemic approach to the characteristics of the concept”, making it difficult to have a “more in-depth view of a given mathematics content” (Moretti *et al.*, 2023, p. 51).

However, it is urgent that another training must be offered to this teacher, in the sense that this subject is seen not only as an individual, but also as a social subject, and, as such, is formed based on a structure that allows the constitution of “its essence in providing students with the means to appropriate the objectifications of non-everyday spheres” (Dias; Souza, 2017, p. 185).

To this end, the institutions responsible for their training must be “taken as means to materialize such an intention”, where specific learning can be achieved – such as Mathematics –, “coming from intentional training processes that are present in both undergraduate and undergraduate courses, during the exercise of the teaching profession” (Dias; Souza, 2017, p. 185).

Therefore, the teacher's process of understanding that he needs to organize the teaching of the mathematical knowledge he learned in his degree in knowledge to the student is not a movement that is constituted “from linear processes, in which the subjects are limited to simple reproduction” (Dias; Souza, 2017, p. 191).

Contrary to this, “it depends on conditions in which subjects interact, in activity, through feedback processes and resignifications of the individual-collective type, mediated by theoretical and practical issues that constitute the object of the activity” (Dias; Souza, 2017, p. 192). It is in this movement of carrying out teaching and learning as an activity (Moura *et al.*, 2010) “that there is a change in the quality of subjects mobilized, motivated, by the need to better become subjects in the activities they carry out” (Moura, 2021, p. 17).

To make this process possible, another training space is necessary that differs from that offered in undergraduate courses: the Mathematics Club would be one of these contexts. This space can act “voluntarily with the intention of making the student the object of the teaching activity and the subject of their learning activity” (Moura; Sforzi; Lopes, 2017, p. 85).

It represents an effort to capture singularities within interdependent movements of social and historical constitutions, highlighted by subjects in their objective reality. Therefore, MathClub represents an option in the face of criticism of the training of teachers who teach Mathematics in the years that make up Elementary School I.

The Club's methodological approach highlights the relationship between the individual and the collective, the logical and the historical, in an organization of Mathematics teaching that provides the learning of a concept, based on the appropriation of mathematical knowledge as a result of human activity in its historical development and culture.

### **3 MathClub's proposal for training teachers who teach mathematics**

In the case of school education, it requires active subjects (Leontiev, 2001) mobilized by reasons, which lead to the constitution of actions and psychic operations, which enable the appropriation of scientific concepts, that occur through the transformation of activity (Leontiev, 2001), what cannot, like any psychic activity, be taught, but only created.

This discussion, put forward by Leontiev (2001), guarantees that in any condition and form in which man's activity takes place, any structure he adopts cannot be considered outside of social relations, or life in society. In other words, "it is in the movement in which human life takes place that a system of activities takes place, some of which replace others" (Leontiev, 2001, p. 67). Therefore, this means that the activity conceives the human action that mediates the interface of the human relationship, the subject of the activity, and the objects of objective reality.

However, why bring up such discussion? Because, it is understood that a space, which is considered to develop the teacher training process, must be structured as an Activity and, therefore, must be imbued with concerns for the provision of a pedagogical activity appropriate to the learning objectives, which can be "[...] organized in a way that generates a certain need in the individual. This need, in turn, will trigger the reason to act" (Piotto; Asbahr; Furnaletto, 2017, p. 119).

The space to which reference is made is the Mathematics Club, a project initially conceived in 1999 at the Faculty of Education of the University of São Paulo (FE-USP), which is currently present in different regions of Brazil, establishing as a teaching training context in the following Higher Education Institutions (HEIs): Federal University of Goiás - Goiânia, Federal University of Santa Maria - Santa Maria, State University of Goiás, Southwest Campus - Headquarters: Quirinópolis, Federal University of Rio Grande do Norte - Natal, Federal Institute of Education, Science and

Technology of Espírito Santo - Vitória, Federal University of the State of São Paulo - São Paulo and Federal University of Uberlândia.

However, what is special about the MathClub structure that has survived more than 20 years since its creation?

In this proposal of the Mathematics Club, as a teaching learning space, there is a new quality: the inauguration within the teacher training unit of the place where the pedagogical activity is carried out, similar to that to be experienced concretely upon leaving the degree (Moura, 2021, p. 5).

Another reason that supports the permanence of the Club's structure in contemporary times is that it is configured as a proposal to think about learning the structure of pedagogical activity, which responds to Vigotski's (2001) call for the necessary and adequate organization of processes of educational-training, which develop in the subject the historical characteristics of the humankind.

As one of the responses to the primordially of having a training space that could handle this proposal, “the emergence of the Club was guided by the search for answers to new questions encouraged by research, [...] which required conceptually and politically dimensioning the social role of the teaching profession [...]” (Moura, 2021, p. 2). And over time, needs were transformed and other reasons were added. This movement has materialized in the following research: Lopes (2004); Cedro (2008); Silva (2013); Borowsky (2013); Hundertmarck (2017); Ferreira (2019); Silva (2019); Silva (2020); among others.

Given the fruitful quantity of research on the Mathematics Club, the question once again arises: who is interested in an investigation into this space? To everyone who understands that the establishment of a teacher training process needs to start from the human dimension of training, which is socially determined in subjective and objective relationships, present in man's actions.

This understanding goes against the simplistic view of training processes for teachers who teach mathematics and the development of teaching practice. Moura (2013, p. 98) corroborates the discussion by stating that “Work in the

dimension of praxis implies, for the worker, complete control over what he performs: planning, defining his instruments and choosing a set of actions that allow him to achieve the goal he envisioned”.

The training proposal of the Mathematics Club is anchored in the concept of Activity made by Leontiev (2001), in the Logical-Historical Movement of concepts (Kopnin, 1978; Sousa, 2018; Sousa, 2014) and the Teaching Guiding Activity (TGA), defended by Moura (2010; 2013), who highlights the need for the worker-teacher to be the subject of his main activity: teaching.

In this vein, there is the purpose of capturing the process of continued training that takes place in the Mathematics Club, in order to understand how teachers are appropriating a form of organization for the teaching and learning of Mathematics offered in Elementary School. To this end, the theoretical-methodological principles of TGA are adopted as a reference. The capture of the training development process will be explained in the next topic, which reports the main stages of a training experiment organized and developed with the research subjects that supported this article.

#### **4 Methodological actions: choosing the trajectory**

The development of the research actions, which supported this article, took place at the Mathematics Club of the State University of Goiás – Campus Sudoeste – Sede Quirinópolis (the aforementioned project has been under development since 2017). The organization of such an investigative context took place based on the structure of a formative experiment.

Davidov and Markova (1987, p. 236) claim that the formative experiment “is a fundamental form of realizing the particularities of the general genetic-causal or genetic-modeling method, [...] being a structure for investigating the development of the human psyche [...]”.

The aforementioned experiment lasted in the years 2022 and 2023. The participating subjects were twenty-five teachers from the municipal public education network in the municipality that is the headquarters of the IES that

houses the Mathematics Club, which was the context of the research. The meetings took place weekly, at night, and lasted three hours.

They were recorded in audiovisual form and were later transcribed to become the universe of data. Along this path, and according to Talizina (2009, p. 29), in order to be successful in using this methodology, it is necessary that “the researcher knows the objective structure of the activity that he will form”. Therefore, next, in Table 1, there is the organizational structure of the actions developed with teachers in continuing education.

Table 1 - Structure of the training experiment

<b>1st Moment<sup>5</sup>: Theoretical appropriation</b>	<b>2nd Moment: planning activities</b>
<p>In these meetings, the objective was for the teachers in training to take upon themselves the need for another organization, first of their pedagogical activities and, later, of the Mathematics teaching that they would develop in their classrooms<sup>6</sup>. This moment allowed the logical-historical movement of concepts presented as a theoretical-didactic proposal that would guide them and that favors means to constitute themselves as subjects capable of dealing with concepts and the theoretical-practical specificities of the pedagogical activity of the teacher who teaches mathematics. Therefore, in these meetings the theoretical-methodological basis on which the activities were based was studied, such as, for example, the understanding of the concept of TGA and Learning Triggering Situation<sup>7</sup> (LTS).</p>	<p>In this second moment, they were asked to plan the activities that would be developed. The teachers were guided to understand the necessary connection between the theoretical and practical elements of the pedagogical activity. This way, it was taken into account that the planned activities presented structural elements of the logical-historical movement of concepts, which materializes in the TGA proposal. Therefore, the planned activities sought: the genesis of the concept in carrying out the historical synthesis, the permanence of essential traits of this conceptual genesis in the LTS, the intimate relationship between the actions of the collective synthesis and the actions that make up the LTS.</p>

Source: Prepared by the authors (2024)

<sup>5</sup> The mathematical contents that would be covered in the planned activities were chosen by the teachers themselves. The planned activities would be developed in the 2nd academic semester of 2023 in municipal public schools where the teachers participating in the research are directors of 4th and 5th year classes of Elementary School I.

<sup>6</sup> MathClub - UEG has an agreement (nº 03/2021/SME-UEG - SEI Process: 202100020007284). It is also part of the network research project “Pedagogical Activity in the training of teachers who teach Mathematics through partnerships between higher education institutions and schools of basic education in different Brazilian regions”, project financed by the National Council of Scientific and Technological Development via Universal Call No. 18/2021.

<sup>7</sup> According to Moura, Sforzi and Lopes (2017), TGA would be an activity with an objective, instruments and modes of action. LTS is the “moment of TGA that embodies the problem that carries within it the core of the need that led man to create it” (Moura; Sforzi; Lopes, 2017, p. 92).

Chart 1 exposes the organizational structure of the formative experiment, a scope of how it happened and an attempt to present the reader with a way to understand it in its entirety. Such peculiarities will be highlighted in the analysis composed of units, episodes and flashes in order to better understand the contributions of the movement that took place at the Mathematical Club.

## **5 The path in which the phenomenon reveals itself: analysis**

In order to understand the evidence of the contribution of this experiment, an analytical structure is needed so that the phenomenon under study can be apprehended in its entirety, that is, it is sought to apprehend the subjects not only “as an existence, but as a convenience, as he should be as a result of his practical activity” (Kopnin, 1978, p. 62).

To this end, a structure was designed based on Vygotski (2007) who, by replacing product analysis with process analysis, highlights that the investigation must have as its basic objective becoming a reconstruction of the development of the phenomenon. To achieve this, Vygotsky elaborates the method of analysis by units. Anchored in the same perspective, Moura (1996) develops a complementary structure to the units of analysis and establishes within them the need to compose them into episodes.

In line with the path indicated by Vigotski (2007) and Moura (1996), Silva (2018) points to a complementarity in the analysis structure proposed by these authors. In the analytical framework composed of units and episodes, Silva (2018) inserts flashes, here understood as signs of a process of transformation of the subject's thinking, that is, “the observable signs that would prove the existence of the process of composition of the subject's meaning” (Silva, 2018, p. 149).

In this movement, analysis is consolidated as the instant of apprehension of objective reality that allows the researcher to point out the interface between what has already been stated and new determinations about the research object in question. In this process, Table 2 shows the development and understanding of the phenomenon based on the following analysis structure:

Table 2 - Structure of the analysis

<b>Unit: the organization of teaching activities based on another theoretical-methodological suggestion</b>	
<b>First episode:</b> <b>TGA's proposal as an articulator of the club's structure</b>	<b>Second episode:</b> <b>the formative contributions of valuing the logical-historical movement in the planning of LTS</b>

Source: Prepared by the authors (2024)

In this unit of analysis and episodes, it is sought to understand from the teachers in training that the acceptance of the theoretical-methodological structure of the Mathematics Club entails the understanding of this context as a space, in which the teacher's intentionality to carry out teaching is a key point, starting for establishing the action plan that will define the mediating instruments of these actions, in a process of “reflection, analysis and synthesis on the part of the teacher [...], which could give new quality to their general way of organizing teaching” (Moura; Sforini; Lopes, 2017, p. 72).

Next, the data analysis unfolds.

### **5.1 First episode: TGA's proposal as an articulator of the club's structure**

The Mathematics Club has its core theoretical-methodological element in the TGA to support its training structure. The TGA also allows MathClub to establish itself as a context in which the teacher in training, by placing himself in the teaching organization movement, is able to enable the learning of mathematical content, based on a “vision that there is a way of organizing teaching, a general mode of action, which allows better quality learning to occur” (Moura, Sforini, Lopes, 2017, p. 97).

It can be seen in the flashes that follow the evidence from the teachers that they understand that the structural composition of the Club is based on the TGA: "The activities that you developed with us: the comic book, which was about numbers, fractions with games and others, they are all organized in the same way, they have different content, but they look similar, they have a goal from the beginning and are not simply exercises” (Episode 1, Flash 1, Azaleia); that they use are like 'guidance' because as you said, it's not something done anyway, so for

me the way planning is done is what catches my attention the most, this focus that exists on the student's learning but also on the teacher's, nowhere else have I experienced this" (Episode 1, Flash 2, Astromelia).

The teachers denote that they understood that the Club, through the establishment of the TGA as a fundamental basis for its actions, allows it to be a space for teacher and student training and that this is only constituted by interrelating the teaching and of the learning activity.

Such activities must be seen as a social process, mediated by instruments and signs, and objectified by a need to appropriate culture, to achieve a common objective: the development of human potential for the appropriation of cultural goods, among these, mathematical contents. The existence of such guidance must be seen as an essential link for the role of teaching to be established: to create the conditions to ensure the subject's relationship with scientific knowledge, leading them to a qualitative transformation in their affinities with this knowledge (Silva, 2018).

Understanding the process of how teachers in continuing education at the Club take upon themselves the understanding of TGA as a basis for the existence and permanence of this training context, implies analyzing them as subjects in teaching activity and also their students as subjects who they will be in a learning activity, considering that the formation and development of these subjects occur in systematic and intentional collective actions.

Thus, at the Club, for these actions, with these characteristics to be carried out, roles historically given to teachers and students are given up, the rules and division of labor are changed, the multiplicity of meanings is echoed, personal voices and private voices, space is given to dialogue in the trajectory of transforming the very object of teacher training.

Therefore, the collective is defended in this training space. Such defense is in line with the understanding that it must be about convergent efforts for human development, being the way to enable "subjects to become partners in actions that aim at the transmission\appropriation of knowledge as a result of the activity that perform together" (Moura; Sforini; Lopes, 2017, p. 73).

In this sense, the flashes that follow show signs that the teachers understand the importance of working together to maintain the basis proposed by the TGA, and, to this end, they begin to negotiate and make decisions as a group, invariably dialoguing on a basis of coherent equality, in which learning can be accessible to everyone: “The characteristic of the club's activities that most catches my attention is the issue of doing everything together, all the steps are done collectively, and this doesn't make the process easier, it makes it richer” (Episode 1, Flash 3, Camelia); “About this, I think that the ways in which activities are carried out here are very different from what I understood as the role of the teacher or the student, and it is not easy to change the way I believed, but also here is a place where we are heard and for I believe that there is a chance for change” (Episode 1, Flash 4, Gardenia).

In the Mathematics Club, built and maintained by the structure of the TGA, it is understood that the teaching activity and the learning activity are closely linked by the need to appropriate culture. Such appropriation takes place in the assimilation of accumulated historical knowledge, embodied in school content, which is aimed at teaching and learning processes, which require planned actions for this purpose (Moura *et al.*, 2010). “This fact leads us to the understanding that, in teacher training processes, it is necessary to consider mobilizing activities for the “[...] appropriation of a generalized way of teaching” (Panossian; Moretti; Souza, 2017, p. 131).

This process must systematically and intentionally allow “in the teacher’s activity, more specifically the teaching activity” (Moura *et al.*, 2010, p. 89) the learning content, the student who learns, the subject who teaches and that all this exists from a general way of appropriating culture and the development of the generic human (Moura, 2002), which is defended by the Mathematics Club.

In this way, it is essential that the teacher, in his training (initial or continuing), is a participant in training spaces in which he is mobilized to distinguish that, alongside the outstanding specialties of the educational phenomenon, there is a process of subjective modification, which not only

changes the reproductions of those involved, but it determines a change in the interpretation of the existing process, which will determine a reorganization in future actions.

Furthermore, the pedagogical activity planned and developed in these spaces will be, at each moment, an expression of the moment and also temporary syntheses that constitute the process of organizing the teaching and learning of scientific concepts.

The second episode will continue the understanding of the phenomenon by highlighting how teachers understand the formative contributions of the logical-historical movement to learn about the processes of emergence and development of mathematical concepts, important for the planning that they would have to carry out for teaching activities that they would develop with their own students at a later stage.

## **5.2 Second episode: the formative contributions of valuing the logical-historical movement in the planning of LTS**

The research subjects, when developing their training actions in this context and, among them, the planning of their teaching activities, ended up opting for the logical-historical movement of concepts to materialize the path of emergence and development of concepts in the activities that were elaborating. According to Kopnin (1978), this is a movement guided by the laws that exist in objective reality in which (logical) thought reflects the historical movement. The unity of the historical and the logical is a premise for understanding the essence of a concept and, anchored in Silva (2018), this unity is understood as an object of its structure, history and development.

Along this path, the Mathematics Club offered teachers in training the conditions to recognize that this movement allows them to overcome the apparent aspect of constructing mathematical concepts, as knowledge neither advances only through appearances, nor is it formed solely as individualized and separate representations from each other.

The following flashes show the evident process that the teachers in

training realize the contributions of choosing the logical-historical movement to support the planning of their teaching activities: “To tell the truth, now that we have started planning I feel a mix of joy and fear, and the fear came when I discovered that the historical synthesis is not ready on any website and that we are going to have to do it and the joy comes from the fact that we are going to discover how the concept came about, because I didn't know either, I don't think any of us know and we will learn before our students” (Episode 2, Flash 1, Dalia); “Let's find out why it was created, where it was created and most importantly for me, why they created it” (Episode 2, Flash 2, Daisy).

According to Moura (2010; 2017), in the development of the TGA, the needs, motives, objectives, actions and operations that involve the teacher and students are mobilized through LTS, which must contemplate the essence of the concept at the same time and expose the need that led humanity to its constitution.

Therefore, based on historical synthesis, LTS seeks to recreate the main moments of the emergence and the development of the concept, considering that “the very construction of the logic of the object contains a history, although there is a tendency to disregard this composition of human understanding (Sousa, 2018, p. 47). Next: “We had never seen this way of organizing math activities, like it starts from the real story of how that content came about, in the real lives of real people” (Episode 2, Flash 3, Flor); “I can imagine the difference in children's learning when they have contact with an activity that values the entire process of how that content was created until it reaches today” (Episode 2, Flash 4, Amarilis).

Organize the teaching of mathematical concepts from the perspective of the LTS, as offered in this continuing education carried out in the context of the Mathematics Club, is in line with the defense that such teaching established can enable the subject (teacher and student) to encounter the essence of the concept in the movement from the social to the individual, which resembles the social experience of humanity when creating mathematical concepts (Moura; Araujo; Serrão, 2019). Such a moment of planning, anchored in the logical-historical

movement, is based on the belief that “[...] learning does not occur spontaneously and only from the biological conditions of the subject, but culturally mediated” (Moura *et al.*, 2010, p. 208).

Therefore, at this moment, in the experiment in which the teachers in training carry out the planning of Learning Triggering Situations, such action is based on the belief that these, according to Moura, Araujo and Serrão (2019) are the materialization of the central action of the TGA and, therefore,

We argue that, [...] situations that trigger learning can bring to classes the possibility of understanding the world that surrounds us, from the moment that abstractions become concrete content for thinking (Sousa, 2018, p. 53).

The following flashes show signs of their understanding of the process under development: “The part that we like the most, the coolest and most fun is the LTS, but it cannot be elaborated in any way, it is tied up in the historical synthesis, the historical synthesis tells the historical movement, from its emergence until today. Then LTS kind of formalizes this, they are inseparable” (Episode 2, Flash 5, Rosa); “I work, it’s too much; find out when it came about and why the concept came about, but I’m curious and I’m already imagining how the children will react, because I never thought that each content had a way of knowing this” (Episode 2, Flash 6, Tulipa).

The elaboration of activities as proposed in the Club, anchored in the TGA, in the wake of carrying out a historical synthesis and subsequent LTS, allows the subject, whether teacher or student, to have an encounter with the essence of the concept, pledged in and by realization of its historical-logical movement, a process that seeks the needs that led humanity to construct a certain concept (Sousa, 2004).

In this sense, LTS materializes this historical and social development in a teaching or learning situation that tends to place the subject in creative tension, similar to those who experienced it, when resolving real problem situations, provoked by a practical or practical need subjective (Moura; Araujo; Serrão, 2019; Moura, 2017).

In the following Flashes such understandings are materialized by the teachers: “I think the idea of thinking about a type of activity to teach mathematics that first needs to discover how that content came about is incredible, I had never heard of this proposal, but I find it fascinating” (Episode 2, Flash 7, Azaleia); “The idea of thinking that we had to find the answers to children's questions, like: aunt, why did they invent this, when did they invent this, what did they invent it for, what was this used for, was very good, because in reality we don't know how to respond, because we don't know, at least we didn't know, nor did we know how to know” (Episode 2, Flash 8, Aster).

According to Sousa (2014), Araujo (2019) and Moura *et. al.* (2017), it is through the LTS that TGA realizes its objective dimension, it is through it that the logical-historical movement materializes in the teaching activity and learning activity.

Such proposals are established in the logical-historical movement, in which the historical focuses on the process of changing the object, in the stages of its emergence and development (Sousa, 2014), and the logical is the means by which thought carries out the mission of “in the process of reflection on the historical, so that the logical reflects the main periods in the history of the object” (Sousa; Moura, 2016, p. 5128).

The defense made for the organization of teaching Mathematics concepts throughout this continued training was based on the premise that “the historical and social contextualization of concepts must be considered, attributing meaning and significance to what will be taught and learned” (Sousa, 2018, p. 45). In the flashes that made up this scene, it is clear that the teachers in training believed that the logical-historical movement can and should be adopted as a didactic perspective for organizing the teaching of mathematical concepts in the classrooms where they teach. In this sense, this proposal serves the possibility of contributing as a path towards the realization of an educational organization that considers the link between the historical and logical aspects present in the wake of the emergence and development of these concepts.

## 6 Final considerations

The research carried out reveals advances in understanding the continued training of teachers who teach Mathematics in the final years of Elementary School I, with the particularity that this process took place in a peculiar training space: the Mathematics Club. Therefore, the actions experienced regarding the organization of teaching mathematical concepts were based on the TGA proposal and what were the formative contributions for these teachers to stand out.

Among these contributions, it was noticeable the apprehension of the historical-logical movement of the concept as a possibility for them to detach themselves from the traditional proposals for teaching Mathematics, which they experienced during the period they were undergraduate students and also when planning their classes at school. The training proposal offered to them enabled them to overcome the didactic approach that is based on the formalism of the concept, with a subsequent symbolic registration, devoid of meaning and meaning for the student and the teacher.

The training of teachers who teach mathematics and the learning of mathematics are processes that, as they are seen in educational reality, devalue the logical-historical character of mathematical concepts, covering up and ignoring the contradictions that constitute the reality pertaining to their emergence and development. Carried out in this way, they predominantly reduce the teaching training process and student learning to an adaptive perspective, in which the option given to these subjects is to comply, to accommodate themselves to what is proposed to them, without many questions.

However, in the training perspective offered by the Mathematics Club, a break in this devaluation was noted by presenting the relevance of understanding the process of emergence and development of mathematical concepts, but also how such process can be incorporated into situations that trigger learning to starting from the study of the logical-historical movement of these concepts. In this way, conditions were provided to promote the assimilation of content to the teacher and student (Davidov, 1988), which

goes beyond immediacy, towards meeting the perception of the need to appropriate mathematical knowledge as a promoter of their development.

## Club De Matemáticas y Formación Docente de Educación Primaria I: tejiendo posibilidades

### RESUMEN

La formación continua de profesores para enseñar matemáticas en los grados de la escuela primaria fue el foco de la investigación que dio origen a este artículo, cuyo objetivo es investigar las acciones de los profesores en formación en el Club de Matemáticas que indican una comprensión de este contexto como espacio educativo. En relación con este objetivo, se pretende encontrar respuestas a la siguiente pregunta: ¿Cómo se apropian los profesores en formación del Club de Matemáticas de una forma de organizar la enseñanza y el aprendizaje de las matemáticas para los últimos cursos de Primaria I? En la búsqueda de respuestas sobre cómo se produce esta apropiación, se organizó un experimento de formación con veinticinco profesores, que duró todo el curso escolar de 2022 y 2023. Este experimento se presenta aquí como la vía metodológica de la investigación. El análisis de los datos se estructura de la siguiente manera: unidad, episodio y flashbacks. Los resultados muestran que los profesores entienden el Club como un entorno formativo en el que se puede organizar la enseñanza y el aprendizaje del objeto de conocimiento a partir de la estructura de la Actividad Orientadora de la Enseñanza, valorando el movimiento lógico-histórico de los conceptos.

**Palabras clave:** Actividad Orientadora Docente; Movimiento Lógico-histórico; Formación Continua; Profesor que enseña Matemáticas.

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