DOI: http://doi.org/10.14393/OBv10.e2026-10

Contributions of the logical-historical movement and collective actions and reflections to teacher training in the Mathematics Club[1]

Contribuições do movimento lógico-histórico e das ações e reflexões coletivas para a formação docente no Clube de Matemática

Aportaciones del movimiento lógico-histórico y de las acciones y reflexiones colectivas a la formación docente en el Club de Matemáticas

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ABSTRACT

This article presents the results of doctoral research on the contributions of the logical-historical movement, collective actions, and reflections to changes in teachers' personal meaning regarding Pedagogical Activity. Based on Cultural-Historical Theories, Activity Theory, and the Teaching-Oriented Activity, the study used a formative experiment to follow teachers through processes of collective action and reflection on Pedagogical Activity. The data indicate that the Mathematics Club is an organization that values the socio-practical reality of the subjects. Through Learning Triggering Situations, teachers were able to appropriate the socio-historical logic underlying the construction of mathematical concepts, thereby forming new motives for teaching. The research highlighted that the unity between theory and practice, experienced collectively, enables the re-signification of teaching activity, resulting in the convergence between social meaning and personal sense of the Pedagogical Activity, consolidating the perception that the development of the student's theoretical thinking is dependent on the intentional organization of teaching by the teacher.

Keywords: In-service Teacher education; Mathematics Club; Teaching-Oriented Activity; Logical-Historical Movement; Collective.

RESUMO

Este artigo apresenta os resultados de uma pesquisa de doutorado acerca das contribuições do movimento lógico-histórico e das ações e reflexões coletivas na mudança de sentido pessoal de professores sobre a Atividade Pedagógica. Fundamentado nas Teorias Histórico-Cultural, da

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DOI: http://doi.org/10.14393/OBv10.e2026-10

Atividade e na Atividade Orientadora de Ensino, o estudo utilizou o experimento formativo para acompanhar docentes em processos de ações e reflexões coletivas sobre a Atividade Pedagógica. Os dados apontam que o Clube de Matemática possibilitou uma organização de ensino que valoriza a realidade sócio-prática dos sujeitos. Por meio de Situações Desencadeadoras de Aprendizagem, os professores puderam apropriar-se da lógica sócio-histórica de construção dos conceitos matemáticos, o que resultou na formação de novos motivos para o ensinar. A pesquisa destacou que a unidade entre teoria e prática, vivenciada coletivamente, possibilita a ressignificação da atividade docente, o que resulta na convergência entre significado social e sentido pessoal da Atividade Pedagógica, consolidando a percepção de que o desenvolvimento do pensamento teórico do estudante é dependente da organização intencional do ensino pelo professor.

Palavras-chave: Formação Continuada; Clube de Matemática; Atividade Orientadora de Ensino; Movimento Lógico-Histórico; Coletivo.

Resumen
Este artículo presenta los resultados de una investigación doctoral sobre las contribuciones del movimiento lógico-histórico y de las acciones y reflexiones colectivas al cambio en el significado personal de la Actividad Pedagógica por parte de los docentes. Con base en las Teorías Histórico-Culturales, la Teoría de la Actividad y la Actividad Orientada a la Enseñanza, el estudio utilizó un experimento formativo para acompañar a los docentes en procesos de acciones y reflexiones colectivas sobre la Actividad Pedagógica. Los datos indican que el Club de Matemáticas posibilitó una organización docente que valora la realidad sociopractica de las asignaturas. Mediante situaciones desencadenantes del aprendizaje, los docentes pudieron apropiarse de la lógica sociohistórica de la construcción de conceptos matemáticos, lo que se tradujo en la formación de nuevas motivaciones para la enseñanza. La investigación destacó que la unidad entre teoría y práctica, experimentada colectivamente, permite la resignificación de la actividad docente, lo que conduce a la convergencia entre el significado social y el sentido personal de la Actividad Pedagógica y consolida la percepción de que el desarrollo del pensamiento teórico del estudiante depende de la organización intencional de la enseñanza por parte del docente.

Palabras clave: Educación continua; Club de las Matemáticas; Actividad orientada a la enseñanza; Movimiento Lógico-Histórico; Colectivo.

1 Introduction

Since the 1990s, the legislative trajectory of teacher education in Brazil has been marked by fragmentation, reflecting the disconnect between government and state policies. As Penna, Bello, and Jacomini (2018) point out, frequent changes in government ideologies prevent lasting action from being consolidated, thereby subjecting education to short-term interests at the expense of the school community's needs. In this context, overcoming the technical and practical rationales of teacher education—rooted in the dissociation between theory and practice (Contreras, 2012)—requires adopting a critical

DOI: http://doi.org/10.14393/OBv10.e2026-10

perspective that involves actively listening to professors and engaging them in designing their own professional development pathways.

Shaped by international pressures, the Brazilian educational landscape has prioritized teacher training focused on self-instructional materials and practices devoid of content (Silva & Zanatta, 2018). To break with this process of de-intellectualization, teachers must recognize continuing training as a historical, social, and political activity and identify themselves as active political agents. From this perspective, questioning the neoliberal foundations of teacher education must go hand in hand with reaffirming teaching as a tool for social and intellectual transformation.

The trend of teacher (de)qualification stems from the devaluation of the profession and the absence of support for professional development. By obscuring the real difficulties faced in schools, this process prevents continuing training from becoming an opportunity to overcome the alienating conditions of pedagogical work. As Leontiev (1978) discusses, the process of alienation can lead professors to lose clarity about the essence of their work. When professors internalize only the meaning imposed by society, their practice becomes mechanical. This restricts not only their pedagogical performance, but also their recognition as agents of transformation. Therefore, continuing training must restore this awareness, reuniting the personal meaning of work with its humanizing social significance.

To overcome alienation and teacher (de)qualification, we must rely on an emancipatory educational proposal that restores the centrality of professors' teaching activities. This proposal permeates their theoretical, practical, and political training. Barbosa's research (2025), the subject of this article, sought to align professors' needs and motivations with the actual object of teaching by transposing the structural elements of Activity in Leontiev's conception (1978, 2021) to the training context. This reorganization of the relationship between the orientation and execution of pedagogical activity enables teachers to recognize themselves in their work, promoting the transformation of their consciousness and praxis (Esteves & Souza, 2017).

Pedagogical activity is understood as a collective and intentional construct that aims to humanize individuals by developing their theoretical thought (Bernardes, 2009). From this perspective, teaching and teacher education are manifestations of the same

DOI: http://doi.org/10.14393/OBv10.e2026-10

entity, connected by causal links that define their existence (Moura, 2017). Organizing continuing training within the theoretical-methodological framework of the Teaching Guidance Activity (Atividade Orientadora de Ensino - AOE) enables the dialectical unity of theory and practice, thereby contributing to the construction of new knowledge in teaching. Valuing collective actions and reflections on mathematical concepts grounded in the logical-historical approach can lead teachers to critical reflections that transcend mere technical execution, promoting a qualitative shift in the meaning of their teaching activity. This transition characterizes teacher education as a process of humanization and development of theoretical thought.

By grounding education in the theoretical and methodological foundations of AOE, pedagogical activity ceases to be a one-sided action. It becomes a mediating system based on the psychological concept of activity. In this sense, AOE promotes unity between teaching and learning activities, placing individuals within a dialectical flow of mutual transformation (Moura, Sforni, & Lopes, 2017). This conception overcomes the fragmentation of teaching work and allows mathematics education to be organized according to the logic of praxis, humanizing those involved.

AOE proposes an organizational model in which professors act as mediators of a collective reinterpretation process. Prioritizing the logical-historical development of mathematical concepts allows teaching to move beyond mere transmission and focus on the purpose of knowledge in relation to humanity's needs (Moura, Sforni, & Lopes, 2017). In this sense, conceptual appropriation becomes the axis of a training unit in which the development of theoretical thought integrates the activities of teachers and learners.

Based on excerpts from Barbosa's (2025) doctoral research on continuing training for teachers in AOE, this article presents how the logical-historical movement of mathematical concepts present in Learning Triggering Situations (SDAs) can contribute to a shift in teachers' personal meaning of their pedagogical activity through study activities developed in the Mathematics Club (CluMat). Grounded in the AOE conception, the Mathematics Club is recognized as a privileged space for training and learning where the dialectic between social and personal meaning materializes (Cedro, 2015).

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The following sections are organized according to the continuing training developed at CluMat, which is grounded in the theoretical-methodological foundation of AOE. The sections trace the research's methodological path through the formative experiment, the formative process, and the shift in the personal meaning of the pedagogical activity. This is all examined in light of the units of analysis, episodes, and their respective scenes. The sections culminate in the results and discussions and conclude with considerations on the formative experiment.

2 Continuing Training from the AOE Perspective

The educational approach grounded in AOE views teaching as a socially and historically situated practice. From this perspective, teachers are recognized as individuals capable of integrating theoretical knowledge with pedagogical practice, establishing a dialectical unity essential to their work. According to Curado Silva (2019), this type of training, interwoven with the work itself, enables professors to understand socioeconomic and political pressures. This autonomy allows them to intervene and subvert the complex conditions imposed by the school environment.

The Mathematics Club (Clube de Matemática - CluMat) is a training space governed by AOE, where playfulness, collective action, and reflections from the SDAs serve as the basis for organizing instruction. The central objective is to foster theoretical thinking among teachers and students. According to Davídov (1988), this is understood as the capacity to conceptualize and reproduce the universal forms of the object of knowledge. This process requires professors to transcend the immediate appearance of content, a possibility within a logical-historical movement. In this movement, professors make generalizations based on conscious abstractions about the essence of mathematics.

The purpose of ongoing training is to articulate the need to teach with the motivations that drive the teacher. According to THC, educational activities such as those at CluMat must transcend technical execution and focus on collective planning involving the genesis of concepts and methodological strategies. As Esteves and Souza (2017) propose, it is through the integration of study activities and teaching practices that professors reorganize their work, ensuring that theoretical connections serve as tools for transforming school reality.

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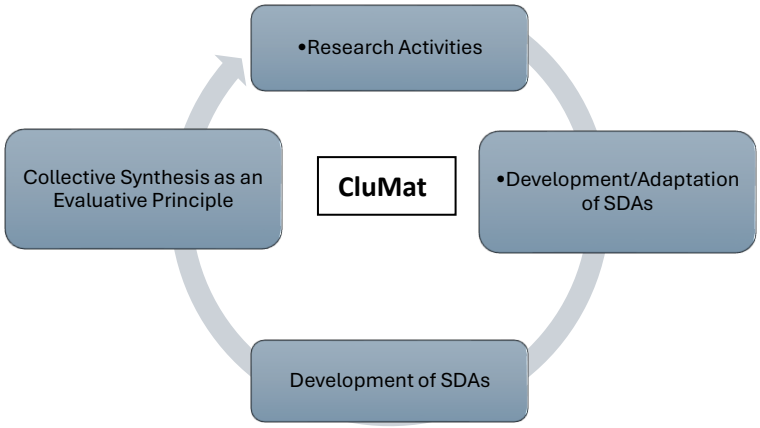
In the CluMat framework, teaching is organized according to AOE principles and guided by intentionality and collective mediation. According to Vygotsky (1998), this process involves signs and instruments that direct the study activities developed by trainers and club members. The structure of the activities prioritizes the logical-historical progression of mathematical concepts, based on an understanding of the conceptual links present in the design and development of the SDAs. These links are fundamental to the attribution of personal meaning, and consequently, to the appropriation of mathematical knowledge. Thus, training provides a space for sharing the actions and operations that define the pedagogical activity, thereby promoting theoretical thinking on both sides (Figure 1).

Figure 1: Development cycle of actions at CluMat



Adapted from Barbosa (2025)

The action development cycle at CluMat is grounded in and guided by the principles of AOE (Moura, 2001, 2010) and is structured into interdependent stages. First, the trainers plan collective study sessions, during which club members internalize the theoretical and methodological framework. Next, Learning Triggering Situations (LTS) are designed and implemented from a logical-historical perspective, culminating in practical application with students in schools. The cycle includes discussion circles and spaces for critical reflection where professors and trainers assess the scope of tasks and student engagement. They then provide feedback on the pedagogical activity.

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CluMat's collaborative nature, rooted in respect for differences and group cohesion, defines it as an authentic training space (Borowsky, 2017). As Vygotsky (2017) argues, knowledge appropriation is a process mediated by relationships with others. Higher intellectual functions first develop in social interactions and then convert into intrapsychic functions. In this sense, collective work in the club is not merely a methodological strategy but rather the ontological condition for the development of the professor's theoretical thinking.

At CluMat, the articulation between study, practice, and collective reflection demonstrates that the appropriation of theoretical knowledge emerges from the intersocial plane. Based on Rubtsov's (1996) collective perspective, the training program illustrates that shared learning activities among participants precede and facilitate the internalization of new pedagogical connections. Therefore, strengthening collective activity in teacher education, and consequently in schools, enhances teaching and transforms how professors understand their intellectual development by appropriating mathematical knowledge grounded in the logical-historical movement of concepts and their connections.

In agreement with Oliveira (2022), we acknowledge that sharing and collaboration are essential to a teaching organization focused on the collective. These elements are fundamental to pedagogical activity because they enable individuals to appropriate theoretical knowledge within a process of qualified interaction. This perspective is based on the idea that human activity requires partnerships and a social division of labor. In this model, collective effort is directed toward achieving common goals (Moura, 2001).

Within the CluMat framework, the logical-historical development of mathematical concepts is a key principle of instructional organization in the SDAs. According to this perspective, professors must coordinate actions that awaken students' genuine interest in the concept, aligning the reasons for the activity with the subject of study (Leontiev, 2021). According to Moura, Sforni, and Lopes (2017), this pedagogical intentionality reinterprets content by recovering its historical genesis and revealing knowledge as a human response to social needs developed over time.

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As Panossian, Moretti, and Souza (2017) postulated, the historical development of the concept forms the basis for teaching that transcends the empirical. In the context of CluMat, this perspective enables professors to organize learning situations that demystify the notion of mathematical knowledge as something ready-made and finished. By emphasizing that objects of knowledge originate from concrete human needs, professors give new meaning to their practice by presenting mathematics as a field of real human activity whose logical progression reflects the progress of civilizations.

We understand that planning instruction based on AOE presupposes investigating the concept's historical genesis to reveal the human need that gave rise to it. This articulation is fundamental because, according to Kopnin (1978), the logical movement synthesizes the historical trajectory while preserving its essence. The professor believes that students establish meaningful connections with the content by understanding knowledge as a human production. These connections ensure the transition from empirical to scientific knowledge, driving higher intellectual functions and theoretical thinking.

With this in mind, the training initiative was structured so that the study methods developed within AOE's theoretical-methodological framework would serve as a foundation for transforming teaching practice through SDAs. The SDAs act as mediators between the professor's instructional activity and the students' study activity. Adopting these principles in CluMat enables professors to mobilize collective study activities within their school context, moving beyond isolated practice and reframing their pedagogical activity through the practical application of the principles discussed in the study and planning.

3 The Methodological Approach to Research: The Formative Experiment

The use of dialectical historical materialism (DHM) as a research method is justified not merely as a technical choice, but also as a lens through which we can perceive the essence of teacher education beyond what is apparent. In this study, DHM is understood as the unity of thought and action aimed at transforming the object (Kopnin, 1978). Our analytical intent was to capture the phenomenon of teacher education at CluMat by examining its inherent tensions and its

DOI: http://doi.org/10.14393/OBv10.e2026-10

embeddedness in society. In accordance with Lefebvre's (1991) dialectic, we rejected the isolation of the object to seek a profound understanding that transcends immediate data and reveals the continuous movement of meaning and the construction of significance that characterizes pedagogical activity.

Specifically, by focusing on changes in teaching quality, we demonstrate that training is a transformation of consciousness that occurs through the confrontation of contradictions, not merely an accumulation of information. Thus, the method recognizes the mutability of teaching consciousness, which evolves according to the exchange of meanings in formative interactions (Moura, 2004). The research examined the contradictions inherent in adopting a new proposal for organizing teaching within AOE, distinct from the traditional approach teachers were familiar with. This allowed us to understand the professor's movement toward more intentional practice. By articulating the parts (individual actions) with the whole (the social process of teaching), the research reveals the connections that underpin the transformation of pedagogical activity based on AOE.

We used the formative experiment as a pedagogical research methodology and inter-institutional collaboration as a field of investigation to identify and understand transformations in teachers' personal sense of pedagogical activity who organize teaching based on the theoretical-methodological framework of AOE. The research took place in the extension course, "*Mathematics Club-Clumat: A Collective Space for Organizing Teaching and Learning,"* a partnership between the Institute of Mathematics and Statistics at the Universidade Federal de Goiás (IME/UFG) and the Professional Training Department (Gerência de Formação dos Profissionais - Gerfor) of the Goiânia Municipal Department of Education (Secretaria Municipal de Educação - SME). The project, conducted in 2023 and 2024, aimed to enhance teaching practice and inform local training policies by grounding itself in the theoretical triad of THC, Activity Theory, and AOE. It was aimed at professors who taught mathematics in the early years of elementary school (3rd to 5th grade).

The study involved 26 volunteer professors whose experience at CluMat revealed a profile of professional maturity with mastery of basic mathematical and pedagogical content. However, they reported difficulties with student learning and a lack of resources

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to address learning difficulties. Participant turnover during the two-year course was managed through a collective onboarding process in which veterans and newcomers shared experiences to ensure the continuity of AOE principles. Motivated by the search for new methodologies, the teachers primarily aimed to move beyond lecture-based classes and redefine their didactic methods. They sought to make mathematics instruction more meaningful and engaging for students.

However, our intention was not just to teach new methods of teaching math, but also to demonstrate and encourage reflection on a new way of organizing math instruction grounded in the theoretical and methodological foundations of AOE.

Implemented within the Municipal Education Network (Rede Municipal de Educação - RME) of Goiânia, CluMat was structured as a space for pedagogical practice focused on developing theoretical thinking. It served as both a training ground for teachers and a learning environment for students. The course was based on AOE, whose pillars were playful teaching tasks, collective actions, and reflections to enable interaction among participants through the design and development of SDAs (Moura, 2001). Through this approach, professors facilitate guided teaching activities based on the needs and motivations of those involved, enabling the sharing and attribution of social meanings.

The syllabus provides theoretical and methodological support for teachers based on the fundamentals of AOE and collective activity. Training progressed to the creation and development of SDAs, in which the logical-historical approach guided the addressing of mathematical concepts. Topics such as number systems and counting were discussed in terms of their conceptual links, including grouping and the numerical base. Educational games and formative assessment were integrated as inseparable elements of the teaching and learning process.

The training's methodological design aimed to transform professors' personal perspectives through a journey divided into two chronological phases. The first year (2023) consisted of the "Laying the Groundwork" phase, which established the theoretical foundations of AOE and the role of collectivity in mathematics education. The following year (2024), the "Trilling a Path" phase consolidated teachers' autonomy in organizing instruction through the collective development of tasks.

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Each 60-hour module was structured in a hybrid model combining 40 hours of in-person interaction and 20 hours of independent study.

A key feature of the course was the inclusion of decentralized meetings at schools, which ensured that practical experience was integrated with the professors' theoretical studies. After professors collaboratively designed and developed the SDAs, they implemented them with students to generate data for subsequent dialectical synthesis. This methodological design reinforced the relationship between theory and practice, which is essential for developing professors' theoretical thinking. Monitoring the tasks in person was essential for professors to reflect on the SDAs' limitations and potential. This process culminated in the conscious reorganization of pedagogical work.

Throughout the four-module, biweekly meetings, the research focused on capturing evidence of change in the personal meaning of pedagogical activity as the SDAs developed. The SDAs were characterized by playfulness, the logical-historical progression of mathematical concepts, and collective actions and reflections. Through systematic observation of actions, dialogues, and reflections, we sought signs of reframing teaching practice from an AOE perspective. The data corpus, consisting of field notes and audiovisual recordings of the meetings, formed the basis for data analysis.

The training was conducted by an inter-institutional team of professors, including the course coordinator, who is a professor at IME/UFG; three teachers from the Goiânia Municipal Education Network (RME), who have experience with other research projects related to the developed theoretical framework; and the researcher, who is also a trainer at Gerfor/SME. The research project was approved by the Research Ethics Committee (Comitê de Ética em Pesquisa - CEP)[4] and aimed to go beyond descriptive observation. To this end, the training experiment was documented using various records, including field notes, audiovisual materials, evaluation forms, interviews, and final reflective activities.

This data collection strategy enabled the investigation of teacher training as a dynamic phenomenon, linking theory to the pedagogical practice experienced at CluMat.

[4] This research was approved by the Research Ethics Committee (CEP–UFG) (opinion no. 6,033,568).

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4 The Formative Movement in Scenes

Understanding the subjective transformations of professors requires a method that breaks reality down into units that embody the characteristics of the whole, rather than fragmenting it (Vygotsky, 2001). In this sense, unit-based analysis was chosen as the strategy to investigate CluMat's contributions to the reframing of pedagogical activity. The investigation focused on how formative immersion from the AOE perspective enables a shift in the teacher's personal understanding of pedagogical activity, addressing the challenge of comprehending the formative phenomenon in its entirety.

To ensure the reliability of these units, we sought theoretical support in the works of Lopes (2018) and Caetano (2024), which provided an overview of teacher training in Math Clubs. This theoretical foundation ensured that the extracted units were not isolated fragments but rather parts that contained the properties of the whole (Vygotsky, 2001). This procedure lent robustness to the investigation, confirming that the empirical data reflect the complexity and totality of pedagogical activity in the context of CluMat. It linked the data from Barbosa's (2025) research to the "guiding principles" of Lopes (2018) and the "constituent elements" of Caetano (2024). In this section, we will discuss two units of analysis, given their significant importance in the shift in the professor's personal understanding of pedagogical activity and the possibility of organizing mathematics instruction on the theoretical-methodological basis of AOE. The two units analyzed are: **The logical-historical movement of mathematical concepts in learning-triggering situations (LTS) and collective actions and reflections as a principle of learning.**

The analysis of the interdependencies between the units is based on the identification of episodes, which Moura (2000) defines as segments that clarify the nature of social interactions. These episodes are organized into scenes that act as lenses, revealing the dialectical movement of the research object and capturing the essence of the educational phenomenon beyond its immediate appearance. Through these segments, the professor's shift in personal meaning becomes intelligible to the researcher.

The phenomenon under investigation—materialized in the actions and reflections of the subjects at CluMat and in everyday school life—was unveiled through the interrelation of the units of analysis: episodes and scenes. This analytical structure,

DOI: http://doi.org/10.14393/OBv10.e2026-10

based on THC and AOE, enables thought to transcend empirical immediacy. Through the lens of MHD, we sought to identify contradictions in the process of abstraction and transform raw data into concrete thought. Chart 1 below summarizes this organization, outlining the units of analysis, episodes, and scenes that underpin the research analysis for a segment of the research.

Chart 1 - Summary of data organization: units of analysis, episodes, and scenes

ANALYSIS UNITS	EPISODES	SCENES
The logical-historical development of mathematical concepts in SDAs.	Logic and history as a unified framework for organizing education.	"The logical-historical approach helps us understand the 'whys'"
Collective action and reflection are principles of learning.	Reflections and transformations in professors' collective actions in response to the SDAs at CluMat.	When the teaching task allows for group work.

Source: Adapted from Barbosa (2025)

The section **The Logical-Historical Movement of Mathematical Concepts in SDAs** discusses how the connection between the logical and the historical in SDAs underpins the development of theoretical thinking. Knowledge of a concept's history is essential for teaching to transcend the empirical dimension (Panossian, Moretti, Souza, 2017). For Kopnin (1978), while the historical represents the object's flow through time, the logical is the means by which this flow materializes in consciousness. In CluMat, this perspective allows professors to organize situations that reframe the content, demonstrating that mathematics is a dated and human form of knowledge. In this sense, this unit analyzes teachers' perceptions of the imperative nature of the logical-historical movement in structuring SDAs. The focus is on how this articulation promotes the process of signification, aiming to produce new meanings and to enable the effective appropriation of theoretical knowledge by students.

To this end, this investigative focus, through the episode, **the logical and the historical as a unit in the organization of teaching**, highlights the club members' initial encounters with the logical-historical movement, mediated by the study of the history of

DOI: http://doi.org/10.14393/OBv10.e2026-10

numbers. The collective discussion of Ifrah's (1989) work on the history of numbers allowed teachers to examine the concept of number from its origins and transformations. According to Sousa (2018), this reflection is imperative in the organization of teaching, as it de-naturalizes mathematical knowledge and presents it as a response to concrete social needs. Thus, the school fulfills its social function by systematizing the appropriation of this culture, allowing students to recognize mathematics as a living and historically situated body of knowledge.

The section **"The logical-historical movement helps us understand the whys"** below presents the discussions and analyses in a more structured manner.

Chart 2 - Scene: "The logical-historical movement helps us understand the reasons why" – Description, representation, and transcript

Description of the scene's context– The theme of the scene was: *Study of conceptual links.* During this session, in addition to reflections on the conceptual links underlying the concept of number, based on Georges Ifrah's book, a discussion circle was held on [5]number-related teaching activities that club members had freely developed in their schools.

Visual representation of the scene – The images show the moment when the theoretical explanation of the conceptual links between numbers was given, followed by club member Leandro's presentation of the teaching activity on multiplying numbers using fingers.

A theoretical discussion of the conceptual connections between numbers based on a study of Ifrah's book.

Presentation of the finger-counting multiplication exercise by club member Leandro.

[5] IFRAH, G. *Numbers:* The History of a Great Invention. Rio de Janeiro: Globo, 1989.

DOI: http://doi.org/10.14393/OBv10.e2026-10

Transcript of the scene – Discussion Circle. (Note: The names in the dialogue below are fictitious to protect the identities of the professors and club members.)

1. Researcher: *In the next module of the course, we intend to design teaching activities on numbers from the perspective of Historical-Cultural Theory, which is why we are studying Ifrah's book on the history of numbers. We need to understand the history of the creation of numbers so that we can apply the historical development of numbers to our learning-triggering situations. Remembering that the logical-historical approach is not about telling the story in a static, crystallized way, but about understanding the movement of knowledge construction based on logic.*

2. Trainer A: *We study history, but we won't tell the whole story to the students exactly as it is in the book; we will understand it and, after studying, show how the development of this knowledge unfolded based on human needs.*

3. Researcher*: In today's meeting, in addition to studying chapters 5 and 6 of the Ifrah book—continuing the series on numbers we've been working on—we'll summarize the main ideas from these texts. But first, let's hold a discussion circle about the development of the number-teaching assignment, which was an open-ended task, in accordance with the guidelines provided at the previous meeting [...].*

4. Trainer A*: Actually, given the problems we're facing in the network and with the suspension of training sessions, we asked you to research and develop an activity on numbers in your schools or even design one, and then, in this case, come here today to discuss this task so we can see if they align with CluMat's fundamentals, such as playfulness, collectivity, and logical-historical movement. We'll have to leave the development of the tasks for next semester because it requires more time for theoretical understanding [...]. The book's theoretical study changes the way we understand humanity's construction of numbers.*

5. Ana*: The book provides the answers to the "whys" of numbers, the use of stones and various objects for counting and representing numbers, as I saw in Chapter 5 on units, tens, and hundreds—the place-value chart. When we teach, we don't explain to children why numbers came to be; we just explain them as they appear in the workbook. Sometimes we even use concrete objects, but we don't show the reasons that led humans to create that knowledge. After I started the course, I learned to ask myself: why did it come about? What's the reason? What is it for? So that I can later explain how it came about. Then I also ask the students why that knowledge emerged, and what they think. An example: why did the dozen come about? What is the reason for this concept? What is the human need? I try to pose and answer the "whys." After that, I think the quality of my class improved.*

6.Trainer A*: If this changes the meaning for you, it also changes the meaning for the children, because you now have a new way of teaching.*

7. **Ana***: My perspective has changed, and even my desire to learn is different—and the need has changed.*

8. Trainer A: *Leandro, were you going to say something?*

9. Leandro: *Yes, it's like the professor said in the last class, right? That we, as teachers, need to be seeking this knowledge so that our class is better and meaningful for the student, because when you bring in this whole framework of the logical-historical movement—how knowledge developed—of course you're not just going to tell the story to the student, but you convey the knowledge more gently, showing them that it isn't just ready-made, the way it appears in the book; that content was constructed within a historical context, and we have to bring that to the students because it will add meaning to the teaching and learning process. We as professors have to seek out that knowledge. And I'm sure that everyone here in this course will leave a little better off; I, for example, am leaving a little better off, because I have a different perspective on what it means to teach mathematics, taking into account all the context we've learned here. It's not easy; there's a lot you don't understand right away in the book—you have to read and reread—and these discussions here are important for clearing up doubts.*

A professor has to be a researcher; they have to research the subject they're going to teach.

DOI: http://doi.org/10.14393/OBv10.e2026-10

10. Ana: *And for us educators, it's even harder to grasp this because we aren't math specialists, so we have to study even more. But the course offers this new approach to teaching that breaks us out of the boxes we're stuck in. I thought I'd be studying more methodology or a game, but the course delved deeper into theoretical study and the logical-historical development of mathematical knowledge. The activity I used, "painting the seven," I had already used before. Still, after I used it again now, after the course, I had a different perspective—I looked for other ways to approach the task, with a fresh perspective and different questions. For example, after working on other activities here at the Club, I learned not to give students the answer, but rather to encourage them to arrive at their own answer. But why this concept? The "whys," right?! My classes were very poor.*
11. Trainer A: *Can you understand that your conception of teaching mathematics is changing?*
12. Ana: *Yes, absolutely! I realized while doing the activity that I have several ways to approach it, and I didn't do that before because I didn't have the perspective I have now. It was a simple activity that has now become a rich one, but only now, after my shift in thinking about math. For me, it's been quite transformative. The quality of my classes has improved, and my students now want to study math.*
13. Leandro: *When I developed the finger multiplication activity with the students, I started asking them questions like: Do you think the way I presented multiplication here is the final version? Was this method of multiplying created this way? And some of them answered no, that before arriving at that method of multiplying, other methods had been created earlier. They really liked my class because I let them speak and ask questions. These classroom discussions are incredibly rich, and we have to let them speak. I believe that math needs to be humanized. Math can be difficult, but it's for everyone.*
14. Ana: *The way we apply and develop activities makes all the difference in students' understanding of the material. And when you ask students "why," it makes them interested in understanding the concept. And math becomes lighter and more accessible.*
15. Trainer A: *E What about you, Professor Lia? Do you notice any change in your understanding of how you organize instruction in your classroom?*
16. Lia: *(laughs) Now I feel like before it was as if I were in prehistoric times. And now there's been an evolution. When reading this text, I was thinking: it took thousands of years to create numbers and develop this symbolism, and we professors want to teach students all of that in a single day, in a single class. That's when I felt like a complete novice. I've been teaching for 15 years and hadn't realized the importance of this logical-historical approach in motivating them to learn the concepts.*
17. Researcher: *Lia, what was your activity on numbers about? What concept did you work on? And did you use the logical-historical approach?*
18. Lia: *I created a problem situation where a group of people needed to record the quantity of grains using the materials I brought, such as fingers, strings, stones, and an abacus. To solve it, they couldn't use numbers because they didn't exist yet. To solve it without numbers, some drew pictures; I divided the class into 6 groups and distributed the materials—ribbons, small stones, an abacus, fingers, and body parts—but we didn't have enough time in two classes. I think they understood the human need that led people to count with objects, because numbers were invented much later, out of the need to record counts. They enjoyed the activity.*
19. Leandro: *One thing that really struck me here at CluMat, Trainer A, was when you said that here we can speak freely and that there is no right or wrong. And when we use the logical-historical progression of mathematical concepts in school, we have to keep the dialogue open with students because they need to understand that mathematical knowledge is evolving and arises from human needs that never end.*

Source: Barbosa (2025)

DOI: http://doi.org/10.14393/OBv10.e2026-10

The situation that arose during this meeting stemmed from studies based on Ifrah's (1989) work, which aimed to understand the logical-historical development of the concept of number. The research prioritized the logical dimension over factual chronology, analyzing how numerical development emerged as an objective response to human needs throughout history.

The professors' understanding of this movement was evident in their support of a pedagogical approach that explores the origins and social functions of concepts. By emphasizing the importance of investigating historical "whys," club members recognize that this inquiry is essential for sparking students' interest and aligning the subject of teaching with the purpose of learning. Club member Ana's statement (speech 5) illustrates this shift in perspective.

Analysis of her statement shows that the logical-historical approach enables professors to access the essence of a concept and propose genuine problem situations (Moura, Sforni, & Lopes, 2017). Ana's experience indicates that clarity about the content's meaning is contagious; the professor's motivation precedes and sustains the student's. Thus, instructional planning must go beyond the technical sequence and organize intentional actions that connect the logic of the subject matter to students' social motivations and needs (Asbahr, 2011; Sforni, 2012).

Leandro (statement 9) also emphasized the need to start from the genesis of concepts to promote mathematical meaning. His statement clarifies how the logical-historical movement mediates between content and student understanding. According to Kopnin (1978), logic is the theoretical translation of an object's historical movement, capturing its essence. This transposition to the plane of thought is mediated by meaning, which Vygotsky (2001) defines as the link between external reality and individual consciousness. Since meaning is a collective and cultural construct, the professor plays an essential role in guiding students to construct new conceptual connections. Through this appropriation of social meanings, thought is structured and moves beyond the empirical plane toward theoretical thought.

Teachers' remarks (Ana: remarks 10 and 14; Leandro: remark 13) indicate that the logical-historical approach has become part of teaching tasks in schools.

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There is a movement toward the fundamentals of AOE, even though the actions reveal the marks of an ongoing formative process. This preliminary application demonstrates the club members' effort to convert theoretical studies into tools for intervening in classroom reality.

The club members' statements reveal a search for the "whys" of knowledge, pointing to a shift toward theoretical thinking. By guiding students in this direction, professors begin working with conceptual links—the essential connections that define an object's structure (Davidov, 1982). This process is inseparable from the logical-historical movement because the essence of a concept is revealed only through an understanding of its human production and transformation (Panossian, Moretti, & Souza, 2017). In this study, the investigation of numerical sensation and one-to-one correspondence provided teachers with an understanding of the origin of numbers, transforming these connections into instruments for pedagogical mediation.

The unit's **collective actions and reflections, as a principle of learning under the auspices of THC, advocate** that collectivity constitutes the founding principle for the appropriation of knowledge. According to Vygotsky's (1998, 2000) genetic law of cultural development, higher mental functions first emerge in the social and interpsychic realm. Through mediation, these functions then become intrapsychic and individual processes. In CluMat, this premise materializes in shared learning activities (Rubtsov, 1996), where sharing tasks and reflections allows teachers to learn from the internalization of collectively constructed meanings. In this logical-dialectical movement, valuing each professor's individual experience as a historical being fuels the contradictions and syntheses that drive theoretical thought (Moura, 2010).

The episode "**Reflections and Transformations in Professors' Collective Actions in the Face of SDAs at CluMat"** sought to reveal the interplay between collective actions at CluMat and school teaching practices. According to Rubtsov (1996), the organization of teaching based on collaboration is crucial for the development of higher mental functions. According to Moura (2001), the essence of a professor's profession lies in creating contexts that transform individuals. Therefore, collective activity is understood not only as a method but also as the social foundation necessary for scientific knowledge to be internalized and converted into a tool for individual thought.

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In the episode, the scene **"when the teaching task enables group work"** prompts reflection and analysis on the importance of collective action in learning mathematical concepts.

Chart 3 - Scene: "When the teaching task allows for group work" – Description, depiction, and transcript

Description of the scene's context – During this meeting, the teaching activity *Junta Pedras* was implemented in the schools of two club members. To this end, the professors were divided into two groups so that they could experience the activity firsthand with the students.

Visual representation of the scene – The images show how the Junta Pedras teaching activity was carried out in schools. The transcript of the scene below refers to the discussion with professors at E. M. Santa Rita de Cássia that follows the completion of the activity.

Development of the "*Junta Pedras*" teaching activity at Santa Rita de Cássia Elementary

Development of the teaching activity *Junta Pedras* at Brice Francisco Cordeiro Middle

T[illegible]uss[illegible]e Cássia Elementary School. (Note: The names in the dialogue below are fictitious to protect the professors' identities.)

1. Trainer A: *So, everyone, we know that schools have different realities, and how tasks are carried out varies from school to school. But here today at Santa Rita School, what did you think of how the task was carried out compared to the original plan?*

2. Leandro: *I think they had trouble recording the symbols; I ended up doing it wrong, too, but the way I did it, I noticed that the boys got more involved, because doing it collectively, the way it was done—where everyone wrote down all their classmates' points—they got more involved. When they record the points individually, they get more distracted. It's a complex activity for the students' level. It involved many operations, but they got very involved, were interested, managed to do the activity and enjoy it, and learned.*

3. Trainer A: *E Leila, as the class professor, what did you think?*

4. Leila: *I thought it was really great; they really liked it, everyone was involved, and I saw that it's easier as a group because they help each other—everyone together—and that makes a difference. I want to thank you all for the task we did here today. Instead of each student recording only their own points, I thought having everyone record their classmates' points worked well; as a group, they helped and learned from each other.*

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5. Trainer A: *I didn't notice any competitiveness among them—did you guys notice any?*
6. Leila and Leandro: *No, there wasn't any.*
7. Trainer A: *They realized it wasn't a competition to see which group could score the most points, but that they had to add up the points from all the groups. I thought that was interesting.*
8. Leila: *Yeah... I thought they were a bit lost at first, but then they started to figure it out, and one group helped the other match the symbols and their values. I thought that the interaction between them was really cool.*
9. Trainer A: *Were you able to see the mathematical need within the activity, or was it just a fun activity for you?*
10. Leandro: *I was able to see it in the different number systems we used, but they were always trying to convert to our system. I thought the interaction between the groups to make the conversions was really good [...]*
11. Leila: *That's right. They constantly wanted to know not only their individual scores but everyone's, because in the end, what mattered was the total points of the whole group.*
12. Researcher: *Were they motivated by the task?*
13. Leila: *Yes, I noticed their motivation; they were constantly engaged with the story and curious about the final score.*
14. Leandro: *I also found them motivated; so much so that when we left, they were ecstatic.*
15. Researcher: *As professors, were you motivated by the task? Does it make sense to work on this type of task with students?*
16. Leila: *Yes, I was motivated because I saw that they were interested, and this type of task also involves other subjects. This combination of play and math is wonderful.*
17. Leandro: *I feel motivated to work on this type of activity. Before, I even had a bias, as I told you earlier. Next week I'm going to do this at my school; I think that with this kind of activity and the interactions that happen among the children, they learn more. Sometimes they learn more from their peers than from the professor because their peers' language is more accessible. These group activities are very important, and we, as math professors, don't give them enough importance; they foster collaboration in solving problems. This type of activity teaches children to think and work in groups, especially since the world today demands teamwork, so why not start this in school? Since school exists to prepare children for life? When I started the program, no, but today I feel motivated to work this way.*

Source: Barbosa (2025)

The meeting focused on promoting the development of the "Junta Pedras" SDA in schools, which focuses on grouping quantities using unconventional symbols. Participants (trainers, PETMAT[6] students, and professors/course participants) were divided between two schools where club members work. The goal was to apply a task that the teachers had already tested theoretically to school practice. This enabled collective reflection on the students' reactions and how their thinking developed in response to the triggering situation.

When the discussion circle began, Trainer A (statement 1) created a space for reflection by asking the teachers about the task's development process at the school.

[6] Mathematics Tutorial Education Program, developed with mathematics education majors and guided by the principle that teaching, research, and community outreach are inseparable.

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In statement 2, club member Leandro emphasized that organizing the task within his group of students was essential to facilitating collective activity and enabling students to collaborate in finding solutions. This demonstrates that when teaching is grounded in collectivity, professors must intentionally promote collaboration to foster autonomy (Silva & Cedro, 2022). The distribution of roles within the student group exemplifies how shared leadership and co-responsibility operate in school practice (Fiorentini, 2004).

From this perspective, the collective becomes an active space for psychological development. Each member commits to the activity's outcome, which strengthens students' social consciousness.

In line with this, the lead professor, Leila, confirmed the students' satisfactory engagement during the activity in statement 4. The professor emphasized that the proposed teaching organization promoted the students' engagement in the collective development of the SDA. Based on AOE, SDAs promote collaboration to the extent that solving a problem requires coordinating collective actions. Integrating playfulness into the concept's logical-historical genesis gives learning new meaning and motivates students in their activities. When discussing peer involvement and solidarity, Fiorentini (2004) emphasizes the emotional aspect as a foundation of the collaborative group. According to the author, constructing a collective identity and providing mutual support humanizes the teaching process and strengthens students' ethical commitment to each other's learning.

The professors made an important observation: dividing the class into groups did not result in competition, but rather an integrated, collaborative effort. Emphasizing that each team's score was vital to the collective gave the task new meaning for the students (Leila, statement 11). This convergence of objectives underscores that the group's success hinges on its members' success. The absence of competition reinforces the idea that collaborative work is sustained by a convergence of goals and the interdependence of individuals when facing a common problem. This experience enabled participants to understand the essence of the shared activity, in which collaboration replaces competition. As Damiani (2008) points out, these interactions have a formative effect, reflected in improved socialization and students' willingness to comply with collective

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rules. This promotes psychological development that prioritizes social awareness and a sense of belonging to the group.

At the end of the discussion circle, student Leandro acknowledges and understands the importance of collective work for learning in light of the development of the teaching task. His statement reveals that teaching structured around collaboration enhances the transition from empirical to theoretical knowledge.

This perception reinforces the idea that professors-in-training begin to integrate the dimension of "how to teach" into their ethical responsibility to socialize historically accumulated knowledge. According to Moura (2001), this intentional organization of teaching is the essence of the teaching profession. In this context, the shared activity proposed by Rubtsov (1996) plays a central role, as social interaction and cooperation enable individuals to reconstruct meaning.

5 Results and Discussion

Conceived as praxis, teacher education requires a critical foundation that integrates theory and practice to pursue a humanizing education (Curado Silva, 2019). Evidence that professors-in-training understand the logical-historical nexus reinforces the idea that theoretical knowledge becomes an instrument of transformation only when mobilized through practical activity. Thus, the SDAs developed as a collective space and time in which theory was studied, interpreted, and incorporated into the club members' pedagogical practice.

According to Moura (2004), teacher training is permeated by social interaction and the collective search for solutions to educational issues. This structure of shared actions enabled the reinterpretation of teaching practice. At the student level, the collaborative nature of the SDAs motivates students by integrating their personalities into the collective effort through bonds of shared responsibility. The Vygotskian premise that humans develop in relation to others (Vygotsky, 1998) emphasizes the importance of socially meaningful activity. In this context, interaction is not merely procedural. Following Rubtsov (1996), interaction enables the restructuring of action and content frameworks, resulting in qualitative advances in the thinking and behavior of those involved.

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Adopting the logical-historical approach as the organizing principle of teaching grounds the professor's pedagogical intent in the essence of the concept, prompting students to attribute new meanings to knowledge. According to Moura et al. (2016), teaching activity only reaches its full potential when it materializes in study activity. This requires the professor's and the student's motivations to align. The concept's logical-historical trajectory facilitates this relationship by transforming the cultural heritage of mathematics into a comprehensible and engaging challenge, thereby fostering mutual motivation to acquire theoretical knowledge.

Human consciousness is, by its very nature, a dynamic and historically conditioned phenomenon whose characteristics depend on social relations (Leontiev, 1978). Thus, recognizing that the acquisition of mathematical concepts necessitates understanding their historical genesis—from emergence to generalization—is essential for signification. This process requires continuous abstraction and interpretation in the systematization of knowledge. As Vygotsky (2001) posits, meaning is the generalization of reality that thought crystallizes, integrating the domain of historical-objective phenomena. Thus, mathematical concepts act as tools of mediation, materializing the subject's consciousness regarding their experience and the social practices that constitute them.

From this perspective, learning grounded in AOE must be based on the logical-historical movement that stems from the collective development of SDAs, bringing content and the individuals involved to life. This historicity awakens students' personal meanings and fosters engagement when there is mutual correspondence between the activity's purpose and the proposed objectives.

Thus, the appropriation of the concept becomes an act of collective consciousness development rather than merely an individualized technical and methodological reproduction.

6 Final Considerations

DOI: http://doi.org/10.14393/OBv10.e2026-10

The development of theoretical thinking enables individuals to consciously act within their reality through abstractions that reveal the essence of objects. In education, this process defines the unique nature of the teaching profession—the ability to organize instruction to transmit historically accumulated culture and foster humanization. Structured continuing training in line with the principles of AOE creates the conditions necessary for teachers to redefine their motives and attribute new meanings to pedagogical activity. This dialectical movement between knowing and acting brings about the development of consciousness in its full social, historical, and human dimensions.

The collective experience of the SDAs, in both the training setting and the school, stimulated professors to transform formal motives into meaningful ones. Continuing training becomes an activity only when professors' purposes align with the study's purpose. From this perspective, meeting the needs that arise in daily school life allows theoretical knowledge to gain vitality through the transformation of the professor's consciousness, stemming from their praxis.

Organizing instruction around AOE fosters motivation that gives practice meaning. This transforms educators' consciousness regarding their socio-practical reality through studying the logical-historical development of mathematical concepts present in the SDAs. The collective development of the SDAs enabled professors to redefine concepts and practices, demonstrating that the evolution of mathematical connections is inseparable from the evolution of pedagogical connections in the process of constituting the teaching subject.

This psychological restructuring enabled the professor to take an active role in the pedagogical activity. This condition is achieved by combining the acquisition of scientific knowledge with reflective and evaluative capacity. This allows the professor to understand the importance of their actions in acquiring concepts and developing students in the face of reframing mathematical and pedagogical content.

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Recebido: *fevereiro/2026*

Aprovado: *maio/2026*